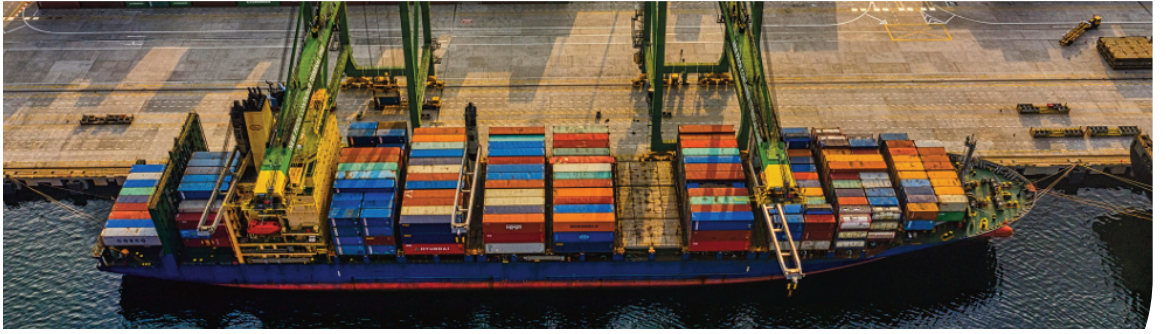

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Policy Brief

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SECURING THE FUTURE OF GLOBAL TRADE IN THE MEDITERRANEAN BASIN: A Cooperative Policy Framework for Tanger Med and Algeciras Ports

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Abstract

This paper examines the nexus between governance structures, digital transformation, sustainability, and port service efficiency through an international comparative lens, with a specific focus on the Tanger Med-Algeciras corridor. Using global best practices – from Singapore to Busan and Kaohsiung –, it explores how public-private coordination, digital innovation, and green transition policies contribute to port competitiveness and integration into global supply chains. Tanger Med serves as a model of end-to-end digitalisation and infrastructure investment, while Algeciras showcases strengths in real-time optimisation and predictive logistics systems. The paper adopts a comparative analytical approach, using global benchmarks to assess governance models, digitalisation maturity, and sustainability strategies across the Tanger Med-Algeciras corridor. It highlights emerging asymmetries caused by regulatory divergence – particularly under the European Union (EU) Emissions Trading Scheme (ETS) – and proposes targeted policy recommendations to align digital systems, cybersecurity frameworks, and decarbonisation strategies, while critically evaluating each port's institutional readiness and level of compliance with evolving environmental regulations.

It concludes by emphasising the strategic complementarity between the two ports, and advocates for coordinated governance to transform the Strait of Gibraltar into a resilient, integrated, and sustainable logistics corridor.

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IEMed. European Institute of the Mediterranean

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Introduction

Maritime transport constitutes over 90% of global merchandise trade by volume, with ports serving as critical nodes within global supply chains and vital assets in national growth strategies (World Bank, 2020). In an increasingly competitive and digitally driven global logistics landscape, port performance depends not only on physical infrastructure but also on governance, technological adaptation, and environmental alignment. As global best practices illustrate – from South Korea's Busan to Singapore's and Taiwan's Kaohsiung – port success relies on synergistic governance frameworks, strategic public-private partnerships (PPPs), deep-water infrastructure, and digital leadership (Lee & Lee, 2003; Cullinane et al., 2006; Chang & Tai, 2021). Busan, through a centralised policy framework led by the Ministry of Oceans and Fisheries, has pioneered port automation and digital logistics, contributing to its rise as Northeast Asia's transshipment hub and generating substantial economic spillovers via adjacent free trade zones. Similarly, Kaohsiung's port authority has implemented smart port technologies and expanded high-value hinterland connectivity, positioning the port as a critical export node for Taiwan's high-tech manufacturing sector, particularly in semiconductors and electronics.

This study explores the evolving dynamics of port development in the Strait of Gibraltar, using a comparative framework that assesses governance structures, technological innovation, and environmental sustainability as key drivers of performance and integration for both Tanger Med and Algeciras, focusing on Tanger Med (Morocco) and Algeciras (Spain) as emerging poles of maritime power. Tanger Med exemplifies Morocco's strategic pivot toward integrated digital infrastructure, automation, and connectivity to industrial free zones, supported by a hybrid governance model combining public oversight and private operation. By contrast, Algeciras focuses on operational resilience through advanced digital twin platforms and collaborative port-call optimisation – anchored in the EU's regulatory and environmental frameworks.

