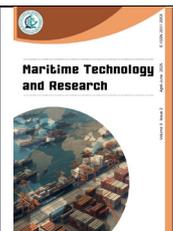




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Research Article

From efficiency to resilience: Strategic shifts in maritime organizations through digitalization, ESG, and human capital (2018 - 2025)

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Abstract

Most existing maritime research examines digitalization, ESG pressures, and human capital separately. This paper fills the gap in explaining how the three factors dynamically reshape strategic orientations in the highly unstable post-2020 period. It explains how maritime organizations reconfigured their strategies between 2018 and 2025. The research is based on sixteen semi-structured interviews with top professionals from different segments of the maritime ecosystem across Europe and Asia, analyzed according to Gioia methodology. The main finding is a structural transformation from an efficiency strategy before 2020 toward a resilience strategy after 2020. It finds that this shift emanates from an interaction between digitalization (a 'sensing' capability) and human capital (a 'reconfiguring' capability). Seven strategic patterns are identified, which include new forms such as glocal ESG adaptation- blending global rules with local innovation- and hybrid leadership- blending technical, digital, and human skills- in addition to more traditional forms like asset diversification or trade pattern flexibility through chartering tonnage. This study is original as it is the first integrated empirical analysis of the interaction, with a rare pre/post-2020 temporal comparison conceptualizing new patterns as specific dynamic capabilities for the maritime sector.

1. Introduction

Approximately 80 per cent of world goods are carried by sea (OECD, 2025). This means maritime transport is the key supporter of global trade. However, its central role has come under increasing challenge from turbulence in the global environment (Tran et al., 2025). There is regulatory tightening on greenhouse gas emissions (Benatti et al., 2024; Benedetti et al., 2025; Tran et al., 2025) and other factors, such as the COVID-19 pandemic, which proved to be a major disruptor, and geopolitical instability, together with an acceleration in digital technologies (Tapaninen & Palu, 2022; Tran et al., 2025); combined, these have reshaped the way maritime organizations plan and execute strategy. Resilience, adaptability, and sustainability were previously efficiency-and-compliance-hidden managerial priorities but have now moved to the forefront of industry agendas.

The IMO 2020 sulfur cap and the revised Green House Gas Strategy of 2023 (AECO, 2024) have set a course for the decarbonization roadmap for firms to balance compliance with innovation-inspiring intense competition among alternative solutions, meanwhile exposing supply chains, port operations, and crew welfare to their very apparent vulnerabilities, laid bare by cost-oriented models' inadequacies in addressing such issues. This has happened concurrently with further breakthroughs in digital twin technology; remote monitoring; predictive analytics; as well as an automation process

at ports that create entirely new forms, through which value can be added while managing risk within maritime strategy, hence demanding fundamental rethink.

Recent studies deal with aspects of environmental regulation (Monios & Ng, 2021), digitalization (Kuo et al., 2022), and risk management in isolation (Akpınar & Özer-Çaylan, 2023). Literature is too fragmented to shed light on collective corporate maritime strategic reconfiguration drivers of the three pressures and leaves important gaps: How do maritime actors balance compliance obligations with the pursuit of competitive advantage? What happens when we talk about sustainability and human capital, in addition to digitalization? How do these dynamics change over time, particularly following global shocks? The study has been designed as a qualitative inquiry based on interviews to answer such questions. The purpose is mainly aimed at detecting the reconfiguration of strategic logics within maritime organizations between 2018 and 2025. For this purpose, three research questions are posed by the study: (RQ1) What have been the changes in strategic priorities among maritime organizations due to global disruptions? (RQ2) What organizational logic and strategy patterns have emerged with respect to digitalization, ESG, and human capital? (RQ3) How do maritime firms deal with the tension that arises out of global regulatory demands versus local operational realities when adapting ESG strategies?

2. Literature background

2.1 Mechanism 1: Digital transformation, HR capabilities, and ESG governance in the maritime sector: An integrated synthesis

