

Divergences and Synergies between European Ports and the Hainan Free Trade Port

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Abstract

Maritime infrastructure sits at the intersection of trade, industry, and security, forming a critical node in the economic relationship between the European Union (EU) and China. While the EU increasingly frames port governance through the lens of economic security and de-risking, China continues to integrate its port development within its wider goals of becoming a major maritime power and advancing global connectivity. This study investigates potential policy cooperation between European ports and the Hainan Free Trade Port in this context, grounded in the framework of strategic narratives and employing a structured, focused comparison across English- and Chinese-language policy, corporate, and academic sources. It argues that despite political and regulatory divergence, the EU and China retain overlapping interests that enable technical alignment. Specifically, the study identifies four pragmatic avenues for bilateral collaboration: green shipping, fisheries compliance, data exchange standards, and intermodal logistics. These technical domains offer actionable pathways for constructive engagement that support Hainan Free Trade Port's ongoing development while accommodating European economic security priorities.

Keywords: EU–China relations, port governance, Hainan Free Trade Port, economic security, strategic narratives, maritime transport

1. Introduction

The maritime domain is a key area of EU-China relations. China is one of the EU's key trade partners (Eurostat, 2026), and around 74% of all the EU's goods trade is handled by ports (The Brussels Times, 2026). Furthermore, China has stakes in more than 20 European ports (EPP Group, 2026). Much like the broader relationship, EU-China cooperation is subject to friction but also includes overlapping interests with the potential for cooperation.

Ports, which are the gateways of trade, industry, and security, sit at the core of EU-China maritime engagement. The EU increasingly views port governance through the lens of economic security and de-risking. In contrast, China's port policy is embedded within its pursuit of global connectivity under the Belt and Road Initiative (BRI) and its goal of becoming a major maritime power.

In this context, EU-China port collaboration faces certain political and regulatory hurdles. However, these tensions do not represent a complete impasse. The purpose of this study is to answer the question: which areas encompass the potential for port policy cooperation even in these times of friction in the broader geopolitical context? Leveraging evidence from policy papers, corporate reports, media reports, and research articles, the paper's argument is that the EU and China share overlapping interests that create opportunities for learning, exchanges and technical alignment. These domains include green transport corridors, fisheries compliance, data exchange standards, and intermodal logistics. Exploring these areas of mutual interest highlights actionable pathways for technical collaboration while supporting the Hainan Free Trade Port's ongoing opening and development.

The paper is structured as follows. The second section reviews existing literature in both English and Chinese. The third section outlines the analytical framework, methodology, and sources. The fourth section examines the strategic narratives shaping EU and Chinese maritime and port policies; it argues that the EU is shifting toward an economic security approach, whereas China aims to become a major maritime power while fostering global commercial connectivity. The penultimate section explores four avenues for practical

cooperation, before the conclusion summarises the findings and outlines areas for future research.

2. Literature review

Existing research on China–EU maritime connectivity, port dynamics, and infrastructure investments centers on at least four core analytical themes, reflecting perspectives from both Chinese and European academic and policy circles.

First, literature evaluates flagship port infrastructure investments, operational models, and competitive dynamics, focusing on major European maritime hubs, such as Piraeus, Hamburg, Antwerp-Bruges, and Rotterdam. Chinese literature explores how long-term capital investment, port governance reforms, and intermodal infrastructure interact with regional economic growth (Liu, 2013, pp. 13-15). Scholarship also shows that initiatives like the China–Europe Land-Sea Express Line and cross-border hinterland transport links transform individual ports into comprehensive supply chain gateways while balancing port competition with functional specialisation (Global Times, 2025). Conversely, recent European port economics literature identifies a ‘tipping point’ or diminishing returns model: while initial capital inflows and state-owned enterprise (SOE) integration (e.g., COSCO) significantly boosted throughput and transshipment efficiency in hubs like Piraeus, subsequent minority stakes in other European ports have yielded limited extra growth, operating primarily as symbolic-strategic presence or source of commercial leverage rather than transformational drivers (Kuipers et al., 2026, pp. 41–57).

Another line of inquiry addresses the geopolitical, regulatory, and security frictions defining the China–EU relationship. Researchers like Zhang (2023, p. 71) and Popławski (2025) analyse how shifting geopolitical frameworks, including the EU’s designation of China as a systemic rival, the rollout of the EU Economic Security Strategy, and heightened US-China rivalry, have reshaped port governance. European policy studies and commentary investigate how foreign direct investment (FDI) in dual-use critical infrastructure may pose structural dependency risks, economic coercion vulnerabilities, and market-distortion effects driven by state-subsidised Chinese SOEs (Ghiretti et al., 2023, pp. 8-9; Solís, 2026).