While both ports have demonstrated considerable progress, recent shifts in global trade and environmental regulation have created new competitive pressures – for instance, in 2024, Tanger Med handled 10.2 million TEUs, more than double Algeciras' 4.7 million (Kerriou, 2025), while the EU ETS has increased operational costs for European ports by up to 8% (Miller, 2025), prompting carriers to reassess routing strategies. The EU ETS introduces a potential regulatory wedge, incentivising carriers to bypass European ports in favour of lower-cost, non-EU alternatives such as Tanger Med (Miller, 2025). These dynamics call for a reassessment of port strategies across the Strait, particularly given the substantial gap in efficiency and throughput observed in 2024, when Tanger Med handled 10.2 million TEUs – more than double Algeciras' volume (Kerriou, 2025).

Beyond competition, however, lies a significant opportunity for strategic complementarity, which can be fulfilled by drawing on successful corridor models such as Busan-Incheon in South Korea or Kaohsiung's integration with inland logistics zones, where coordinated governance and digital interoperability have enhanced cross-port synergies. Tanger Med's scale and digital throughput orientation can be paired with Algeciras' precision and smart-port capabilities to establish a globally competitive, sustainable logistics corridor. This paper argues for a coordinated policy response focused on interoperable Port Community Systems (PCS), joint cybersecurity frameworks,

harmonised decarbonisation efforts, and workforce upskilling programmes — key enablers of a sustainable logistics corridor defined by efficiency, resilience, environmental performance, and digital integration. In doing so, it aims to contribute to the discourse on how governance, digitalisation, and sustainability converge to shape the next generation of port efficiency, resilience, and integration, both regionally and globally.

Regulatory context and ETS-induced strategic risks

Spain and Morocco operate under distinct port governance and environmental regulatory regimes. As a member of the EU, Spain adheres to increasingly stringent climate regulations, most notably the EU ETS, which imposes market-based carbon pricing on maritime operations. In contrast, Morocco follows a nationally-led decarbonisation strategy that emphasises flexibility, investment incentives, and gradual alignment with international environmental norms.

This regulatory divergence introduces both a risk and an opportunity. On the one hand, the ETS creates a growing cost differential for carriers operating through EU ports — raising average operational costs by up to 8% (Miller, 2025) — and has already prompted strategic rerouting decisions in favour of non-EU alternatives like Tanger Med. On the other hand, this divergence presents an opportunity to develop a coordinated policy framework that mitigates carbon leakage, prevents trade distortions, and aligns green transition investments across the Strait of Gibraltar. This policy brief addresses that core challenge: how to reconcile divergent environmental regimes through strategic cooperation to enhance port competitiveness, sustainability, and regional integration.

The link between governance, digitalisation, sustainability, and port services efficiency

Global maritime transport facilitates over 90% of world merchandise trade by volume (World Bank, 2020). Consequently, container ports function as critical nodes within global supply chains, serving as key enablers for trade integration and industrialisation, especially in economies pursuing export-led growth strategies. For countries ranging from the Four Asian Tigers to emerging economies like Morocco, as well as developed ones such as Spain, the development of efficient and technologically advanced port infrastructure has been pivotal to their economic success.

These benchmarks are particularly relevant to the Gibraltar Strait corridor, where Tanger Med and Algeciras pursue distinct yet complementary strategies — volume-driven throughput and real-time operational precision, respectively. Drawing from the successful integration models in South Korea and Taiwan, this comparative lens helps identify key enablers of a seamless, interoperable logistics corridor between the two ports.

