KALÉ
One Intelligent Platform. One Logistics Community

State of Port Digital Readiness & Stakeholder Adoption of Port Community Systems

Maritime research annual report 2026





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Disclaimer

This report is completely based on the study conducted by Kale Logistics Solutions and the opinions expressed are from the stakeholders representing the logistics industry. This is for information purposes only and it does not constitute an offer, recommendation, or solicitation to any person/entity. For clarifications, please write to info@kalelogistics.com.

Executive summary

Ports today are undergoing a transformative shift as digitalisation becomes essential to sustaining efficiency, transparency, and competitiveness in global trade. With more than 80 per cent of world goods moving through maritime channels, port ecosystems face increasing pressure to modernise long-standing manual processes, eliminate data silos, and strengthen collaboration among diverse actors. Digital technologies-most notably Port Community Systems (PCS), real-time data platforms, and automated reporting mechanisms-are at the core of this transformation. This report synthesises survey insights, extrapolated industry patterns, and global research to evaluate digital readiness within port authorities and the critical role stakeholders play in enabling PCS adoption.

Survey results reveal that port authorities and shipping lines are the strongest enablers of PCS adoption, each demonstrating 83 per cent support. This alignment reflects a global trend in which strategic decision-makers and operational leaders are taking active responsibility for driving digitalisation initiatives. Government agencies also show significant readiness, with 67 per cent support, indicating growing policy momentum toward national single window systems, electronic documentation standards, and integrated trade compliance. These three stakeholder groups form the backbone of digital transformation; their combined influence sets the direction for ecosystem-wide modernisation.

Terminal operators show moderate adoption readiness at 50 per cent, mirroring their operational complexity and varying levels of system maturity. Many terminals have invested in automation and IoT capabilities, yet integration with broader PCS frameworks remains uneven. Meanwhile, customs authorities and freight forwarders—each at 33 per cent—emerge as the least digitally aligned stakeholders. Their slower transition reflects global realities: legacy systems, manual verification processes, and fragmentation within the forwarding community often hinder seamless data exchange. These groups represent the most critical bottlenecks to full digital integration and require targeted investment and structural support.

Despite these disparities, opportunities for digitalisation are substantial. PCS platforms enable real-time visibility, predictive operations, reduced congestion, and stronger environmental performance. They eliminate redundancies in documentation, lower the risk of operational disruptions, and foster transparency across the supply chain. As technological capabilities evolve—driven by AI, IoT, automation, and 5G—ports are expected to transition from functional hubs into intelligent, data-driven logistics ecosystems.

The path ahead requires coordinated commitment. Digital transformation cannot succeed through isolated adoption; it demands a holistic, multi-stakeholder approach grounded in interoperability, policy alignment, and robust infrastructure. Ports that embrace digitalisation proactively, supported by engaged stakeholders, will be better positioned to navigate future trade disruptions and strengthen their role as critical facilitators of global commerce.



Introduction

Ports today sit at the center of global trade, serving as the primary gateways through which over 80 per cent of the world's cargo flow. The complexity of modern supply chains, combined with the rapid pace of technological change, has prompted ports around the world to accelerate their digital transformation journeys.

Digitalisation is no longer a peripheral initiative but a core enabler of efficiency, competitiveness, and national trade facilitation goals. As shipping lines demand real-time visibility, governments introduce stricter compliance requirements, and logistics ecosystems face mounting pressure to operate seamlessly, port authorities have found themselves compelled to rethink legacy systems, manual processes, and fragmented data flows.

This report examines the digitalisation readiness of ports by integrating global industry trends with exclusive survey insights. Moreover, it emphasises on the future of digitalisation such as sea-air or multimodal corridors, which would be highly essential to stay competitive in a fast-changing world.

Moreover, in an industry, which experiences more than 150 per cent increase in cybersecurity attacks since the pandemic secured data sharing norms will define competitiveness and tackling vulnerabilities in the long run. Last but not the least, it also stresses on why standardised data sharing frameworks is a must-have rather than a good-to-have. Though the survey data available is limited to specific stakeholder support metrics, the patterns reflected align strongly with global findings from recognised bodies such as UNCTAD, IAPH, and the World Bank.

By combining these inputs, this report paints a holistic picture of where ports stand today in their digital transformation journeys, what is driving progress, and which structural challenges still impede widespread adoption. It also proposes a roadmap for enhancing PCS-driven digitalisation while maintaining a human-centered lens that recognises the cultural, organisational, and operational realities of port ecosystems.



What is a Port Community System?

A Port Community System (PCS) is a neutral, digital platform that enables secure and seamless information exchange among all stakeholders involved in port and logistics operations. It connects public and private entities such as ports, terminals, shipping lines, freight forwarders, container freight stations, customs authorities, transport operators, and regulators onto a unified and integrated system. The core purpose of a PCS is to simplify, standardise, and automate port-related processes, replacing fragmented, paper-based workflows with real-time digital coordination. By allowing stakeholders to share data once and reuse it across the supply chain, a PCS reduces delays, improves visibility, and enhances overall operational efficiency.

Key functions typically include vessel and cargo reporting, berth and yard planning, truck appointment scheduling, electronic documentation, customs clearance support, and performance monitoring. By enabling advance information sharing and synchronised decision-making, a PCS helps reduce congestion, turnaround times, and administrative costs.

In essence, a PCS acts as the digital backbone of a modern port ecosystem, supporting smoother trade flows, better regulatory compliance, and improved competitiveness in global logistics networks.



Role of Technology Innovation

Technological innovation is the backbone of a modern PCS, enabling seamless coordination among diverse stakeholders across the port ecosystem. Advanced digital tools such as cloud computing, data analytics, and real-time data exchange allow ports to replace fragmented manual processes with integrated, automated workflows.

Technologies like IoT and AI support real-time cargo tracking, predictive planning, and efficient resource utilisation, while secure digital platforms enable paperless documentation and faster regulatory clearances. By enhancing visibility, transparency, and collaboration, technology empowers PCS to reduce congestion, improve turnaround times, strengthen compliance, and build resilient, future-ready port operations.

AI frenzy?

The surge of interest in Artificial Intelligence within PCSs reflects the growing need for smarter, faster, and more predictive port operations. AI is transforming PCS from a data-sharing platform into an intelligent decision-support system.

Through machine learning, predictive analytics, and automation, AI enables accurate demand forecasting, dynamic berth and yard planning, congestion prediction, and proactive exception handling. This growing enthusiasm is driven by the need to handle rising cargo volumes, reduce human dependency, and enhance operational resilience. As ports move toward data-driven ecosystems, AI is becoming central to creating adaptive, self-learning, and future-ready PCS.



Objective of the study

Understanding current digitalisation state of ports

The primary objective of the study conducted by Kalé was to gain a comprehensive understanding of the current state of digitalisation readiness within global port ecosystems and to assess how different stakeholders contribute to or hinder the adoption of integrated digital platforms such as Port Community Systems (PCS).

Stakeholder readiness mapping

As ports around the world grapple with challenges such as congestion, rising cargo volumes, inefficient coordination, and fragmented data flows, the need for a unified digital framework has become increasingly urgent. This report was designed to capture direct insights from port authorities, terminal operators, shipping lines, customs agencies, freight forwarders, and other ecosystem players to evaluate how prepared each group is to transition toward fully digital, collaborative operations.

Factors influencing digital readiness

A core goal of the study was to identify the enablers and barriers that influence adoption patterns. By analysing stakeholder willingness, technological capability, process maturity, and existing operational gaps, Kalé sought to map out the areas where digital transformation is already underway and where significant work remains. This involved exploring how ports currently manage cargo movement, documentation exchange, vessel coordination, land-side traffic, and compliance processes—and understanding how digital tools can create measurable improvements. The study also examined the degree of integration across stakeholders, recognising that a port's digital maturity is ultimately defined by the strength of its weakest link.