Furthermore, recent geopolitical developments, such as uneven national risk perceptions among EU member states (Martin et al., 2024, pp. 12-18), highlight growing momentum toward an integrated EU Port Strategy and harmonised FDI screening.

Third, there is an emerging focus on cyber, data, and technological security in maritime logistics. Research on platforms like China's LOGINK details how data aggregation across global supply chain nodes creates risks such as commercial intelligence leaks and surveillance of military logistics, noting that technological and software penetration of ports represents a critical, under-regulated vector of strategic exposure (Corradi, 2024).

Fourth, scholars examine the strategic, economic, and logistical mechanics of emerging maritime and Arctic routes, with a focus on the Northern Sea Route. Studies in this strand evaluate how Arctic passages shorten transit times between Asian and European trade hubs, offering commercial shipping an alternative to vulnerable geopolitical chokepoints like the Suez Canal (Liang, 2025). At the same time, researchers also highlight significant operational constraints of the Northern Sea Route, including high initial economic shipping costs and asymmetric trade complementarity between China and European economies (Wang & Wang, 2021, p. 1105).

While offering invaluable insights, current scholarship in the EU-China port interaction realm remains largely focused on macro-level geopolitical analysis and structural trade and logistics modeling. A gap remains in investigating technical, working-level cooperation and practical mechanisms on the ground, which could provide policymakers with realistic frameworks for balancing open economic engagement with strategic autonomy.

3. Methodology and Sources

The analytical approach of this study is grounded in the framework of strategic narratives, defined as the structured stories political leaders craft regarding historical contexts, current events, and future trajectories in international relations. Political actors utilise these narratives to project power, align expectations, and alter the surrounding policy discourse to advance their objectives (Miskimmon et al., 2014, p. 2).

Applying this framework allows for a structured analysis of the core narratives shaping EU and Chinese approaches to maritime affairs in general and ports in particular. Unpacking these narratives helps clarify the motives behind existing policy measures and anticipate future regulatory directions. Specifically, examining the discursive drivers behind EU and Chinese port policies highlights key points of divergence, uncovers potential avenues for cooperation, and identifies practical partnerships capable of enduring shifting geopolitical dynamics.

Methodologically, the paper employs a structured, focused comparison (George & Bennett, 2005, pp. 3–36) across four policy domains. Each case is systematically evaluated broadly along the same comparative verticals, examining the definition of the policy domain, the primary challenges within the domain, the European and Chinese strategic approaches, and potential cooperative pathways synthesised from these respective stances and challenges.

This analysis draws on a diverse set of primary and secondary sources, including official policy documents, media reports, peer-reviewed literature, and corporate materials. Utilising both English and Chinese language sources allows the paper to bridge a major linguistic gap that often constrains comparative research in this field.

Finally, certain research limitations must be acknowledged. Given the technical nature of port operations and maritime decarbonisation, publicly available desk research data remains scarce. Consequently, supplementing this documentary analysis with field interviews of technical experts represents a valuable direction for future research to further advance practical EU-China port policy cooperation.

4. Framing the Blue: What the EU and China See When They Look at the Oceans

4.1. The European Union: Economic Security and De-Risking

The EU's approach to maritime affairs is shaped by its overarching policy pursuits of economic security and de-risking. Economic security roughly stands for the bloc's collective capacity to safeguard the functioning of its society, public order, and strategic

independence through a resilient economy (European Commission & High Representative of the Union for Foreign Affairs and Security Policy, 2023, Sections 1-2). Acknowledging that Europe's security is fundamentally intertwined with its commercial linkages, the EU strives to proactively identify, deter, and mitigate vulnerabilities arising from external dependencies. This posture responds to the EU's perception of a geopolitical environment where external actors weaponise asymmetric trade flows, deploy coercive economic measures, or exploit state-subsidised mass production to target critical technologies (European Commission & High Representative of the Union for Foreign Affairs and Security Policy, 2025 Section 1, Section 3).

De-risking is a reflection of how the EU operationalises economic security. It is a policy alternative to economic decoupling, aimed at neutralising critical vulnerabilities in external relationships without severing commercial, political, or scientific ties. De-risking functions through four pillars in the economic domain. First, it aims to reduce structural dependencies on single-source suppliers for critical raw materials and clean technologies. Second, it enforces existing trade defence instruments more assertively to counter economic coercion and market distortions. Third, it designs new defensive mechanisms, such as outbound investment screening, to prevent the leakage of sensitive dual-use technologies that could enhance the intelligence or military capabilities of systemic rivals. Finally, it prioritises global alignment, partnering with international coalitions to diversify trade routes and reinforce supply chain resilience through alternative infrastructure investment frameworks (von der Leyen, 2023).