Digital transformation shapes maritime operations across ships, ports, and hinterland networks, encompassing new technologies (IoT, AI, MASS, blockchain) and new governance structures (Haasis & Hapsatou, 2022; Al-Hargusi et al., 2024; Zhang & Lv, 2022; Durlık et al., 2023; Durán et al., 2021). This is not only a technical transformation but is also a transformation in increasing human capabilities and in the re-design of HR practices and governance mechanisms to address environmental-social-governance (ESG) imperatives (Autsadee et al., 2024; Kong et al., 2024). In most cases for maritime actors- from small ports up to big classification societies- the integration between these digital, human, and governance capabilities is very substantial (Meyer et al., 2021; Autsadee et al., 2024; Deepak, 2025; Negara, 2024). The transformation takes place due to both institutional pressures and competition dynamics (Kuo et al., 2021; Nguyen, 2024) Institutional pressures influence the speed of adoption and highlight the necessity of capacity building to maintain competitiveness (Kuo et al., 2021; Meyer et al., 2021). Motivations for efficiency, safety, and compliance can support such a transformation (Nguyen, 2024). More importantly, the literature connects digital economy development to ESG performance through governance improvement and energy efficiency pathways (Kong et al., 2024). This is an instance of direct interaction between the governance structure in classification societies' institutions and other organizations with innovation sustaining coordinated governance requirements (Negara, 2024; Al-Hargusi et al., 2024). HR capability is a component without which realization benefits from digitization would not be possible. Competitiveness enablers emphasized by the literature are workforce transformation and continuous human resource development (HRD) that imply emerging HR practices, as empirically evidenced in major ports to sustain competitiveness under automation, as well as sustainability pressure situations (Deepak, 2025). A transparent approach towards aligning human operators' capabilities with digital systems based on reliability, safety, and trust building has also been articulated (Han et al., 2021) Maritime ESG governance is aligned with digital transformation. The literature claims that digitization supports ESG performance by fostering innovation, developing transparent governance, and promoting informed decisions through data (Kong et al., 2024). Other, more empirical, research highlights the necessity for an ESG evaluation system specific to the maritime sector, together with a governance mechanism (Lee et al., 2023). Digital governance will enable compliance management and risk management once cybersecurity is strong enough so that no failures in ESG can happen through it or because of it (Negara, 2024; Al-Hargusi et al., 2024). Existing literature emphasizes

governance-related challenges in smart port integration, specifically regarding cybersecurity vulnerabilities and the requirement for inclusive governance frameworks (Dağıstan et al., 2025). Trusted ESG metrics need strict valuation on strategic asset data accompanied by its governance (Lim et al., 2024).

2.1.1 A synthesized framework: Digital transformation-HR capabilities-ESG governance (DTEG)

Based on these strands, a coherent framework can be developed that connects digital transformation and HR capabilities with ESG governance through three interdependent pillars:

1) *Digital infrastructure, data governance, cyber-resilience*: The industry's digital transformation is dependent on strong data platforms (IoT, AIS data analytics) and infrastructures (Zhang & Lv, 2022; Durlík et al., 2023). Because of ship/port interconnectivity, cybersecurity and risk management are important (Tam & Jones, 2019; Tam et al., 2019). Distributed ledger technologies (blockchain) facilitate trust-and-traceability-enhancing mechanisms across port ecosystems (Durán et al., 2021).

2) *HR capabilities and organizational readiness*: HR transformation and capability-building are prerequisites for digital adoption, emphasizing the alignment of HRD with automation and data-driven decision-making (Autsadee et al., 2024; Deepak, 2025). Human-centered design must align with system design to improve safety, reliability, and operator trust in digitalized environments (Han et al., 2021). Capability building comes first before leveraging technology as a force multiplier, hence making sure that there is an appropriate structure and sustainability over time (institutionalization), (Deepak, 2025).

3) *ESG governance, sustainability metrics, and value creation*: Specific governance mechanisms are required to facilitate ESG performance through digital transformation, as emphasized by Kong et al. (2024). The literature provides a call for an industry-specific maritime ESG governance system that should be guided by data analytics (Lee et al., 2023). This further involves the scaling of digital solutions via smart-port governance (Dağıstan et al., 2025) and maritime data assets integration into ESG reporting (Lim et al., 2024).

2.2 Mechanism 2: ESG as a performance and risk-management asset

Environmental, Social, and Governance (ESG) factors are increasingly being framed as core determinants of both performance and risk management in the maritime sector- from shipping operations to port logistics (Pangalos, 2023; Chen, 2025). In capital-intensive maritime markets, ESG directly influences access to finance, cost of capital, and risk profiles attached to investment decisions that determine long-term value creation (Pangalos, 2023; Chen, 2025; Gupta & Chaudhary, 2023). The literature discusses ESG not as a compliance agenda, but as a strategic asset working through three intersecting channels: one channel about enhancing resilience on a risk governance operations level, another channel shapes financing conditions with investment performance, and the third channel is about data driven measurement operationalization. The first channel means that data driven measured ESG oriented governance makes companies more resilient on the operational level. Resilience oriented literature emphasizes sustaining ability for safe navigation through turbulent times by an integrated approach towards the architecture of risk management systems (Bhatia & Kumar, 2024; Zavitsas et al., 2018). A flexible environmental policy can provide resilience for maritime supply chains under stress (Zavitsas et al., 2018). This happens at the same time as governance oversight. Risk-based approaches to safety and compliance by Port State Control (PSC) authorities influence maintenance practices and accident-prevention efforts in establishing governance as a mechanism for reducing operational risk (Karahalios, 2021; Bayar, 2024). The fact that ESG-aligned governance ensured levels of service during the COVID-19 pandemic demonstrated that service levels can be maintained even during a crisis (Gavalas et al., 2022). Environmental risk