Awareness of advance technologies

Another critical objective was to uncover the level of industry-wide awareness about advanced technologies such as AI/ML, Blockchain, IoT, 5G, and cloud-based platforms. Ports vary significantly in their exposure to and adoption of such technologies. Kalé aimed to determine whether digitalisation is viewed as a strategic priority, a compliance requirement, or merely an operational enhancement—and how these perceptions shape investment decisions. The study thus provides clarity on the digitalisation culture within ports, highlighting readiness not only in terms of infrastructure but also in mindset and organisational alignment.

Need for the study

Digital Maturity Assessment

Ports struggle with congestion, delays, and fragmented data, hurting cargo flow and competitiveness. Kalé identified the need for a structured digital maturity assessment to ensure technology is effectively adopted and utilised.

Capability to leverage new technologies

Rapid tech advances demand ports assess readiness. The study checks if stakeholders can truly adopt and benefit from emerging digital tools.

Impact of Global mandates

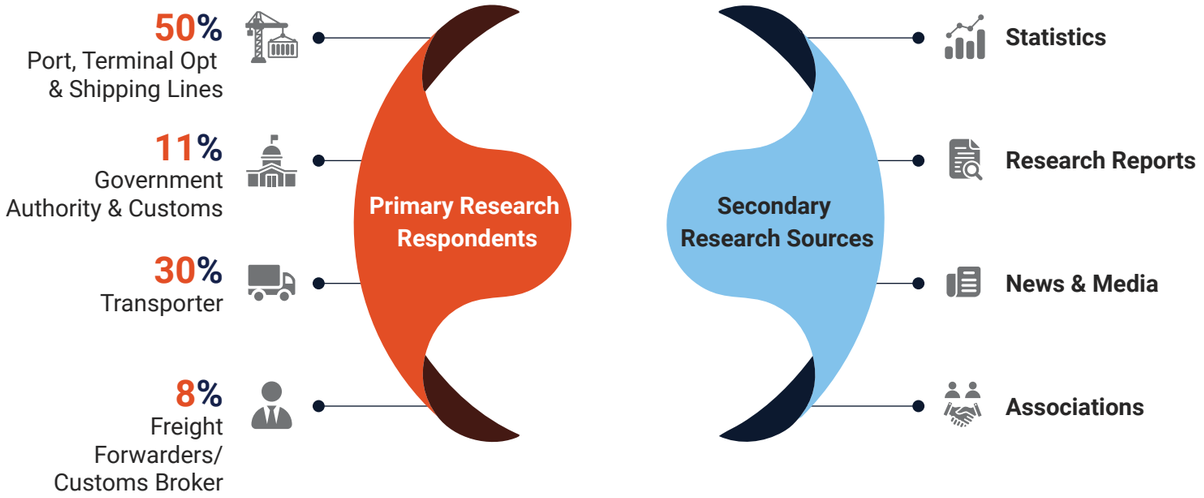
With rising global mandates and compliance pressures, ports must accelerate digitalisation but lack clear benchmarking. The study bridges this gap, offering clarity and actionable insights to help ports plan a confident, future-ready digital journey.

The World Bank's Logistics Performance Index reveals a direct correlation between digital maturity and trade competitiveness. Nations with digitally advanced port systems enjoy quicker cargo clearance, more accurate documentation flows, and fewer bottlenecks—advantages that enhance their standing in global logistics rankings. As a result, countries that once viewed digitalisation as an option now increasingly see it as a national priority tied to economic growth.



Research methodology

This study uses a mixed-method research approach, combining primary stakeholder insights with extensive secondary research to assess the digitalisation readiness of port authorities and the role of stakeholders in accelerating Port Community System (PCS) adoption.



Primary Research

- Engagement with port ecosystem entities across geographies, including port authorities, terminal operators, shipping lines, government agencies, freight forwarders, and technology providers.
- Data collected through structured surveys and expert discussions focused on digital maturity, PCS awareness, adoption drivers, and stakeholder influence.
- Survey responses were normalised and benchmarked against qualitative inputs and global trends to ensure representativeness.
- Findings indicate that port authorities and shipping lines are the strongest enablers of PCS adoption, followed by government agencies, with terminal operators, customs, and freight forwarders playing supporting roles—consistent with global market behaviour.

Secondary Research

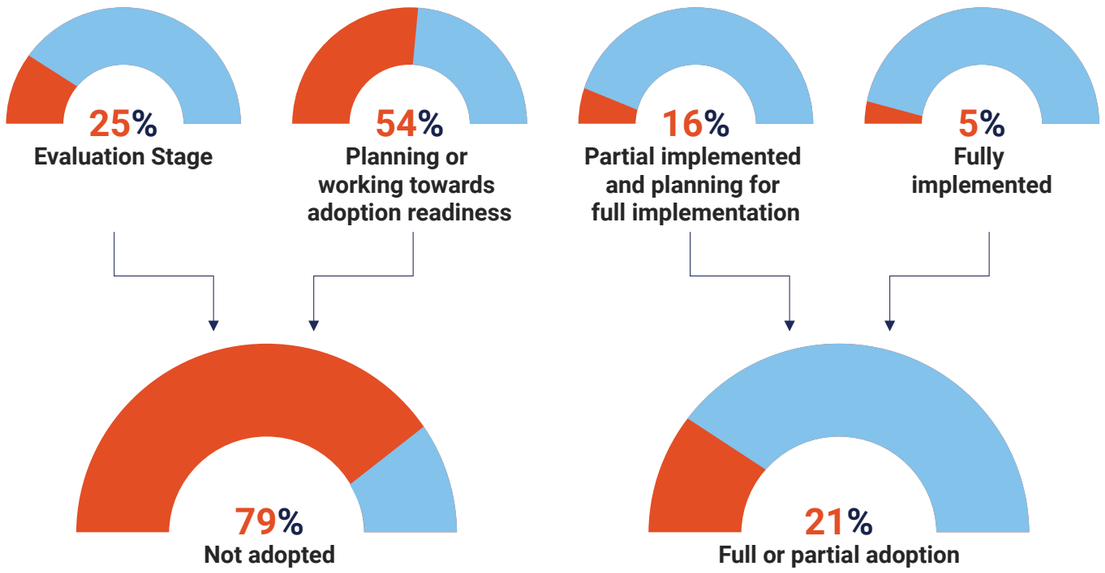
- Comprehensive review of multiple global and regional sources, including port authority disclosures, regulatory publications, multilateral trade bodies, industry whitepapers, and PCS implementation case studies.
- Used to benchmark maturity levels, validate stakeholder roles, and contextualise primary findings within real-world deployment experience.

Port digital status existing condition

The survey question provided focuses on identifying which stakeholders serve as the biggest enablers of PCS adoption. Nearly 79 per cent of respondents said their port has not yet adopted a Port Community System, while the remaining 21 per cent have either a partially or fully operational PCS. The former represents a major chunk of developing nations while the rest is more developed with high income and GDP.

Only 21 per cent of respondents have adopted a Port Community System in any form. Just 5 per cent have a fully implemented PCS and 16 per cent a partial one. The remaining 79 per cent have not yet started: 54 per cent are still planning and 25 per cent are evaluating.