This defensive framework of economic security fundamentally shapes the EU's approach to ports. The EU Ports Strategy is one of the manifestations of de-risking. As ports handle approximately three-quarters of the Union's external trade, they are no longer managed as apolitical transport links, but as multi-functional industrial hubs central to Europe's defense readiness, energy transition, and supply chain resilience (European Commission, 2026b, Sections 3-4).

The Port Strategy is complemented by other policy initiatives that support its implementation. On the economic front, the EU leverages risk-based, non-discriminatory

foreign investment screening designed to prevent third-country actors from establishing undue control over key EU assets, including coastal infrastructure (European Union, 2026, Chapter II, art. 4, paras. 1-2, 15; European Commission, 2026b, Section 2.2). On the security front, the EU strengthens defensive capabilities through initiatives like the European Ports Alliance (European Commission, 2024), while coordinating with NATO to secure dual-use military logistics corridors (European Commission, n.d.-a). Finally, the framework binds resilience to the green transition by promoting alternative fuel bunkering and the utilisation of EU Emissions Trading System (ETS) revenues to advance decarbonisation (European Commission, 2026b, Section 3.1).

The EU Industrial Maritime Strategy, introduced alongside the Port Strategy in March 2026, responds directly to the EU's perceptions of intensifying international competition, distortive non-market practices, and foreign financing dependencies that may threaten European autonomy. The strategy connects the strategic importance of maritime manufacturing with European sovereignty, and it aims to protect Europe's leadership in high-end shipbuilding and equipment, among other fields. It also strives to strengthen the European production of complex, alternative-fuel vessels and clean technologies necessary for the green transition (European Commission, 2026a, Section 2.1). Furthermore, it doubles down on the protection of critical offshore infrastructure while supporting military mobility through dual-use construction mechanisms. Ultimately, the strategy's goal is to ensure that the technological advancements and dual-use assets deployed across European waters are engineered and maintained within a secure, protected regional value chain, anchoring the Union's long-term economic security and defence readiness (European Commission, 2026a, Sections 4.2-4.3).

4.2. China: Maritime Great Power and Global Connectivity

China's approach to the ocean is driven by its ambition to become a major maritime power and to enhance global connectivity via the Belt and Road Initiative (BRI).

China's pursuit of becoming a major maritime power was officially elevated to a national priority during the 18th National Congress of the Communist Party (Hu, 2012, Chapter

VIII, Section 1). In this effort, China integrates the utilisation of marine resources and the growth of the blue economy with the protection of the marine environment and the defense of national maritime sovereign rights. At the same time, China's maritime interests are backed by the defensive capabilities of its modernised armed forces. This is a model where global trade networks and maritime infrastructure are systematically developed alongside naval defense readiness (Xi, 2013).

In its pursuit of enhancing global connectivity, China launched the BRI. Under the initiative, physical infrastructure is a strategic priority, intended to weave regional corridors across Asia, Europe, and Africa. In terms of port policy, this initiative emphasises eliminating transport bottlenecks, optimising port infrastructure, expanding shipping routes, and harmonising technical, customs, and transshipment standards (National Development and Reform Commission et al., 2015, Section 4). Furthermore, China frames its ocean policy around the concept of a 'maritime community with a shared future', presenting the oceans as an interconnected ecosystem requiring collaborative stewardship, which positions China as a proponent of global maritime cooperation (Xinhua News Agency, 2019).

4.3. The Evolution of EU-China Port Cooperation in Light of Narrative Divergence

The trajectory of EU-China maritime engagement highlights a shifting balance between economic necessity and strategic friction. Throughout the first two decades of the 2000s, Beijing's "Going Out" strategy converged with Europe's need for liquidity following the 2008 financial crisis, driving a rapid expansion of Chinese capital across Europe (Xu, 2011). Between 2004 and 2021, Chinese enterprises executed twenty-four acquisitions and announced thirteen greenfield maritime projects across the EU and its broader periphery, including the Western Balkans (Ghiretti et al., 2023, pp. 8-9). Led primarily by COSCO and China Merchants, these investments established a Chinese state-backed commercial presence in at least fifteen EU ports, bringing approximately ten percent of Europe's total container throughput under Chinese corporate influence (Ghiretti et al., 2022).

The Greek Port of Piraeus serves as a classic example of this era of capital convergence. China's footprint began in November 2008 when Athens and COSCO signed an initial

€831.2 million, 35-year concession agreement granting a COSCO subsidiary, Piraeus Container Terminal (PCT), operational control over Piers II and III. In 2012, this lease was extended until 2052 (Ghiretti et al., 2023, p. 21). Amid the Greek debt crisis and the government facing intense fiscal pressure from international lenders (BBC News, 2015), COSCO in 2016 capitalised on state asset liquidations to secure a 51 percent majority stake in the Piraeus Port Authority for €280.5 million, with an option for an additional 16 percent equity stake contingent on completing mandatory infrastructure upgrades (Georgiopoulos, 2016).