A review of international best practices reveals several common success factors. South Korea's Port of Busan, a major transshipment hub in East Asia, exemplifies the role of state-backed investment and PPPs in infrastructure development, driven by clear policy alignment between central government, port authorities, and private operators. These PPPs succeeded through long-term concession frameworks, tax incentives, and integrated planning with special economic zones. Its

growth was further reinforced by the seamless integration with nearby industrial zones and free trade areas, supported by multimodal connectivity and coordinated land-use planning (Lee & Lee, 2003). Likewise, Singapore's rise as a global maritime leader is closely linked to the creation of the Maritime and Port Authority of Singapore (MPA), which centralises port governance and strategic planning, ensuring operational efficiency and innovation (Cullinane et al., 2006). Taiwan's Port of Kaohsiung – its busiest port and a critical export gateway for high-tech goods – has succeeded due to sustained investment in deep-water infrastructure, backed by coordinated industrial policies targeting high-value manufacturing exports (Chang & Tai, 2021). These cases offer valuable lessons for the Tanger Med-Algeciras corridor, particularly in designing stable PPP frameworks, incentivising co-location of logistics and manufacturing, and aligning port governance with national industrial strategies.

These international experiences offer valuable parallels with Morocco's flagship port, Tanger Med, which stands out as a regional model of port digitalisation, automation, and integration. Echoing Busan's approach, Tanger Med operates under a hybrid governance model: it is overseen by the Tanger Med Port Authority (TMPA), a public institution ensuring strategic oversight, while terminal operations are delegated to leading private operators such as Maersk, MSC, and Marsa Maroc. This division of roles fosters efficiency, competitiveness, and responsiveness to global trade dynamics. Moreover, like the integration seen in Busan and Kaohsiung, Tanger Med is connected to the Tangier Free Zone and broader industrial platforms via multimodal transport infrastructure, including rail links, enhancing its function as a key export platform, particularly in the automotive sector.

Singapore's institutional model finds its reflection in Morocco's Tanger Med Special Agency (TMSA), which ensures long-term planning and strategic coherence across port development initiatives. Meanwhile, the port's deep-water infrastructure – with berths ranging from 17 to 28 meters – mirrors the technical capabilities of Kaohsiung, allowing Tanger Med to accommodate the largest container vessels, thereby securing its integration into major global shipping routes.

Overall, the development of Tanger Med illustrates how Morocco has effectively internalised lessons from global port leaders, positioning itself within global supply chains through strategic public-private coordination, infrastructure investment, and digital innovation.

Besides, improving port services efficiency can be achieved by expanding extensive margins through increased investment in port infrastructure. This encompasses the construction of new terminals, docks, or logistics zones to accommodate higher cargo volumes and diversified merchandise, supported in Morocco by strategies such as the National Port Strategy 2030 and the Green Logistics Roadmap, which align with EU sustainability standards and have attracted funding and technical cooperation from the EU and the European Investment Bank (EIB) – positioning Tanger Med as a complementary hub to Algeciras in a cross-Strait corridor model akin to South Korea-Taiwan port integration. It also involves the development of hinterland connectivity via new rail and road links to regional markets (Haezendonck et al.,

2014). However, enhancing intensive margins equally contributes to efficiency gains within port operations. This can be achieved through the adoption of advanced digital technologies, such as Port Management Systems (PMS) and Port Community Systems (PCS), which streamline cargo handling and reduce vessel turnaround times. Concurrently, the implementation of automation, including Artificial Intelligence (AI)-powered cranes and robotic systems, facilitates the optimisation of container operations, yielding lower operational costs and fewer delays (El Imrani, 2024). Predictive, data-driven maintenance technologies further support infrastructure efficiency by minimising downtime and extending the lifespan of port equipment (Kovaleva et al., 2020).

In the Moroccan context, digital transformation in port operations holds substantial promise for enhancing the national logistics sector. The case of Tanger Med illustrates how advanced digital systems have led to substantial performance gains – such as a 70% reduction in container dwell time and vessel turnaround times under 24 hours – thanks to full integration with the PortNet system and multimodal rail links (Tanger Med Port Authority, 2025; Tanger Med Port Authority, 2022). These improvements have positioned Tanger Med 5th globally in the 2025 Container Port Performance Index (Zouiten, 2025). Notably, Tanger Med utilizes "PortNet", a port community system that interlinks all supply chain actors, thereby reducing administrative bottlenecks and improving coordination between shipping lines, customs authorities, and terminal operators. This system serves as a digital public infrastructure led by the National Ports Agency (ANP) and the Ministry of Transport. Initially launched in 2011 as a government-backed, non-profit platform, PortNet operates on a proprietary system but with open integration protocols to ensure interoperability across stakeholders. The platform is co-developed and continuously upgraded through PPPs, involving shipping lines, freight forwarders, customs authorities, and terminal operators, making it central to Morocco's port modernisation strategy (PortNet, 2023). The integration of real-time tracking and predictive analytics has further optimised vessel scheduling, strengthening Tanger Med's status as a global logistics hub.