PCS adoption status



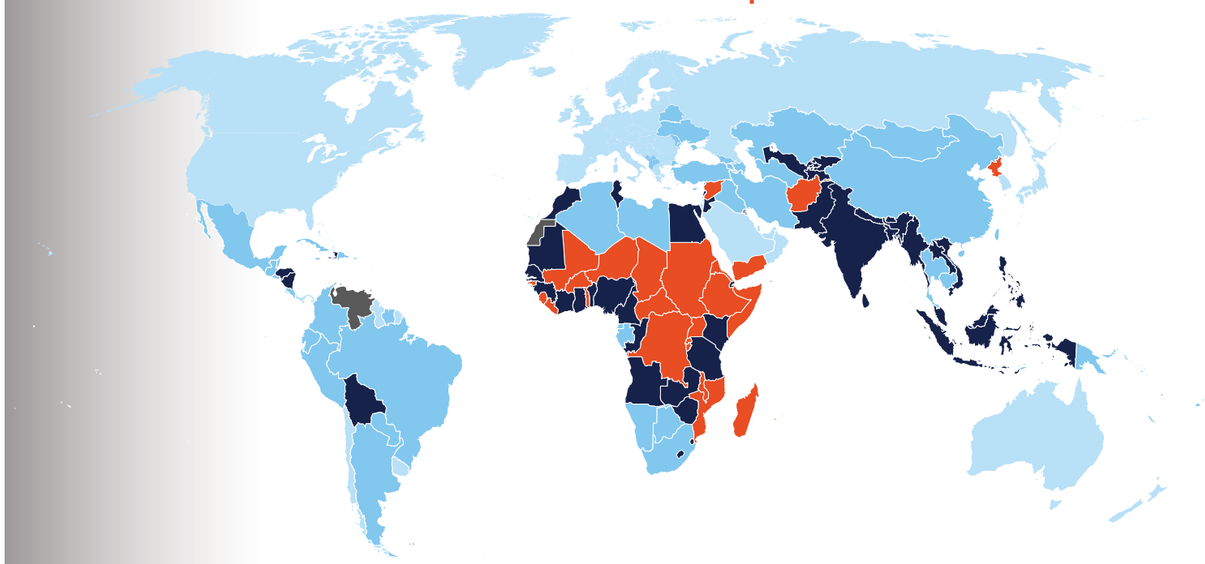
Half of ports in high-income countries still have no fully integrated PCS project at all, so adoption is far from universal even in wealthy markets. The real gap is in getting systems fully running: most operational PCSs are in high-income countries, while over 80 per cent of ports in low- and middle-income countries have yet to implement one.

Global status of PCS implementation

The digitalisation of ports has been a topic of global focus for the past decade, but the urgency has intensified post-2020. Disruptions across global supply chains, rising vessel turnaround pressures, labour volatility, and mandated reporting standards have brought digital transformation to the forefront. Many ports previously relied heavily on paper-based processes, manual documentation reviews, and isolated terminal operating systems that did not communicate with one another. These inefficiencies created congestion, increased dwell times, inhibited real-time coordination, and ultimately reduced competitiveness for national trade corridors.

According to the latest UNCTAD assessments, only a small proportion of ports worldwide have achieved advanced levels of digital maturity. Less than one-third of ports have implemented integrated systems capable of orchestrating multi-stakeholder coordination. An even smaller subset—about 22 per cent—possess fully interoperable data exchange environments that enable seamless communication between customs, terminals, and shipping lines. These figures highlight a yawning gap between technological aspiration and operational reality. Yet, even within this fragmented landscape, the momentum toward digital transformation is unmistakable.

Per cent of Ports not adopted PCS



Income level alone does not predict PCS adoption. Half of high-income ports in our sample have not adopted a PCS, compared with 42 per cent of lower-middle-income ports, which suggests that governance and stakeholder coordination matter as much as funding.

50% High Income

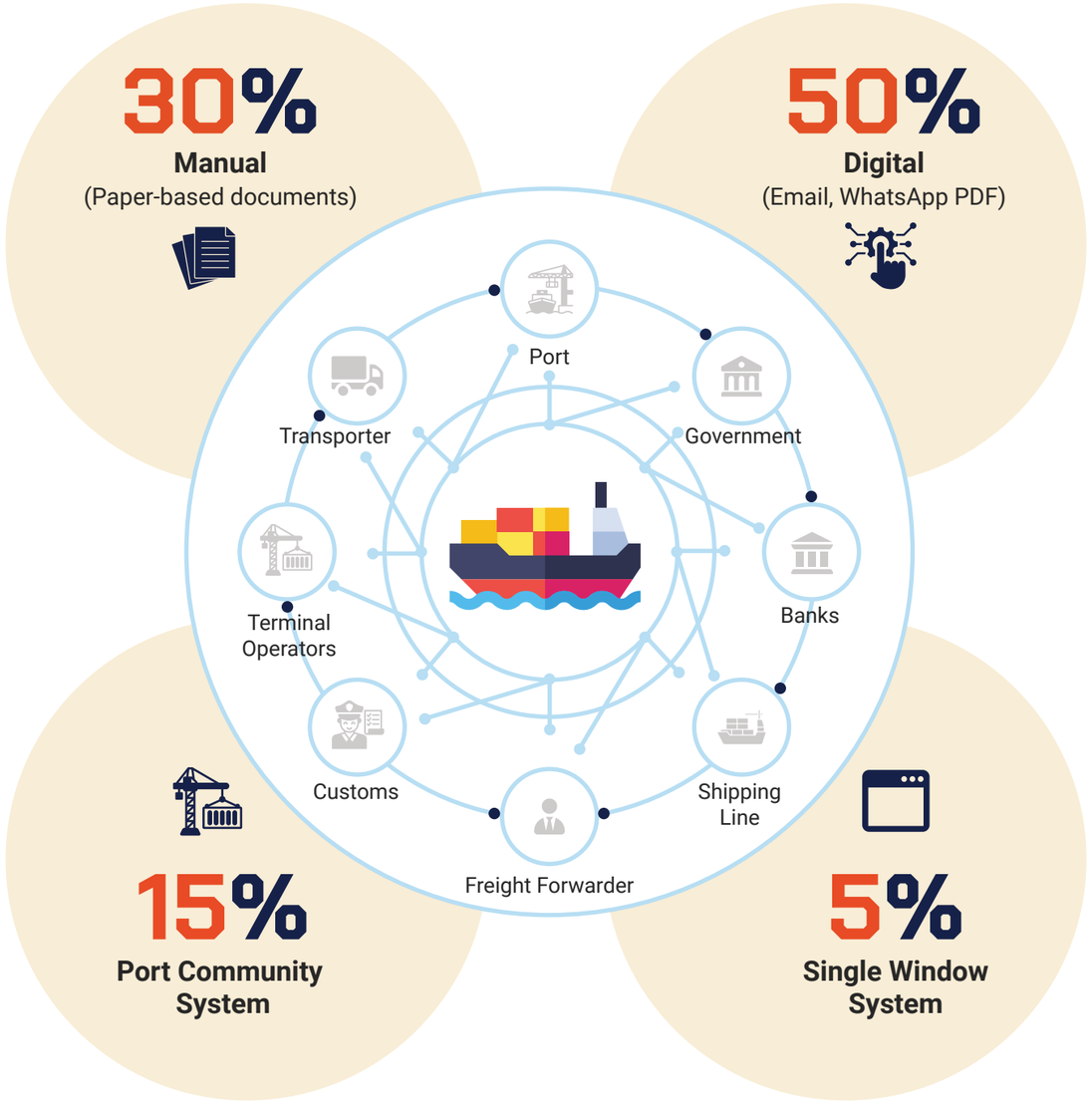
48% Upper-middle Income

42% Lower-middle Income

85% Low Income

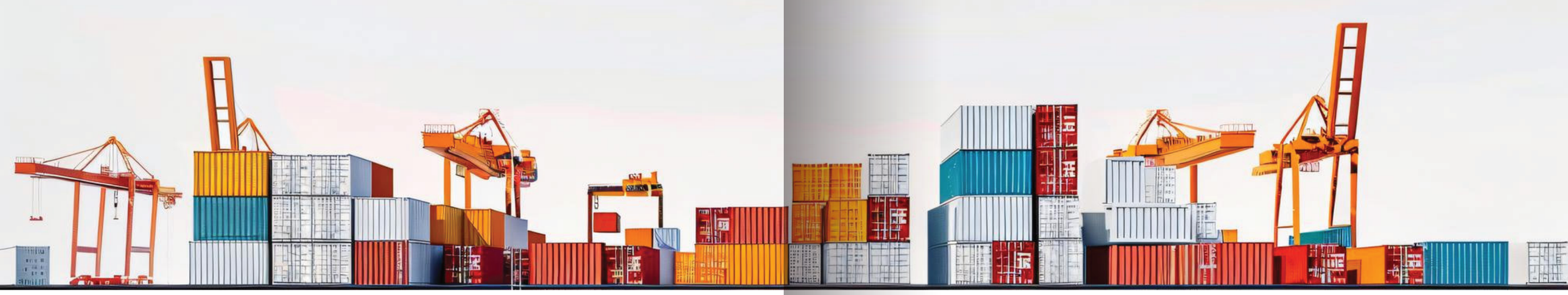
Stakeholder support and enablement

Speaking about data sharing between stakeholders, our respondents gave varied answers. While the ones in developed markets claimed to share data via a Port Community System or a Single Window dashboard, other gave a mixed response reflecting their overall digital ecosystem.