This era of unhindered port infrastructure acquisition peaked between 2013 and 2020, giving way to a much more restrictive operational environment. As European perceptions shifted toward economic security, third-country investments in critical infrastructure faced heightened political scrutiny and rigorous regulatory review. Consequently, China's influence in ports came to be viewed with increasing suspicion (EPP Group, 2026); the European Union underwent a paradigm shift toward economic security and de-risking, and third-country investments in critical domestic assets faced heightened political suspicion and stringent regulatory screening. Simultaneously, Beijing's appetite for overseas capital deployment dissipated after the pandemic (Kratz et al., 2021).

This shift was demonstrated during COSCO's bid for the Tollerort container terminal at the Port of Hamburg. Although the Chinese state enterprise initially sought a 35 percent ownership stake (Grieshaber, 2022), Berlin intervened, forcing a reduction of the equity share to 24.99 percent to prevent Beijing from obtaining voting rights or undue strategic leverage over Germany's critical transport infrastructure (Associated Press, 2023).

5. Practical Avenues for EU-China Port Cooperation

While large-scale infrastructure acquisitions face regulatory headwinds, localised, port-to-port technical collaboration presents a potentially viable pathway for advancing shared operational and environmental objectives.

5.1. Green Shipping

Green shipping entails implementing environmentally conscious methods in the maritime sector, such as adopting cleaner energy sources and streamlining vessel routes, to drastically lower greenhouse gas output and curb atmospheric pollution (Khussein, 2024).

The promotion and implementation of green shipping is not without challenges. Economic, regulatory, and operational bottlenecks hamper this transition. Although the International Maritime Organization mandates sustainable, zero- and near-zero-emission (ZNZ) fuels for the 2050 energy mix, these green alternatives remain significantly more expensive than conventional fossil fuels due to limited production scale. Bridging this price gap requires state involvement, yet current public funding and regulatory frameworks lack the transparency needed to incentivise early adoption (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, 2025).

Furthermore, the industry suffers from a first-mover disadvantage. Pioneering companies face high capital costs to rebuild storage and distribution infrastructure, alongside the risk of stranded assets if fuel supplies remain low (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, 2025). Overcoming these barriers requires complex coordination across fragmented maritime value chains. Without broad port buy-in to establish widespread bunkering networks, green corridors risk becoming isolated, single-route experiments rather than drivers of a global transport transformation (World Economic Forum, 2025).

Regardless of these challenges, European and Chinese marine industry players have pioneered progress in this field. The Port of Gothenburg has positioned itself as Northern Europe's premier bunkering hub for sustainable fuels. In 2022, Gothenburg published formalised operating regulations for ship-to-ship methanol bunkering (Hakirevic Prevljak, 2022), and it executed the world's first non-tanker ship-to-ship methanol transfer in 2023 with the *Stena Germanica* (Bruno, 2023). In 2026, vessels like the *Eco Maestro* routinely utilised these established setups for weekly commercial loops connecting Gothenburg to

Antwerp and Rotterdam, leveraging methanol's high compatibility with existing logistics infrastructure (Port of Gothenburg, 2026b).

European hubs scale decarbonisation initiatives through international port alliances, such as corridors connecting Gothenburg with Rotterdam and Antwerp, integrating public-private coalitions, government subsidies, and shore-power electrification (Port of Rotterdam, 2022). Operationally, these corridors serve as collaborative testbeds to upgrade bunkering infrastructure and technical sandboxes that de-risk private investments and establish scalable, low-emission operational baselines (Weterings, 2024).

China's maritime decarbonisation strategy is largely driven by state-directed, localised testing grounds. Following the launch of its full-island customs operations, the Hainan Free Trade Port's has emerged as an important regulatory sandbox. Hainan Free Trade Port's flexible regulatory framework enables China to rapidly build and verify the commercial feasibility of domestic green supply chains, positioning its mega-ports as vital infrastructure nodes for low-carbon international trade. This is highlighted by the 'Green Hub Port of Yangpu,' which pairs infrastructure expansion with alternative fuel integration (Finn, 2025).

Hainan has been pursuing an integrated lifecycle system, successfully demonstrating a domestic model that handles the production, storage, distribution, and fueling of green methanol derived locally from urban organic waste (COSCO SHIPPING, 2025). To scale up these zero-carbon transport corridors, China is simultaneously piloting advanced maritime engineering technologies, including all-electric container ships equipped with modular lithium battery swaps and high-voltage shore power charging (Si, 2026).