In parallel with digitalisation, automation has become a pivotal driver of competitiveness and efficiency in global port operations, a trend that Morocco has actively embraced through developments at Tanger Med. The introduction of automated cranes, robotic container handling systems, and AI-based logistics platforms – such as predictive yard planning and real-time vessel scheduling powered by machine learning algorithms – has significantly reduced operational costs and enhanced throughput. These advancements have allowed Tanger Med to process cargo at record speed, reinforcing its role as a preferred transshipment hub for major shipping companies such as Maersk and MSC.

Beyond gains in operational efficiency, automation contributes to enhanced safety by reducing manual operations and the associated risk of human error. However, the rapid deployment of automation raises concerns regarding labour market implications, particularly the potential for workforce displacement (Guznajeva et al., 2020). Mitigating these effects requires proactive investment in upskilling programmes to equip workers for emerging roles in

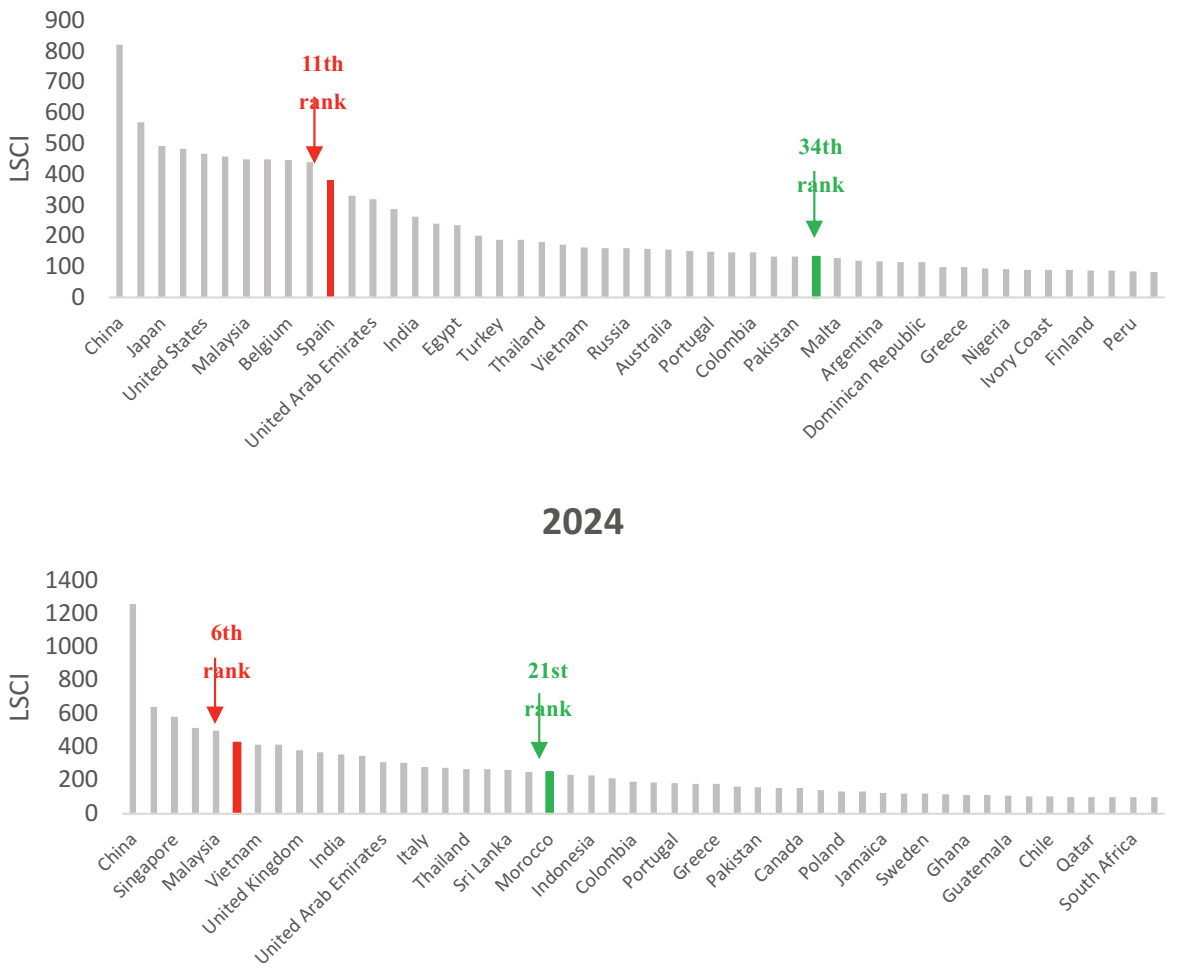
managing and maintaining automated systems. While Morocco has initiated training programmes in collaboration with global logistics firms, broader expansion is necessary to ensure national coverage and inclusivity. Morocco's overall digital capability ranks moderately, with a Network Readiness Index (NRI) score of 45.1 in 2023, compared to Spain's 64.3 – highlighting a maturity gap in digital skills and infrastructure that must be addressed for effective port modernisation (Portulans Institute, 2023). A relevant model to replicate can be found in the specialised vocational schools established for the automotive (IFMIA) and aerospace (IMA) sectors in Morocco. These institutions reflect successful partnerships between the state (as funder) and industry stakeholders (as programme designers and implementers). Though Morocco already has a transport and logistics training institute (IFTL), there remains a pressing need for a dedicated training centre specialised in port services and maritime logistics.