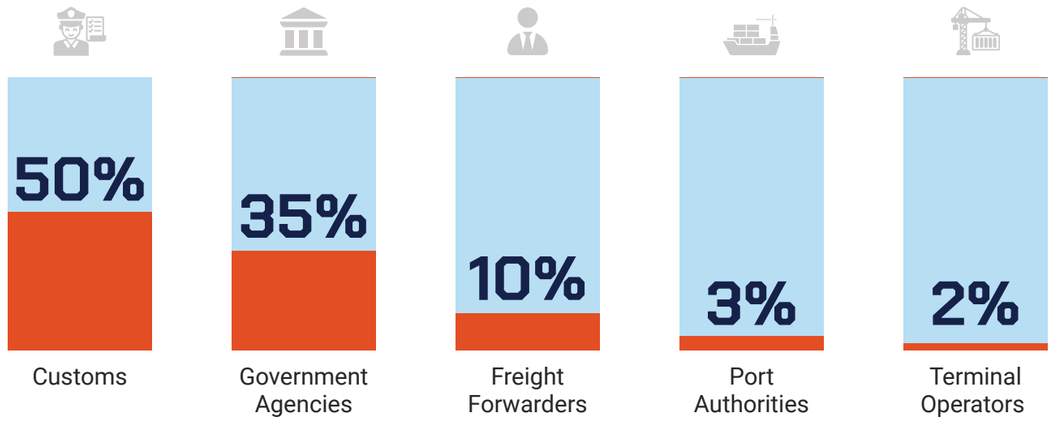


- 30 per cent of respondents claimed manual paper-based documentation is still in process
- 50 per cent of respondents claimed that they use digital channels such as emails and whatsapp for communication
- 15 per cent of our respondents claimed that they are actively communicating through a PCS in the ecosystem
- 5 per cent claimed that their communication is through a Single Window System





Perceived blockers of PCS adoption



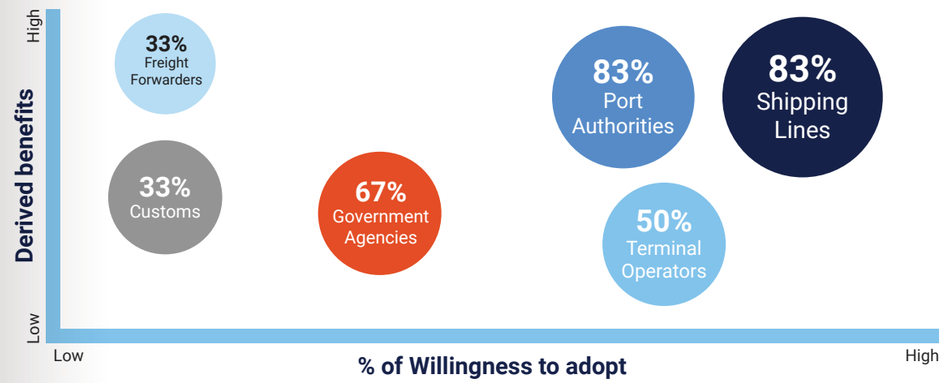
A significant bottleneck in the modernisation of maritime logistics is the uneven adoption of Port Community Systems (PCS), largely driven by institutional resistance. Survey data reveals that 50 per cent of respondents identify Customs as the primary blocker to seamless PCS integration, often citing rigid regulatory frameworks and a traditional reliance on physical verification. This is closely followed by other government agencies (35 per cent), whose fragmented requirements create a "silo effect" that complicates data standardisation. When 85 per cent of the perceived resistance stems from regulatory and public bodies, it highlights a critical disconnect between the digital goals of the private sector and the administrative inertia of state authorities.

This resistance creates a ripple effect across the entire supply chain, stifling the efficiency of private stakeholders. While freight forwarders (10 per cent), port authorities (3 per cent), and terminal operators (2 per cent) are viewed as minor contributors to the deadlock, they remain caught in a system where manual and semi-digital processes—like PDF sharing via WhatsApp and email—remain the "safe" default. To move beyond this impasse, the report suggests that true digital synchronisation requires more than just better software; it demands a high-level policy shift that incentivises Customs and governmental bodies to transition from being gatekeepers of data to active facilitators of a unified Single Window environment.

Stakeholder support in PCS adoption

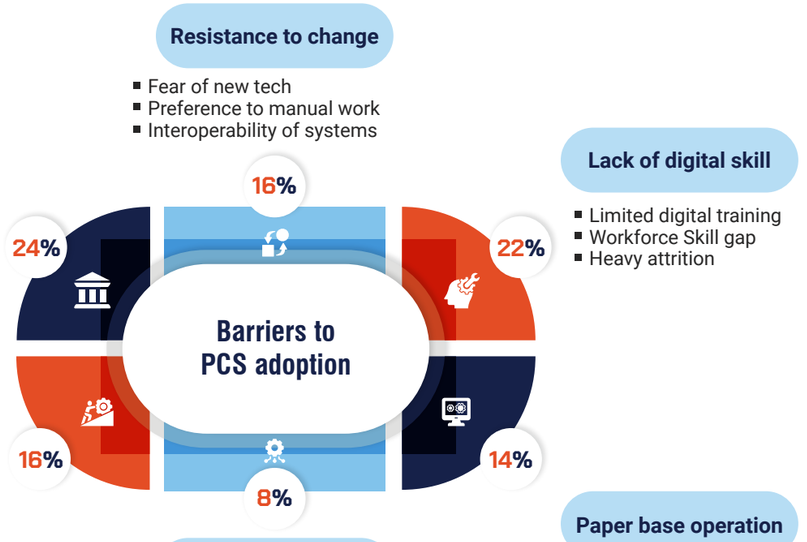
The prominence of port authorities and shipping lines in the survey is particularly notable. It suggests that the entities most directly responsible for vessel calls and operational planning are also the strongest supporters of system-wide digitalisation. This alignment indicates that digital transformation efforts are gaining traction at the strategic apex of port ecosystems. The strong role of government agencies also aligns with rising regulatory expectations around digital reporting, environmental sustainability, and transparency. Terminal operators, positioned at 50 per cent support, reflect a moderate readiness level. Given that terminals play a significant operational role—from cargo handling to yard management—their digital integration is crucial. However, many global terminals operate proprietary systems or legacy infrastructure that complicates integration into larger PCS ecosystems.