The convergence of the European and the Chinese approaches to green shipping corridors could provide a pathway for localised international maritime cooperation. Even though the global transition toward zero-emission shipping faces a bottleneck due to the lack of progress on the International Maritime Organization Net-Zero Framework (Global Maritime Forum & Getting to Zero Coalition, 2025, pp. 2-3, 14-15), the Port of Gothenburg and the Hainan Free Trade Port could establish direct technical cooperation focused on fuel

standard interoperability, which ensures that Hainan's localised, circular-economy green methanol meets the verification baselines of Europe's FuelEU Maritime framework (European Union 2023a, Chapter V). From a broader perspective, the Port of Gothenburg and the Hainan Free Trade Port could leverage their advantages to contribute to global efforts to advance green shipping.

Leveraging this 'sandboxing' (Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, n.d.) approach that allows for localised testing, a coordinated piloting mechanism between Gothenburg's multi-port European network and the Hainan Free Trade Port could contribute to the establishment of scalable operational blueprints required to transform isolated green corridors into viable, end-to-end global trade routes.

5.2. Tackling Illegal, Unreported, and Unregulated Fishing

In the maritime domain, threats have evolved beyond conventional military rivalries to include non-traditional security challenges, such as Illegal, Unreported, and Unregulated (IUU) fishing. Illegal fishing occurs when vessels operate within a state's jurisdiction without permission or in defiance of regional conservation mandates. Unreported fishing involves misreporting or concealing catch data from national or regional authorities, while unregulated fishing is conducted by stateless vessels or those flying the flag of a country that is not a member of the relevant regional fisheries management organisation, meaning they operate in a manner inconsistent with or in contravention of that region's international conservation measures (Food and Agriculture Organization, n.d.-f). This illicit activity threatens marine biodiversity by exploiting weak administrations and monitoring gaps, which can drive local fisheries toward collapse, distort trade markets, and exacerbate food insecurity and transnational organised crime (Food and Agriculture Organization, n.d.-e).

The fight against IUU fishing is impeded by operational bottlenecks, such as the sheer vastness of the high seas, which makes physical maritime interdiction cost-prohibitive for countries lacking human and technical capacity. This geographical reality is further complicated by widespread non-reporting, fragmented regulatory regimes, and a lack of

economic disincentives that fail to systematically block unverified consignments, allowing illicit catches to remain highly profitable (Swan, 2004, Chapter 5).

In this context, international governance has pivoted toward land-based port controls. This process culminated in the June 2016 entry into force of the FAO's Port State Measures Agreement (PSMA) (Food and Agriculture Organization, n.d.-b), the first legally binding international treaty targeting IUU fishing by transforming voluntary guidelines into enforceable mandates (Food and Agriculture Organization, n.d.-a). Consequently, global ports have been elevated into the primary line of defence against IUU fishing, acting as institutional chokepoints where standardised inspection mechanisms and automated information exchange legally deny entry and essential services to non-compliant vessels (The Pew Charitable Trusts, 2018).

The European Union's anti-IUU strategy partly relies on market access restrictions and working with ports to crack down on IUU fishing (Popescu, 2017, pp. 4–5). As the EU's primary seafood importer, Spain operationalises this framework through an integrated customs-fisheries IT system capable of executing automated checks and multi-parameter risk analysis on all incoming catch certificates (Environmental Justice Foundation et al., 2017, p. 2; European Court of Auditors, 2022, Table 1).

The Port of Vigo is a critical node in this setup. Operating as the largest fishing port in the EU, Vigo's localised enforcement relies heavily on digital tracking. Under its GESPECA framework, vessel operators are legally mandated to transmit digital catch reports before arrival, allowing port authorities to cross-check live data and coordinate docking procedures (López Veiga, n.d.). To expand this digital oversight, the port's projected 'Lonja 4.0' blueprint outlines plans to transition to a paperless management system integrating automated slot-allocation software (Port Authority of Vigo, n.d.). By anchoring compliance to pre-arrival declarations and localised barcode tracing, Vigo serves as a land-based 'enforcement chokepoint' that shifts the regulatory burden away from chasing ships at sea (Natural Resources Defense Council & MRAG Americas, 2022, pp. 30–33; Butler, 2026).

China's approach to tackling IUU fishing includes accession to international agreements, national statutory overhauls, and regional infrastructure upgrades. Internationally, China strengthened its maritime governance by acceding to the FAO Port State Measures Agreement in April 2025 (Lam, 2025; Food and Agriculture Organization, 2025b).

At the national level, it implemented a revised federal Fisheries Law on 1 May 2026. This statutory framework mandates continuous vessel catch logs, criminalises the alteration of satellite navigation data, and establishes mandatory designated-port unloading guidelines backed by joint civilian fisheries enforcement and coast guard tracking. (Standing Committee of the National People's Congress, 2026, Chapter III, arts. 34-35, 38, Chapter V, arts. 54, 56, 59, 63).