forms one major channel through which ESG objectives interact with cost control and risk mitigation-allocation channels, particularly on bunker related emissions (De et al., 2021; Sun et al., 2023).

Secondly, ESG factors increasingly determine various maritime financing and investment channels. For example, in the dry bulk sector, ESG drivers have been singled out as primary determinants of investment inflows that drive capital allocation and valuation dynamics (Pangalos, 2023; Chen, 2025). This finding is consistent with a broader literature identifying the cost of capital as sensitive to credit ratings by agencies incorporating ESG factors (Chen, 2025). Integration relates to risk-adjusted outperformance: analyses undertaken on ESG indices during highly volatile markets show them capable of sustaining competitive levels of risk-adjusted return performance and, thus are resilience enhancers within investment portfolios (Gupta & Chaudhary, 2023; Bhatia & Kumar, 2024; Liu & Hamori, 2020), while climate transition risk and quality/assessment-of-ESG play new roles in shaping portfolio return for shipping as an asset class (Bouteska et al., 2025). Thirdly, these are enabled via data, and analytics. The Maritime Big Data application has a wider potential for the better shipping management and implementation of policies on which ESG reporting and risk management depend, thus enabling the translation of ESG considerations into actionable risk control measures (Bui & Nguyen, 2021). Bunker strategies now position environmental objectives alongside operational resilience, reflecting a shift in how port planning models account for environmental stressors and associated risks (Yücel & Yurtoren, 2019). This is evidence supported by multi-criteria optimization tools that help establish it as more than just a reporting exercise, but as an actual tangible asset, where governance integrates it within operations (Bhatia & Kumar, 2024; Xidonas & Essner, 2022).

2.3 Research gap and contribution

The literature reviewed above in Sections 2.1 to 2.2 clearly shows that, apart from being merely forces, which are mostly analyzed separately, regulation, digitalization, ESG, and human capital are critical forces. Mechanisms found in the literature are quite distinct: (1) digitalization is found to improve operational efficiency (Margaretha et al., 2024), (2) ESG forms a performance-and risk-management asset (Zhang et al., 2024), (3) human capital is an important enabler of both digital and ESG benefits (Deepak, 2025; Ogedengbe et al., 2024), (4) strategic talent management becomes a driver toward achieving long-term alignment (Sridar et al., 2025), and (5) effective governance is required to orchestrate digital and ESG synergies (Sudomyr & Habor, 2025).

However, particularly in the maritime context, the synthesis of these elements remains a major gap in research. While general cross-sector evidence again suggests aspects of human capital that enable digital transformation to improve ESG performance (Zhang et al., 2024; Ding et al., 2024), very few maritime specific studies empirically test how these three elements combine to foster resilience in shipping lines, port authorities, and logistics firms (Gap A), (Margaretha et al., 2024; Yu, 2025).

Several associated and as yet unaddressed areas reinforce that this main gap is directly related to RQ1 and RQ2, as identified in the literature:

1) *Lack of mechanistic links to resilience*: While the role of dynamic capabilities is established in a generic setting (Zhang et al., 2024), maritime-specific research on how DCs (coordination, learning absorption) mechanistically translate digitalization into resilience as robustness, adaptability, and recoverability remains scant or absent. Mechanistic studies make a distinction between simple associations or correlations and relationships describing the actual pathway through which an independent variable transmits its effect on a dependent outcome via intervening constructs at different levels.

2) *Missing HR-ESG-Resilience Link*: Maritime-specific empirical work linking HR transformation (including talent management and leadership) to ESG outcomes and resilience remains restricted, even though obvious alignments between HR and automation have been noted as a requirement (Gap C) (Deepak, 2025; Ogedengbe et al., 2024.; Evans-Uzosike & Okatta, 2020).

3) *Contextual Heterogeneity*: There is a need for comparative, cross-regional studies to identify the contextual drivers and barriers that explain heterogeneity in adoption and outcomes across different actors (e.g. carriers, ports) and regions (Gap E), (Margaretha et al., 2024; Yu, 2025). This gap provides the direct justification for RQ3.