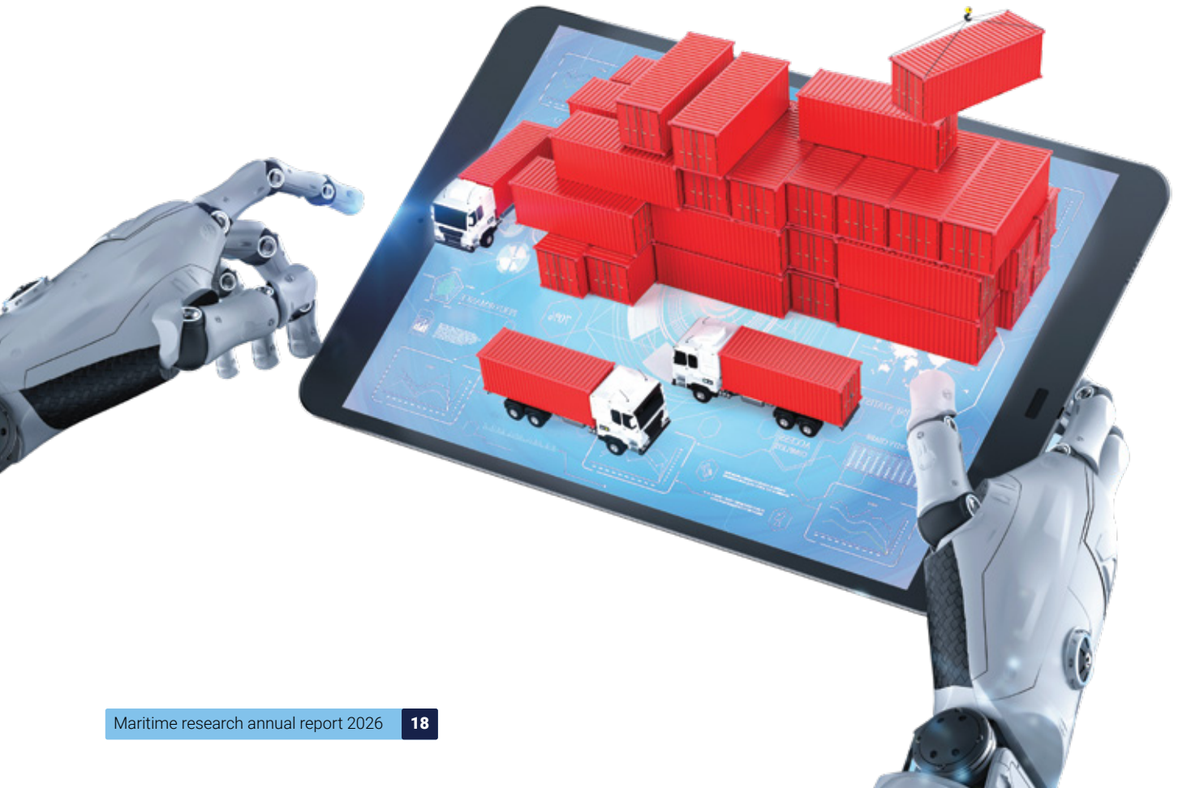
The lowest-scoring groups—customs and freight forwarders—represent the most persistent challenges to digital interoperability. Both groups often face structural barriers such as legacy systems, fragmented operations, and complex compliance-driven workflows. Their hesitance or inability to fully adopt PCS functionalities creates bottlenecks that reduce the overall impact of digitalisation efforts. This dynamic reflects a global issue: a port's digital maturity can never exceed that of its least digitalised stakeholder. This brings us to the most critical question of which stakeholders are willing to support digital readiness the most against their implied benefits. Here Port authorities and Shipping Lines stand on top with 83 per cent willingness thereby citing them as the biggest enablers. While Freight Forwarders and Customs come at the lower end with 33 per cent has willingness to adopt and feel the derived benefits are medium.



Challenges Hindering Digitalisation Efforts

Despite growing momentum around port digitalisation and trade facilitation, the adoption of PCS continues to face a set of deeply interconnected structural, operational, and human barriers. The survey findings indicate that these challenges rarely exist in isolation; instead, they reinforce one another, slowing progress and diluting the impact of digital initiatives.





Regulatory limitations (24%)

Emerged as the single most significant barrier to PCS adoption. Many ports operate within outdated or fragmented regulatory frameworks that have not evolved in step with latest digital trade practices. In such environments, even well-designed PCS initiatives struggle to scale beyond pilot phases without clear legal backing and inter-agency alignment.

Digital skill gaps (22%)

As PCS platforms move beyond basic data exchange to advanced orchestration and analytics, ports require personnel capable of managing digital workflows, interpreting operational data, and maintaining integrated systems.

Budget challenges (16%)

While PCS solutions increasingly follow cloud-based and modular deployment models, concerns around upfront costs, integration effort, and long-term sustainability persist. For ports dependent on public funding or operating in cost-sensitive regions, competing infrastructure priorities often delay digital investments, even when the long-term efficiency benefits are well understood.

Resistance to change (16%)

Many port ecosystems are accustomed to manual controls and informal coordination mechanisms developed over decades. Fear of new technology, concerns about role displacement, and a preference for established processes contribute to slower adoption.

Paper-based processes (14%)

Even ports with partial digital systems often revert to paper at key handoff points, weakening end-to-end process integrity.

Lack of system integration (8%)

Respondents noted that poor integration between terminal systems, customs platforms, shipping lines, and logistics partners leads to fragmented data, duplicate effort, and inconsistent views of cargo status.

Digital readiness across the port ecosystem

Overall Digital Readiness of Ports: Momentum with Structural Gaps

PCS adoption is no longer a question of if, but how fast and how holistically. Survey findings indicate broad support for PCS adoption across the port ecosystem; however, readiness varies significantly by stakeholder group. While port authorities and shipping lines emerge as strong enablers, other critical participants—particularly terminal operators, customs agencies, and freight forwarders—face structural, regulatory, and capability constraints that slow ecosystem-wide digitalisation.

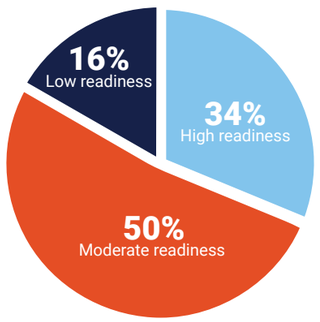
Survey findings indicate that port digital readiness has moved beyond early experimentation and is now firmly in a transition phase. When asked to assess the current level of digital readiness within their ports, 50 per cent of respondents described it as moderate, citing uneven preparedness across different stakeholders within the port ecosystem. A further 34 per cent rated their digital readiness as high, reflecting strong progress among leading ports, while 16 per cent acknowledged low readiness, primarily due to gaps in integration, skills, and legacy processes.

This divergence highlights a central insight: PCS adoption is not a single-entity technology decision, but an ecosystem coordination challenge. Value is realised only when digital readiness reaches a critical mass across all stakeholders involved in cargo movement, regulatory clearance, and information exchange.

Key insight:

Ports are no longer debating whether to digitise—but how fast the slowest stakeholders can keep up.

Port digital readiness distribution



Most ports are digitally progressing, but uneven stakeholder readiness limits ecosystem-wide impact.



What is driving stakeholders to go digital?

Beyond readiness levels, the survey explored why stakeholders are investing in digital transformation. Responses point to a clear hierarchy of motivations, revealing that digitalisation is increasingly driven by strategic intent rather than operational compulsion alone.

Across the ecosystem, commitment to a long-term vision or strategic objective emerged as the dominant driver, cited by approximately 60 per cent of respondents. This suggests that digital initiatives are no longer viewed merely as efficiency projects, but as foundational to future competitiveness, resilience, and compliance.

The second set of drivers reflects capability-building needs. Digital skills and training accounted for roughly 15 per cent of responses, highlighting recognition that technology investments must be matched by workforce readiness. Data-driven decision-making is at 18 per cent, underscoring growing reliance on analytics, predictive insights, and performance intelligence to manage increasingly complex port operations. Interoperability and other enabling factors made up the remaining share, reinforcing their role as necessary—but not primary—motivators.

A deeper stakeholder-level analysis reveals distinct motivations across the ecosystem, reinforcing the need for differentiated engagement strategies. Port authorities and government agencies consistently cited vision and long-term objectives as their primary drivers. For these stakeholders, digitalisation is closely tied to national trade competitiveness, regulatory modernisation, sustainability goals, and transparency mandates.