Sustainability, like in most economic sectors, has emerged as a key priority within port activities, and Moroccan ports are increasingly aligning with international environmental objectives. The growing scale of maritime trade intensifies environmental pressures, including greenhouse gas emissions, marine pollution, and energy inefficiency. Morocco's port sector is responding by initiating a green transition that leverages renewable energy assets and cross-sectoral expertise. This includes investment in climate-resilient infrastructure, digital trade solutions, and renewable energy integration, such as photovoltaic installations and low-carbon fuel bunkering. The deployment of shore-to-ship power at Tanger Med enables docked vessels to utilise cleaner energy sources, thus significantly lowering emissions (Bosich et al., 2023). This implementation is supported by high-voltage connection systems, grid stability infrastructure, and standardised plug-in interfaces – key enablers seen in successful use cases like the Port of Gothenburg and Rotterdam. Additional initiatives, such as zero-emission fuel production and electric-powered cruise ships, aim to further reduce environmental impacts and reinforce long-term sustainability. By 2030, Morocco aspires to transform its ports into benchmarks for ecological and energy transition, harmonising maritime development with marine ecosystem preservation (IMO, 2023).

The changing balance of ports in the Strait of Gibraltar

The competitive landscape of the Strait of Gibraltar must be understood within the context of the significant, sustained maritime strategic development undertaken by both Morocco and Spain over the past two decades. This collective success is quantifiable using the Yearly Liner Shipping Connectivity Index (LSCI), an UNCTAD metric that measures a country's integration into global shipping networks. Between 2008 and 2024, Spain's LSCI ranking dramatically improved from 11th position to 6th globally, while Morocco simultaneously advanced from 34th position to 21st, outperforming the Middle East and North Africa (MENA) regional average (ranked 43rd in 2024), and reflecting massive investments in infrastructure, trade liberalisation, and logistics platforms that have directly supported a 12% increase in Foreign Direct Investment (FDI) inflows to port-linked industrial zones between 2020 and 2024 (UNCTAD, 2025 [Figure 1]). This shared momentum, driven by both Spain's role as an EU gateway and Morocco's emergence as Africa's prime logistics hub, confirms that the region's prosperity is intrinsically linked to sustained port sector development (Kulenovic, 2015). However, the subsequent phase of competition has revealed structural divergences, particularly in the race for maximum throughput and operational efficiency.