To seal supply chain loopholes, the law levies heavy administrative fines on shore-based operators providing fuel, ice, or processing to undocumented 'Three-No' vessels, which are rogue ships operating without names, valid certificates, or registered homeports (Standing Committee of the National People's Congress, 2026, Chapter III, art. 37).

Locally, Hainan Province operationalises the fight against IUU fishing under its 15th Five-Year Plan by deepening its regional fishery 'Three-Walks' transformation, which shifts traditional nearshore fishing toward onshore industrial parks and deep-sea aquaculture while consolidating catches into modernised fishing port economic zones backed by advanced marine economy monitoring infrastructure (Hainan Provincial Committee of the Communist Party of China, 2025, Section 4, para. 12; China Shipbuilding Newspaper, 2026).

The European Union and China share overlapping interests in stabilising global supply chains and combating marine resource depletion, as they are the world's premier seafood markets, processors, and traders (Zhang, 2025, pp. 19-20; European Market Observatory for Fisheries and Aquaculture Products, 2025, pp. 20–28; Food and Agriculture Organization, n.d.-d, Part I). These shared interests manifest in the EU's and China's joint participation in key multilateral cooperation mechanisms such as the Food and Agriculture Organization's Blue Ports Initiative (Food and Agriculture Organization, n.d.-c; Karleskind,

2023, para. 32), which facilitates strategies to transform traditional fishing ports into sustainable, regulated economic hubs (Food and Agriculture Organization, 2025a, pp. 1–2). Similarly, following China's accession to the PSMA, the two sides have shared operational standards. Both jurisdictions now deploy ‘port interception’ to choke off the economic incentives of illegal fishing by denying port access and logistical services to non-compliant vessels (Food and Agriculture Organization, n.d.-a).

This regulatory alignment opens practical pathways for technical cooperation on the interoperability of digital product traceability systems. Given the two sides’ PSMA participation, they have a shared interest in digital chain-of-custody data (Chen & Wang, 2025, pp. 7–8). Bilateral cooperation could prioritise technical training on catch documentation while fostering joint policy positions within multilateral ocean governance bodies. Furthermore, aligning Hainan’s aquaculture traceability systems with global benchmarks, such as the Port of Vigo’s transparent supply chain model, would ensure processed exports meet EU market standards. This alignment would reduce compliance friction while reinforcing global supply chain integrity.

5.3. Data Governance and Regulatory Sandboxing

A modern seaport's operational efficiency is shaped by an integrated digital network. This digital layer is structured around software systems comprising the Maritime Single Window, the Trade Single Window, and the Port Community System.

The Maritime Single Window (MSW) is a digital platform that allows the electronic submission of standardised information required for vessel arrival, stay, and departure. This ship-clearing portal became mandatory in 2024, under the International Maritime Organization’s Convention on Facilitation of International Maritime Traffic (International Maritime Organization, n.d.). Complementing this is the Trade Single Window (TSW), which is a digital portal enabling traders to submit all regulatory documents for import and export clearances. This cargo-clearing mechanism is compulsory under the World Trade Organization’s Trade Facilitation Agreement (Sahu et al., 2023, pp. 186–187, 198). The Port Community System (PCS) serves as a neutral, secure electronic platform that connects

public and private stakeholders to coordinate logistics and physical cargo execution (Mendes Constante, 2019, p. V). These three systems are not the same, but they are not neatly divided from each other either. The PCS may cover functions of an MSW or TSW, while MSWs can be integrated into the PCS or TSW (Sahu et al., 2023, pp. 186–187).

While these systems accelerate port throughput, their application introduces a complex administrative and geopolitical challenge: the friction of data sovereignty. Efficient logistics require frictionless, cross-border data sharing, but national security and commercial competitiveness demand data protection (Yu & Wang, 2025, p. 6). Sharing granular transport data exposes sensitive trade patterns, and this digital interdependence broadens global cyberattack vulnerabilities, with maritime cyber incidents rising significantly (van Schoote et al., 2026). Ports are confronted with a dual imperative: to remain globally competitive, they must integrate into transnational digital networks; yet to preserve their national security, they must defend their sensitive data.

Under the EU Ports Strategy, the European Commission treats ports not merely as maritime transport interfaces, but as strategic dual-use infrastructure (European Commission, 2026b, Section 2.2). Since major ports in the EU serve as critical military mobility corridors, some in the EU view the consolidation of marine operational data by foreign state-backed platforms as a liability (Berendsen, 2022; Vălean, 2023).