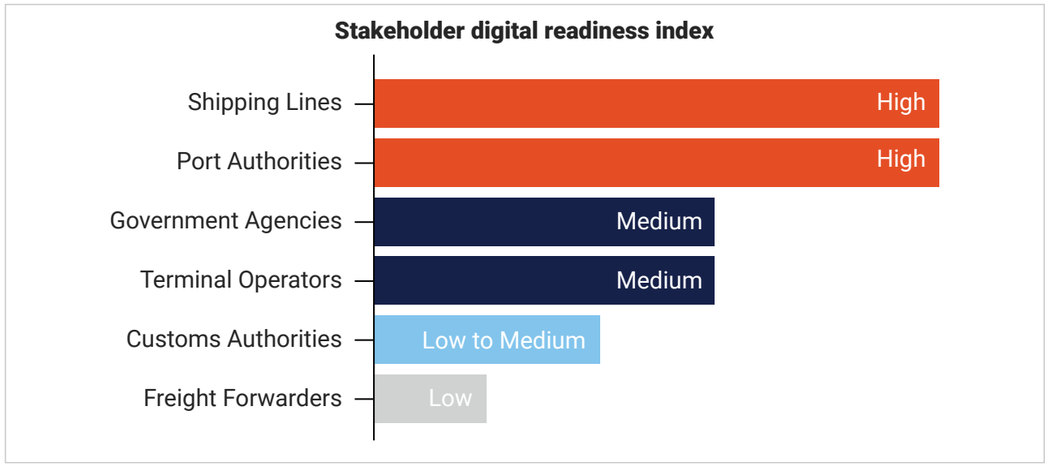
Customs authorities identified data-driven decision-making as their most critical driver. This aligns with global trends toward risk-based inspection, automated targeting, and analytics-led clearance models. Freight forwarders and terminal operators placed greater emphasis on digital skills and training, reflecting operational realities. For these groups, the ability to use systems effectively and integrate digital tools into daily workflows is a prerequisite for adoption.

Key insight:

PCS adoption accelerates when transformation narratives are tailored to stakeholder priorities—strategy for authorities, intelligence for customs, and capability for operators.

PCS adoption: an ecosystem-led transformation

Port Community System (PCS) adoption is no longer a standalone technology initiative. It has become an ecosystem coordination challenge shaped by leadership, regulation, and commercial pressure. Survey findings indicate a clear hierarchy of influence across stakeholders, with port authorities and shipping lines emerging as the strongest enablers. However, uneven digital maturity across the ecosystem continues to limit the full value of PCS investments.



Port authorities: From infrastructure managers to digital orchestrators
Port authorities are emerging as the primary leaders of port digitalisation. Their system-wide mandate enables coordination across terminals, shipping lines, customs, inland transport providers, and government agencies. Many advanced ports have deployed integrated PCS platforms, real-time vessel traffic systems, and automated clearance workflows, supported by formalised data governance frameworks.

Regulatory mandates—most notably the IMO's Maritime Single Window (MSW)—have further accelerated this shift by driving digital reporting and reducing manual documentation. While investment capacity varies across regions, institutional readiness among port authorities to lead PCS adoption remains high.

Shipping lines: Demand-side drivers of digital standardisation
Shipping lines rank alongside port authorities as key enablers of PCS adoption. Global carriers depend on real-time visibility, standardised documentation, and synchronised port operations capabilities enabled by PCS platforms. The rapid adoption of electronic bills of lading and automated delivery processes has increased pressure on ports to modernise. Shipping alliances amplify this effect by requiring consistent data standards across all ports of call, making digital integration a competitive necessity.

Key insight:

- PCS adoption accelerates when transformation narratives are tailored to stakeholder priorities—strategy for authorities, intelligence for customs, and capability for operators.
- Shipping lines act as demand-side enforcers of digital readiness, often making PCS adoption unavoidable for ports.



Government agencies: Policy enablers—when execution aligns
Government agencies influence PCS adoption through regulatory frameworks, compliance mandates, and digital trade initiatives. National Single Window (NSW) programs have reduced fragmented reporting and improved transparency and clearance efficiency. However, regulatory impact depends on execution. Without interoperable PCS platforms at the port level, policy mandates alone cannot deliver end-to-end digital trade processes.

Terminal operators: Operational centrality, uneven readiness
Terminal operators are critical to PCS effectiveness, providing real-time data on vessel, yard, and gate operations. Survey results show moderate support (~50 per cent), reflecting a digital divide within the terminal community. Large global terminal groups have advanced automation and TOS platforms, while smaller operators often rely on legacy systems that are costly to integrate. Despite these constraints, PCS integration offers clear benefits, including reduced congestion and improved asset utilisation.

Customs authorities and freight forwarders: The missing links
Customs authorities and freight forwarders show the lowest support levels (~33 per cent), despite their central role in trade facilitation. Customs operations remain constrained by legacy systems and manual processes, while freight forwarding is highly fragmented and dominated by SMEs with limited digital capacity. These gaps reflect structural constraints rather than resistance, but they significantly limit end-to-end PCS value.

Key insight:

- PCS adoption succeeds when regulation is matched with interoperable systems and institutional capacity building.
- Terminal operators are a conversion point—PCS value multiplies when they integrate, but remains partial when they do not.
- PCS success depends on lifting the lowest digital denominator across the ecosystem.
- PCS value is unlocked when orchestration bridges readiness gaps—not when technology is deployed in isolation.

PCS Adoption Is a Coordination Challenge
PCS adoption follows a clear readiness gradient. Port authorities and shipping lines are positioned to lead; terminal operators are selectively ready; customs authorities and freight forwarders face systemic barriers. This imbalance explains why many PCS initiatives stall after deployment. Without ecosystem-wide coordination, digital investments deliver visibility—but not control. Sustainable PCS success requires orchestrated adoption across all stakeholders.

AI use cases in maritime

AI in ports: from pilots to daily operations

AI has moved from experiment to everyday tool in ports, but few operators can yet prove what it earns. In an August 2026 survey of 103 port and terminal experts by BCG and TIC4.0, 44% had moved beyond early testing to scaling AI. Only 11% tracked its contribution systematically, and just 4% could point to a measurable gain in earnings (BCG, Oct 2026).

The same pattern shows up across shipping. In a September 2026 Marcura and Thetius survey, 63% of maritime professionals used AI daily, yet only 8% described their organisation as mature and governed in its use (Smart Maritime Network).

AI in maritime: key numbers

Figure	What it shows	Source
44%	Port and terminal respondents scaling AI or beyond (56% of companies above $8 bn revenue, 32% below $1 bn)	BCG/TIC4.0, 2026
4%	Can show a measurable earnings gain from AI	BCG/TIC4.0, 2026
41%	Name unclear ROI as the main barrier, ahead of data quality (32%) and systems integration (30%)	BCG/TIC4.0, 2026
61%	Say freight forwarders are the customers asking hardest for AI-enabled services	BCG/TIC4.0, 2026
72%	Maritime organisations using, piloting or planning agentic AI; only 15% say their governance is ready	Marcura/Thetius, 2026
$4.3 bn➔$32.7 bn	Maritime AI market, 2024 to 2030 forecast (40.6% CAGR).	Grand View Research