Figure 1. Yearly Liner Shipping Connectivity Index (LSCI) for Morocco and a sample of 49 countries – comparison between 2008 and 2024 scores



Source: UNCTAD Stat

In this context, ports in the Atlantic and Mediterranean basins have become indispensable strategic assets, where efficiency determines economic competitiveness (Sanchez et al., 2003), and strategic alignment can be further enhanced through frameworks such as the EU-Morocco Advanced Status Agreement, Deep and Comprehensive Free Trade Area (DCFTA) negotiations, and regional maritime conventions under the Union for the Mediterranean (UfM). Morocco's Tanger Med offers a compelling case study, having demonstrated rapid ascension through massive investment – over €8 billion since inception – supported by international partnerships with entities such as the EIB, AFD, and global port operators like Maersk and MSC, alongside proactive digital integration. In 2024, the port complex handled a record 10.2 million TEUs,[1] placing it among the world's largest and most efficient transshipment hubs (Tanger Med Port Authority, 2025). Furthermore, its operational efficiency, measured by anchorage and turnaround times, earned it a ranking as the fifth most efficient container

[1] Twenty-Foot Equivalent Unit: a unit that standardises the measurement of containerised cargo capacity and is based on the dimensions of a standard 20-foot-long container.

port worldwide in the 2025 Container Port Performance Index (CPPI), notably surpassing all its Mediterranean and European rivals (Zouiten, 2025).

On the other shore of the Strait of Gibraltar, Algeciras port is facing increasing structural pressures, despite being a perennial powerhouse. The port's transshipment activity declined in the first half of 2025, a shift partially attributed to carriers re-evaluating global trade routes and seeking optimised, reliable transit times – a critical factor in reducing trade barriers (Hummels & Schaur, 2013).

This competitive divergence was starkly illustrated by Maersk's 2025 rerouting decision, which cut an average of five days in transit time between Asia/Middle East and the US East Coast by removing the Algeciras port call (Tanger Med Special Agency, 2025b). While operational efficiency was a key factor, the move also underscores a broader strategic shift linked to the EU ETS, which imposes rising carbon costs on vessels docking at EU ports. In contrast, non-EU ports like Tanger Med are not yet subject to such pricing mechanisms, creating a regulatory asymmetry – or gap – that incentivises cost-driven rerouting.

This divergence presents both a risk and an opportunity: a risk, in the form of potential carbon leakage, where emissions are displaced rather than reduced, and a challenge to the long-term competitiveness of EU ports like Algeciras; and an opportunity, for policy-makers to either align regulatory standards across borders or leverage these differences to promote more efficient, lower-cost logistics corridors – provided sustainability is not compromised. This policy brief argues that rather than reinforcing competition, this moment offers a chance to develop a harmonised, cross-Strait regulatory framework that balances environmental integrity with operational efficiency

This evolving dynamic is further illustrated through a direct comparison of Tanger Med and Algeciras ports, whose divergent performance metrics underscore the shifting centre of gravity in Mediterranean logistics. In 2024, Tanger Med handled 10.2 million TEUs, reflecting 18.8% growth over 2023, while Algeciras managed 4.7 million containers, reinforcing Tanger Med's rising dominance in throughput capacity (Upply, 2025). The efficiency gap is equally stark: Tanger Med ranked 5th globally in the 2025 Container Port Performance Index, far ahead of ALG's 20th place (Zouiten, 2025). This operational advantage was instrumental in Tanger Med's securing strategic rerouting decisions, such as the Maersk MECL service, which shifted from Algeciras to Tanger Med due to a five-day transit time saving (Tanger Med Special Agency, 2025b). The divergence also reflects deeper digital strategy choices – Tanger Med's end-to-end digitalisation, incorporating AI, blockchain, the use of drones, and full dematerialisation of container passage, contrasts with Algeciras' focus on advanced digital twin infrastructure, JIT optimisation, and AI-driven maintenance (Tanger Med Special Agency, 2025a). While both ports are pursuing innovation, their strategies are increasingly complementary rather than competitive: Tanger Med prioritises volume and scale, whereas Algeciras emphasises precision and service reliability. This nuanced strategic divergence, however, unfolds against a backdrop of regulatory asymmetry, where the EU ETS policy wedge continues to distort carrier decisions in favour of non-EU ports (Miller, 2025).

Policy recommendations: leveraging Tanger Med-Algeciras complementarity for a resilient, integrated Strait corridor

As global port competition shifts toward digital performance, environmental sustainability, and supply chain resilience, the Strait of Gibraltar emerges as a strategically unique maritime corridor with exceptional potential for integrated development. Realising this potential demands a policy framework that transcends national competition, encouraging structured collaboration between the region's two principal ports: Tanger Med and Algeciras. Each port offers distinct yet complementary digital and operational strengths that, if aligned through joint policy actions, could establish the Strait as a global leading logistics corridor.