To counter this vulnerability without sacrificing logistical speed, European maritime policy pursues data security through federated digital architectures. The EU Data Act mandates the technical interoperability of common European data spaces. This regulation requires data platforms to facilitate the automated, real-time transmission of data through open interfaces, and even calls for automated data-sharing agreements. Furthermore, the Data Act also endorses data minimisation by promoting technologies that bring algorithms to the data, allowing organisations to derive valuable analytical insights without the unnecessary transmission or copying of raw datasets (European Union, 2023b, Recital 8, Chapter VIII, art. 33, para. 1, art. 36, para. 1). These provisions indirectly support a decentralised, federated approach to data exchanges and data security.

These dynamics and provisions are demonstrated by the PortGuard initiative, a joint development involving the Port of Rotterdam. Functioning as a federated data space, the framework allows independent operators of critical logistics, energy, and mobility networks to coordinate without consolidating sensitive operational details into a vulnerable, single database. As information remains at its source and is accessed only via authorised, secure interfaces, the system generates what operators term ‘strategic asset intelligence’ to assess infrastructure risks and conditions (Digidentity, 2026).

China utilises a centralised model of maritime logistics and data governance. This system is anchored by the state-sponsored logistics platform National Public Information Platform for Transportation and Logistics (LOGINK), which aggregates massive global shipping datasets to drive trade efficiency and national economic strategy (Reisboard, 2026). Under China’s Data Security Law and Cybersecurity Law, data is treated as a sovereign, state-regulated asset, making its exchange strictly controlled (Standing Committee of the National People’s Congress, 2021, Chapter I, arts. 1, 4, 6, 8; Standing Committee of the National People’s Congress, 2025, Chapter III, Section 1, art. 23, Section 2, art. 39)

This is reflected in the administrative system of the Hainan Free Trade Port, which is organised around the institutional principle of ‘first-line liberalisation, second-line control’ formally operationalised through a whole-island customs closure. The ‘first line’ governs the interface between Hainan and the international community, allowing goods, maritime vessel flows, and logistics operations to enter the island under streamlined clearances and substantial tariff exemptions. The ‘second line’ acts as a domestic customs and regulatory frontier separating the island from the Chinese mainland (Huld, 2025; VesselsLink, 2026; Norton Rose Fulbright, 2026).

To operationalise information management in this system, the Hainan Free Trade Port implements a dual-control data architecture. While low-risk commercial data can flow relatively freely, any datasets containing ‘important data’ or restricted personal information are subject to local storage and national security clearing mechanisms (Xinhua News Agency, 2025; Zuo, 2025). Consequently, maritime operators in Hainan have to maintain a

partitioned administrative and data environment, ensuring that international logistics data remains isolated and properly audited before any outbound transmission occurs.

The federated, peer-to-peer data-sharing architecture of the Rotterdam port represents an efficient end-state for global maritime integration, but it may not be directly applicable to the case of the Hainan Free Trade Port. Given that China's data laws treat critical port and logistics data as protected assets, any direct, unmediated flow of this information is not feasible without restrictive security reviews.

However, an intermediate solution of cross-border data regulatory sandboxes may facilitate the Hainan Free Trade Port's management of the dual imperative of market openness and national data security (Li & Yin, 2025, pp. 1–3). One approach to this could be to establish a bilateral policy exchange between the port authorities of Rotterdam and Hainan, focused on technical standards and administrative alignment to develop localised, data-agnostic interfaces (e.g., verifying customs status via encrypted tokens without sharing raw underlying logistics databases (Henry et al., 2025, p. 1)) that would allow international maritime operators to safely coordinate logistics with European partners, and Hainan's domestic regulators to retain the compliance visibility required by Chinese data and cybersecurity laws.

5.4. Intermodal transport

Intermodal transport is the practice of transferring containerised freight directly from ocean-going vessels onto trucks or rail infrastructure without long-term yard staging (TransLogistica Poland, 2023). Optimising these logistical links connecting a seaport terminal to inland rail, road, or barge networks is required to mitigate yard congestion and enhance overall port throughput capacity (United Nations Conference on Trade and Development, 2024, p. 93).

The European Union aims to support intermodal integration (European Commission, n.d.-b; European Commission, 2023, Explanatory Memorandum, Section 1). The Sustainable and Smart Mobility Strategy mandates the digitalisation of mobility to advance paperless

freight transport (European Commission, 2020, para. 7, Milestone 11). A premier European model for this framework is the Port of Gothenburg's 'Railport Scandinavia' initiative in Sweden (Port of Gothenburg, n.d.). In 2025, Gothenburg moved over 60% of its total maritime container volume directly inland via an integrated rail network (Itimoudis, 2026; Port of Gothenburg, 2026a) The same metric for the Port of Hamburg stands at around 50% (Port of Hamburg, 2025), while the Port of Antwerp-Bruges aims to reach 15% by 2030 (Port of Antwerp-Bruges, n.d.). This streamlined system relies on specialised border and access automation software. Using high-speed rail optical character recognition (OCR) portals, the system automatically scans container IDs, labels, and ISO codes without requiring manual stop-and-inspect checks (Visy, 2023; APM Terminals Gothenburg, 2023).