Seven AI use cases with proven results

Use case	What AI does	Proof point	How a PCS enables it
Predictive ETA and berth planning	Forecasts arrival times from AIS, weather and port-call history; replans berths automatically	Rotterdam's Pronto predicts arrivals within about 20 minutes up to 7 days ahead and cut waiting times by 20% (IMarEST, Apr 2026)	Shares one arrival time with pilots, terminals, agents and tugs
Just-in-time arrival	Advises ships to slow down instead of racing to anchor	PSA's OptEVoyage was applied to over 3,000 port calls, saving an estimated 180,000 t of bunker fuel and about 564,000 t of CO2 in a year (IMarEST)	Needs berth availability shared before the ship sails
Landside truck orchestration	Matches trucks to container moves and gate slots	PSA's OptETruck cut empty truck trips by more than 50% (IMarEST)	Truck appointment and gate data already sit in the PCS
Document data extraction	Reads bills of lading, manifests and invoices and fills systems automatically	The most adopted port use case: 62% of BCG/TIC4.0 respondents use or are exploring it	Clean data flows once into the PCS instead of being rekeyed
Predictive maintenance	Predicts crane, straddle carrier or engine failures from sensor data	48% of port respondents use or explore crane failure prediction (BCG/TIC4.0); CMA CGM and Wärtsilä signed AI-backed predictive maintenance for 14 LNG-fuelled ships in 2025 (IMarEST)	Maintenance windows can be shared with berth plans
Cargo visibility and forecasting	Predicts dwell time, congestion and yard capacity	Los Angeles' Port Optimizer gives over 5,000 companies up to 40 days of advance cargo visibility (IMarEST); in the BCG survey, operational forecasting rises from 49% using it today to 67% expecting benefit within three years	Combines data from lines, terminals and customs
Customs risk targeting	Scores consignments so officers inspect the riskiest ones	Matches this report's own finding that Customs is motivated mainly by data-driven decision-making	Gives Customs advance, structured cargo data

Roadmap to a connected port community

From paper to predictive: a five-stage PCS maturity model

Most ports are not choosing between “no PCS” and “full PCS”. They are somewhere along a path, and each stage builds the data foundation the next one needs. The model below gives port communities a shared way to say where they are and what comes next.

Stage	What it looks like	What moves a port to the next stage
1. Paper and email	Documents exchanged on paper, email or WhatsApp; data rekeyed at every handover	A shared digital vision agreed by the port authority and Customs
2. Digital documents	Individual organisations digitise their own processes (TOS, Customs system), but systems don’t talk to each other	Common data standards and a governance body for the port community
3. Single window	Regulatory data submitted once through a Maritime or National Single Window; commercial data still siloed	Extending the single window to business-to-business exchanges
4. Port Community System	All stakeholders exchange regulatory and commercial data through one neutral platform	Clean, consistent data flowing across the community
5. Predictive, AI-enabled PCS	The platform forecasts arrivals, congestion and dwell times and helps stakeholders plan ahead	Continuous improvement and measurement of results

Where respondents stand today. Our survey shows that most ports are still in the early stages. 79 per cent have not yet adopted a PCS: 25 per cent are evaluating and 54 per cent are planning. 16 per cent have a partial PCS and only 5 per cent a fully implemented one. Half of respondents still rely on email or WhatsApp for day-to-day coordination, which places them at Stage 1.



A three-phase plan

Phase 1: Build consensus (0–6 months). Form a port community council with the port authority, Customs, terminal operators, shipping lines, forwarders and transporters. Map current processes, measure baseline KPIs, and agree on the scope and governance model of the PCS.

Phase 2: Deliver quick wins (6–18 months). Launch the modules with the fastest visible benefit, typically vessel call management, delivery orders and truck appointments. Connect to the Maritime Single Window, which has been mandatory under the IMO FAL Convention since January 2024.

Phase 3: Scale and optimise (18–36 months). Bring all stakeholder groups on board, retire paper processes, and start using the data for forecasting and decision support.

What each stakeholder can do now

Stakeholder	Three actions
Port authorities	▪ Lead the port community council ▪ Set a timeline for retiring paper documents ▪ Publish KPIs so progress is visible
Customs	▪ Join the PCS governance body from day one ▪ Accept advance electronic cargo data for risk targeting ▪ Align Customs and PCS data standards
Terminal operators	▪ Connect the TOS to the PCS ▪ Share berth and yard availability with the community ▪ Move gate operations to truck appointments
Shipping lines	▪ Submit manifests and arrival data once through the PCS ▪ Share ETAs early to support just-in-time arrival ▪ Adopt electronic bills of lading
Freight forwarders	▪ Replace email-based bookings with PCS transactions ▪ Use PCS cargo tracking for customer visibility ▪ Take part in user groups to shape services
Transporters	▪ Register on the truck appointment system ▪ Use digital delivery orders instead of paper ▪ Share fleet availability to cut empty trips

Measuring progress

Before a PCS goes live, ports should record a baseline for these five measures: vessel waiting time, container dwell time, truck turnaround time, document processing time, and paper documents per port call. Repeat the measurement every six months. A PCS that cannot show its value will struggle to keep stakeholder support.

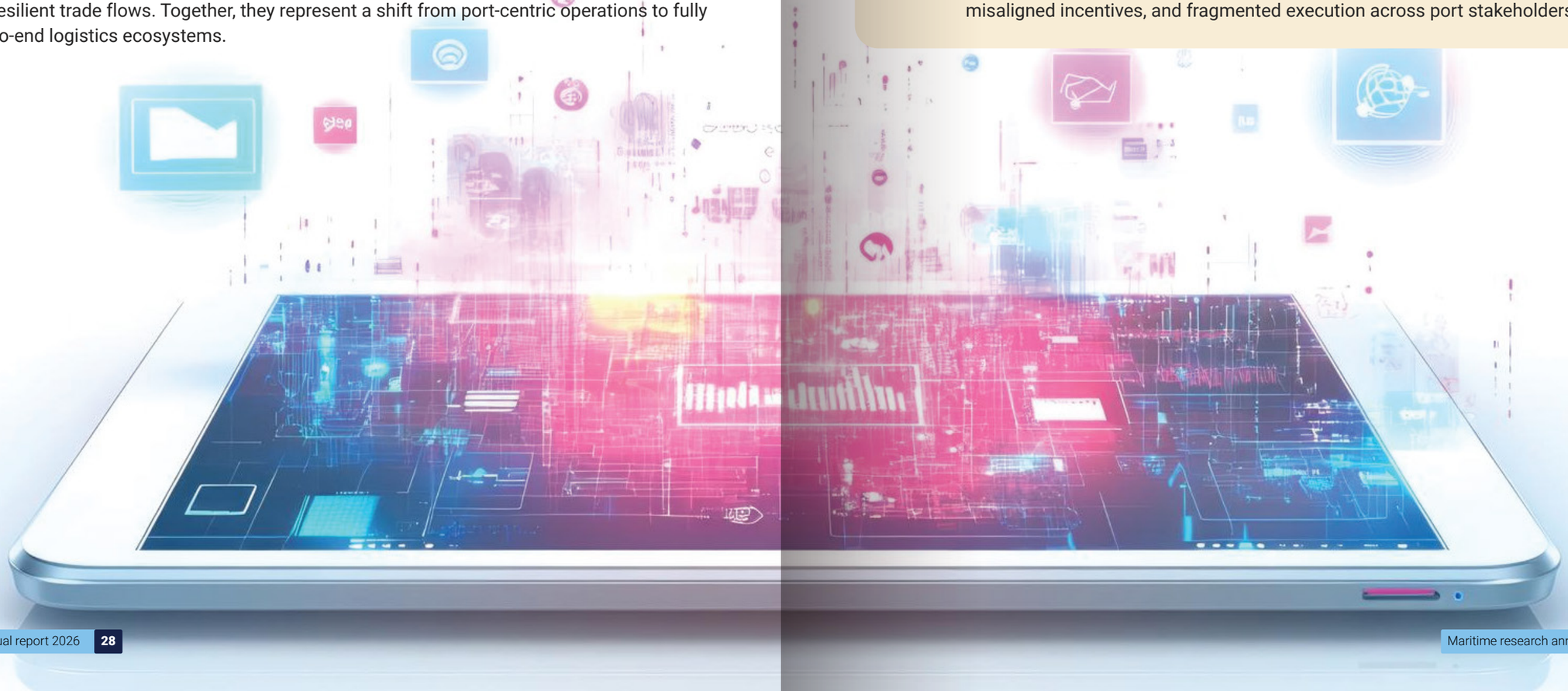
Beyond PCS – Dry Ports, Freight Corridors & More

Beyond PCS, the next phase of logistics transformation is being shaped by the rise of dry ports, integrated multimodal corridors, and digitally connected inland logistics ecosystems. Dry ports extend port functions inland, enabling customs clearance, cargo consolidation, and value-added services closer to production and consumption centres.