This paper provides a direct contribution to supporting the integration between the gaps. Empirical evidence for strategic transformation involving more than one region (Gap E) is provided, while long-term trends (RQ1 and RQ2) are established, answering the question of what enables digital-and ESG-driven resilience through dynamic capabilities (Gap B)- theorizing on human capital and hybrid leadership (Gap C).

3. Methodology

3.1 Research design

The study is qualitative and interpretive. This type of design best suits work aimed at capturing organizational processes and strategic reconfigurations. Gioia methodology (Gioia et al., 2013; Kressmann & Mueller-Seeger, 2025) was applied to ensure rigor in data coding from first-order codes or informant-centric terms to researcher-oriented themes or second order codes and, finally, aggregate dimensions.

The Gioia methodology is a strict inductive approach in qualitative research that allows concepts to be systematically developed from detailed textual data. The method enables dynamic phenomena of strategic change nature to be studied, since it permits the tracing of how actors make sense of evolving contexts over time (Nag et al., 2007; Kressmann & Mueller Seeger, 2025). This paper applies the Gioia method, because an emerging logic between 2018 - 2025 among maritime actors regarding digital/environmental/leadership transformations needs to be captured at a very detailed level.

2018 was selected as the start year of the pre-2020 period, because this is when a globally unified transition phase in maritime regulation and technological modernization began. In April 2018, the IMO adopted an Initial GHG Strategy that set off preparations within the entire sector toward decarbonization measures to redefine investment, as well as operational decisions among shipping companies, ports, and classification bodies. At the same time, it placed an order for delivery prep work on board implementation by organizations between 2018 through early 2020 concerning the IMO's sulfur cap starting in 2020. Driven by regulatory shifts and market instability, most participants viewed 2018 as a foundational baseline for recalibration. Utilizing 2020 as a central inflection year provides a logical framework for analyzing shifts in strategic orientation within the maritime sector.

3.2 Data collection

The qualitative design of this research is aimed at achieving depth, richness, and understanding of meaning within specific contexts, rather than at any kind of statistical generalization (Denzin & Lincoln, 2011). Following the logic of purposeful sampling, this study identifies a "diverse cross-section" of participants from across the maritime ecosystem to ensure data saturation (Patton, 2015, p. 125). As Patton (2015) argues, this methodological approach focuses in-depth on relatively small, purposefully selected samples to "capture variation" rather than achieve numerical representativeness (pp. 101-102, 265). Appropriate sample size (n = 16) was determined based on conceptual saturation point beyond which no new themes or insights emerged with additional data (Guest et al., 2006). It reported full compliance with Gioia method's requirement for prioritizing conceptual depth over sample size.

The 16 semi-structured interviews offered by senior professionals, with roles as shipowners, port workers, digital innovators, roles/titles, and training institutions were conducted during a maritime conference. Eight were before 2020 (2018 - 2020) and another eight after 2020 (2021 - 2025), clearly showing the change due to the COVID shock and acceleration in regulations. Each

interview was an average of 4,348 words long, making a total corpus of about 26,089 words. The participants are from Northern and Western Europe, Southern Europe, the UK, and Singapore.

Table 1 Demographic profile of maritime interviewees (n = 16).

ID	Country	Role / Title	Sub-sector	Experience (Years)	Notes
P01	Norway	Fleet Manager	Offshore services	20+	Focus on risk and vessel logistics
P02	Denmark	Managing Director	Ship management	25+	Business strategy and HR focus
P03	Netherlands	Technical Superintendent	Commercial shipping	20+	Involvement in compliance and training
P04	Greece	Operations Manager	Tanker operations	15+	Emphasis on flexibility and safety
P05	Singapore	Head of Innovation	Maritime tech / digital	10 - 15	Strong focus on digital transformation
P06	Germany	Director of Training	Maritime education / training	25+	Focus on crew competence and leadership
P07	UK	Compliance Officer	Classification / auditing	15+	Regulatory focus, IMO regulations
P08	Denmark	Port Operations Manager	Port logistics	20+	Focus on infrastructure and green corridors
P09	Norway	HR Manager	Offshore support vessels	10+	Crew retention and leadership training
P10	Netherlands	Shipowner / Executive	Bulk shipping	30+	Family business, long-term strategic view
P11	Greece	Marine Engineer	Technical operations	20+	Safety and engineering systems
P12	Singapore	Strategy Analyst	Shipping logistics	5 - 10	Youngest participant, data-driven mindset
P13	Germany	Sustainability Director	Maritime energy transition	10+	ESG reporting and emissions compliance
P14	UK	Business Development Lead	Maritime services (global)	15+	Commercial alliances and market entry
P15	Norway	R&D Manager	Green maritime tech	10 - 15	Hybrid systems, decarbonization focus
P16	Netherlands	Project Coordinator	Maritime digitalization cluster	5 - 10	EU project participation, stakeholder engagement