China accelerates intermodal freight infrastructure as a national strategic priority, embedded within the system integration and digitalisation mandates of its 15th Five-Year Plan (Innovation Center for Energy and Transportation, 2026). Beijing also aims to deploy artificial intelligence to seamlessly link maritime hubs with rail corridors to optimise long-distance transport efficiency (Zhang, 2025; Huang, 2026).

This logistical improvement is critical for the Hainan Free Trade Port following its full independent customs closure. Operating outside mainland China's standard tariff regime, the free trade port's primary bottleneck is the 'second line', which is the physical and administrative checkpoint separating the island's special tax jurisdiction from the Chinese mainland.

If outbound cargo transferring through Hainan triggers complex value-add calculations, the Free Trade Port's competitive throughput speed would be negatively impacted (Dealflow, 2026). To preserve its role as a frictionless trade gateway connecting ASEAN and the Chinese interior, Hainan has to continue innovation in clearing outbound intermodal freight dynamically across this second line boundary (Thomas, n.d.; Liu, 2025).

The operational convergence between the European Union's push for multimodal corridors and China's digitalised intermodal mandates under the 15th Five-Year Plan creates an opportunity for technical exchanges and cooperation. Both jurisdictions are bound by a

shared economic reality in which maritime supply chain resilience is dependent on the physical and digital clearance speed at landside border interfaces. Because the Port of Gothenburg and the Hainan Free Trade Port both strive for systems that decouple maritime loading docks from landside administrative staging, they share an interest in standardising border-automation architecture.

From a policy cooperation standpoint, dialogue between these two hubs focusing on regulatory and operational interoperability could be practical. Exchange could center on the structural models of Gothenburg's inland port dry docks, which shift customs clearance processing away from the physical shoreline to inland terminals (Portnews, 2010). This baseline policy coordination could provide Hainan with an administrative blueprint to decouple physical container arrivals from time-intensive customs processing, allowing the port authority to maintain its mandate of rapid, automated clearance loops across the second line.

For the European Union, engaging in technical and policy dialogues regarding Hainan's newly deployed administrative mechanisms offers clear strategic value. As Hainan strives to establish its role as a key regional gateway under the 15th Five-Year Plan, there is a necessity of aligning these new customs gateways with globally interoperable data and document standards (Chen, 2026; Ma & Chen, 2026).

By conducting exchanges on administrative models regarding automated gates and single-window harmonisation, both sides can ensure that global container traffic remains resilient against systemic bottlenecks, significantly lowering international transit friction while fully preserving the sovereign regulatory oversight and security mandates of both regions.

6. Conclusion

Deepening EU-China maritime cooperation requires navigating real political frictions, particularly regarding European concerns over foreign infrastructure ownership and China's

strict data sovereignty laws. However, as this paper demonstrates, meaningful bilateral engagement remains achievable through targeted, technical collaboration.

By establishing joint frameworks for alternative fuel interoperability, Gothenburg and Hainan can contribute to the global efforts toward green shipping. In maritime governance, aligning digital product traceability systems offers a practical path to combat IUU fishing and secure transparent seafood supply chains. In data governance, partitioned sandboxes and standards-focused exchanges enable secure logistics coordination without compromising data protection laws. Finally, technical dialogues on intermodal automation can enhance supply chain resilience and reduce friction at critical customs lines.

Technical cooperation through these pathways can strengthen the broader EU–China economic relationship in two key ways. First, pragmatic, localised coordination on shared policy interests builds baseline strategic trust, which could encourage more favorable economic measures at the bilateral level. Second, by connecting European ports with the Hainan Free Trade Port, technical cooperation can facilitate increased EU exports to China, directly addressing Brussels' concerns over its growing trade deficit with Beijing.

At the end of the day, the work is just beginning. Future research could assess the commercial viability of shared green fuel bunkering standards between European ports and Chinese hubs like Yangpu. Furthermore, future scholarship could evaluate how digitised port monitoring platforms can be integrated into multilateral anti-IUU enforcement frameworks. Assessing whether pilot data sandboxes and protocol-translation gateways can reduce compliance friction for foreign shipping lines without triggering cybersecurity concerns regarding state-linked platforms is also a research avenue worth pursuing. Moreover, it is also worthwhile investigating how evolving customs procedures along Hainan's second-line boundary impact the administrative speed and operational efficiency of intermodal trade corridors connecting China with international markets.

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