Where ports start their digital journey

60%	25%	10%	5%
Vessel scheduling	Customs clearance	Congestion management	e-Invoicing

This reduces congestion at seaports while improving cargo velocity and cost efficiency. Integrated multimodal corridors further strengthen this ecosystem by synchronising road, rail, inland waterways, and ports through unified digital platforms. Real-time data sharing across modes allows seamless cargo movement, optimised routing, and better asset utilisation. When supported by intelligent technologies such as AI, IoT, and data analytics, these corridors enable predictive planning, lower emissions, and resilient trade flows. Together, they represent a shift from port-centric operations to fully connected, end-to-end logistics ecosystems.



In Summary

PCS adoption does not fail due to a lack of intent or available technology. It falters when digital readiness, incentives, and capabilities remain uneven across the port ecosystem. The survey findings make it clear that technology alone is not the constraint; rather, the primary challenge lies in aligning policy, systems, processes, and people around a shared digital operating model. Encouragingly, the ecosystem is moving in the right direction. Port authorities, shipping lines, and government agencies have emerged as strong enablers of digitalisation, reflecting a growing strategic recognition of the role modern port systems play in trade efficiency, compliance, and competitiveness. At the same time, customs authorities and freight forwarders remain pivotal stakeholders whose digital maturity will ultimately determine whether PCS delivers true end-to-end integration or remains a partial solution.

Interoperability gaps consistently surface as the most critical barrier—limiting seamless data exchange, slowing trade documentation, and preventing community-wide collaboration. These challenges are compounded by organisational silos, skills shortages, and resistance to change, underscoring that PCS adoption is as much a transformation initiative as it is a technology program.

The findings reinforce a central truth: digital transformation in ports is a collective journey. Sustainable PCS success requires ports to evolve beyond platform ownership toward active ecosystem orchestration—coordinating stakeholders, enabling interoperability, and driving structured change management. Ports that adopt this ecosystem-driven, human-centered approach will be best positioned to navigate rising trade complexity and thrive in the next phase of maritime logistics.

PCS adoption is not constrained by technology availability, but by uneven digital readiness, misaligned incentives, and fragmented execution across port stakeholders.

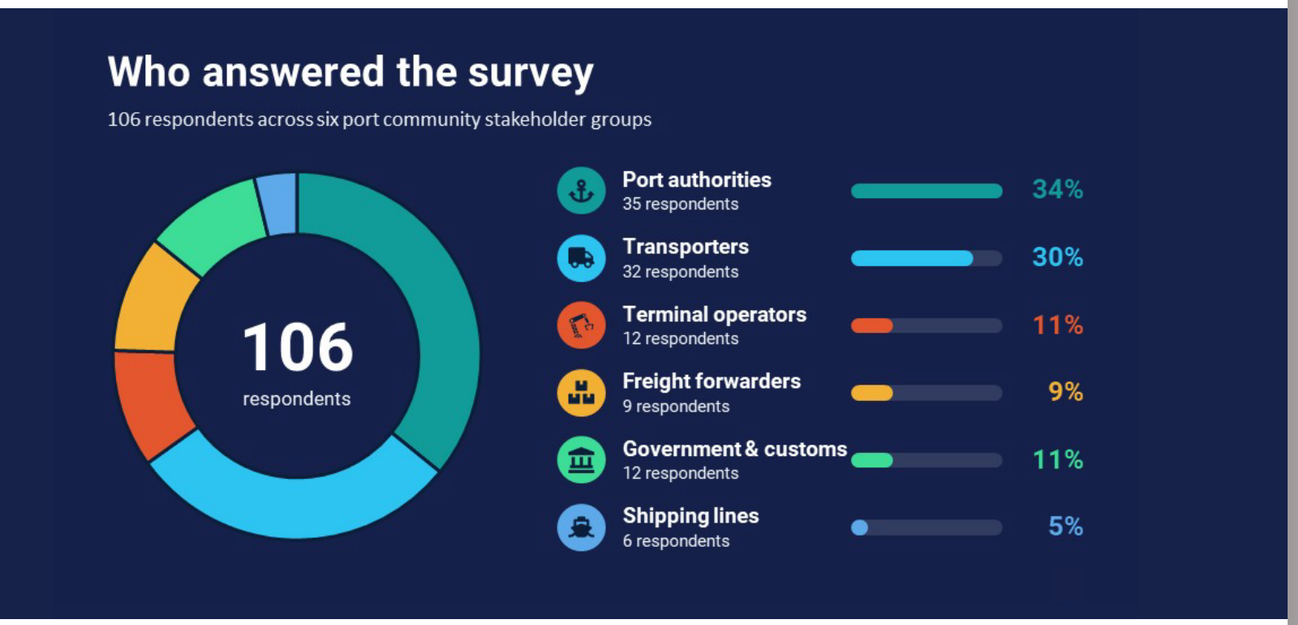
Annexure

Research methodology

This report combines a survey of port community stakeholders (primary research) with a review of published industry data and research (secondary research). Kalé conducted an online survey of port and maritime stakeholders between Jan-26 and Mar-26. The questionnaire combined multiple-choice, ranking and rating-scale questions, and covered five areas:

1. Current state of digitalisation and communication tools in the port community
2. Status of Port Community System (PCS) adoption
3. Barriers to adoption and the stakeholders seen as blocking progress
4. Support for PCS and the benefits each stakeholder group expects
5. Awareness of advanced technologies, including AI, IoT, blockchain and 5G

The survey received 106 complete responses from 14 countries across 6 regions.





Respondents were senior professionals in operations, IT, management and policy roles. They were reached through Kalé's industry network, maritime associations and direct outreach.

All percentages are calculated from the 106 respondents unless a chart states otherwise. Where a question allowed more than one answer, totals may exceed 100 per cent, and the chart notes this. Support scores show the share of each group that rated their support for PCS as based on that group's own respondents. Figures are rounded to the nearest whole number, so some totals may not add up to exactly 100 per cent.

To place the survey findings in a global context, the report draws on published research from international organisations, industry bodies and market analysts from the below sources:

- UNCTAD, Review of Maritime Transport 2025 (24 Sep 2025)
- World Bank, Logistics Performance Indicators 2.0
- IMO, Facilitation (FAL) and the Maritime Single Window
- European Commission, European Maritime Single Window environment
- DCSA, soft barriers to eBL adoption and Breakbulk News on 11% eBL adoption
- Offshore Technology on CYTUR cyber data and Maritime Executive
- HaverAnalytics, The Economics of a Chokepoint Crisis (8 Sep 2026)
- BCG and TIC4.0, Ports Are Scaling AI (Oct 2026)
- Smart Maritime Network on the Marcura/Thetius AI survey (30 Sep 2026)
- IMarEST, Smarter ports: data and AI are reshaping port operations (10 Apr 2026)
- Grand View Research, Maritime AI market

About Kalé

Kalé is a global vertical SaaS company, providing a suite of software solutions for the logistics industry. It counts several Fortune 500 companies including large airports, and seaports as its customers. With in-depth domain knowledge and technical expertise, Kalé has developed a suite of comprehensive digital enterprise solutions. Its flagship product is the Cargo Community Platform, which offers a single source of data to support operational flows, disseminating information to various stakeholders and facilitating the paperless exchange of trade-related data between stakeholders.



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