Tanger Med has pursued a comprehensive digital transformation strategy anchored in next-generation technologies, including AI and blockchain, enabling a fully dematerialised logistics ecosystem (Tanger Med Special Agency, 2025a). This model enhances end-to-end cargo traceability and streamlines border formalities, contributing to high productivity and throughput. In contrast, the Port Authority of the Bay of Algeciras (APBA) has implemented its "Next Generation Port" strategy with a focus on operational resilience and precision, deploying a Digital Twin control tower to enable predictive analytics and real-time decision-making (De los Santos et al., 2019). Initiatives such as "Pit Stop Port Operations" exemplify Algeciras' emphasis on optimising vessel port calls through collaborative digital platforms.

While Tanger Med scales for throughput and integrated logistics zones, Algeciras specialises in high-frequency optimisation of port calls, making both ports ideal complements. Aligning these digital strengths under a joint strategic framework would transform the Strait from a zone of fragmented competition into a model of cross-border port cooperation.

To this end, four key policy imperatives emerge:

1. Interoperable digital systems for cross-Strait efficiency

The most immediate and impactful policy action is to mandate interoperability between Port Community Systems (PCS). A bi-directional, machine-to-machine data exchange mechanism — especially for the high-density Ro-Ro[2] traffic connecting Europe and Africa — is essential for operational alignment (SAM Algeciras, 2025). Interoperability would enable synchronised logistics processes, seamless customs clearance, and true Just-in-Time vessel coordination. Establishing a cross-Strait digital task force to enforce international data standards and integrate port operations digitally is critical to reducing duplication, increasing transparency, and enhancing trade facilitation.

2. Shared cybersecurity protocols for maritime infrastructure protection

As both ports transition to hyper-connected digital ecosystems, the risk of coordinated cyberattacks becomes a systemic threat to supply chain continuity (ITF, 2021). While Tanger Med has already implemented advanced cybersecurity protocols (Tanger Med Special Agency, 2025a), the absence of a bilateral security framework exposes the corridor to vulnerabilities. Governments on both sides must formalise cross-border cybersecurity

[2] Roll-on/Roll-off (Ro-Ro) traffic is a type of cargo transport involving wheeled vehicles that are rolled onto and off of ships using built-in ramps, rather than being lifted by cranes. It contrasts with Lo-Lo (Lift-on/Lift-off), where cargo is loaded/unloaded by crane.

architecture, including a shared threat intelligence platform, joint incident response teams, and periodic cyber-drills. Harmonising cybersecurity standards will safeguard critical infrastructure and ensure resilience against digital threats.

3. Coordinated green transition to prevent regulatory fragmentation

The commercial and environmental impacts of the EU ETS highlight the risk of regulatory divergence across the Strait. Without coordination, decarbonisation measures could result in carbon leakage or distorted port competitiveness (IMO, 2023). A bilateral framework between Spain (as EU representative) and Morocco should align emission pricing mechanisms and jointly invest in green port infrastructure – including shore power facilities, low-carbon fuel bunkering, and renewable energy integration. Such alignment is essential to ensure environmental sustainability and secure the Strait's reputation as a green shipping corridor.

4. Joint workforce development for the smart port transition

Automation and digitalisation will alter labour demand across the logistics sector, potentially creating regional inequalities, and digital skill gaps (Guznajeva et al., 2020). A socially responsible transition requires the creation of joint vocational training centres focusing on high-demand skills such as data analytics, AI-driven port system management, and cyber-logistics. These centres could draw inspiration from existing sector-specific training models in Morocco (e.g., IFMIA, IMA) and be co-funded by public institutions and industry actors. Incentivising firms to upskill their workforce would enhance labour resilience and ensure the socioeconomic inclusivity of the port modernisation process.

Conclusion

In conclusion, the Tanger Med-Algeciras corridor presents a unique opportunity to showcase how complementary digital and operational models can be aligned through policy coordination. Through joint digital infrastructure, harmonised sustainability strategies, coordinated cybersecurity, and inclusive workforce policies, the Strait of Gibraltar could evolve into a globally recognised example of cooperative port governance and sustainable logistics integration – a model not only for regional prosperity but also for resilience in an increasingly complex global trade environment.

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