To capture temporal variation, two explicitly time-anchored prompts were included in the interview protocol. Initially, participants were prompted to contemplate strategic practices “in the timeframe leading up to 2020 (roughly 2018 - 2020)” with questions like “How did your company conventionally handle digitalization/ESG/compliance prior to 2020?” and “what were your pre-2020 overarching strategic priorities?” The second set of prompts focused on “the period after 2020 (2021

- 2025)", including questions such as "Following 2020, what changed in your strategic orientation?" and "In what ways did regulatory and global disruptions influence your decisions after 2020?". Year 2020 is used as an inflection point because it falls together with two major disruptions acknowledged by all participants: a global COVID-19 pandemic and the introduction of the IMO 2020 sulfur cap. Respondents could clearly compare the two periods in the structured prompts, enabling a distinction in findings that emerged inductively from paired reflections.

To provide narrative context to **Table 1**, participants were selected as deep experts deliberately representing a cross-section of the maritime ecosystem in those specific strategic areas being investigated. The sample, for example, includes offshore services (P01, P09), providing insight into strategic risk and human capital management; leaders from technology and innovation sectors (P05, P16), clearly articulating digital transformation and collaborative ecosystems; port operations managers (P08), focused on infrastructure and green corridors; and classification and sustainability directors (P07, P13), providing that all-important regulatory/ESG compliance perspective. Expertise diversity was not only important for the sampling strategy, but also for the institutional logic triangulation of the data.

3.3 Data analysis

The Gioia framework (Gioia et al., 2013) was applied to code the interview data. A multi-step highly rigorous and transparent inductive process is described as follows: Initial open coding created first-order categories based on participant vocabulary. For example, in explaining compliance before 2020 a participant said, "We just need to tick the box for IMO;" this quote was coded into a very specific 1st order code 'Compliance as a tick-box exercise'. These and similar codes- for example, 'Treating regulation as a burden', 'Cost-focused compliance'- were grouped into a second order theme 'Reactive Compliance'. This theme was then used in contrast with post-2020 themes, such as 'Innovation from compliance', to distil an aggregate dimension, 'Glocal Adaptation'.

This process was repeated for all interviews. In the final level of analysis, seven strategic patterns comprised and summarized at a higher level these second-order themes, reflected as broader concepts in glocal adaptation, alliances, risk management, digital and sustainability human capital, and organizational learning. A temporal lens was applied to highlight reconfigurations before and after 2020.

3.4 Trustworthiness and validity

To ensure rigor, the four criteria for trustworthiness established by Lincoln and Guba (1985) were adopted.

1) *Credibility*: Data triangulation (Patton, 2015) was used to make sure interpretations reflected what participants actually meant. Since the study was about "logics" and sensemaking that were captured at a very senior professional level, triangulation was primarily conducted within the main interview dataset, rather than with any secondary document sources, by rigorously cross-comparing answers between different organizational roles (e.g., shipowner versus port), regions (Scandinavia versus Asia), and sub-sectors (offshore versus logistics). Both convergent-consistent pattern findings, as well as explicitly divergent views, were reported. A double coding check on a subset of data by two researchers independently coded all differences, which were negotiated until resolved, ensuring interpretative consistency.

2) *Dependability & Confirmability*: To ensure the process was logical and well-documented (dependability) and that the findings were grounded in the data, rather than in researcher bias (confirmability), a detailed audit trail of coding logs and analytic memos was maintained. The researchers also actively engaged in negative case analysis, systematically searching for and examining data that contradicted emerging patterns in order to refine themes.

3) *Transferability*: While qualitative findings were not statistically generalizable, transferability (the potential applicability to other contexts) was enhanced by providing rich, thick descriptions of the participants and their contexts, as detailed in Section 3.2 (Data Collection).

4) *Ethics*: All participants were fully anonymized, and informed consent was obtained prior to the interviews.

4. Findings

This section presents the seven aggregate strategic dimensions derived from the Gioia analysis, which are the final products of the inductive coding process detailed in Section 3.3: Niche Expertise, Glocal Adaptation, Alliances, Risk Management, Digital and Sustainability, Human Capital, and Organizational Learning. Each dimension is discussed in terms of its evolution between the pre-2020 period (2018 - 2020) and the post-2020 period (2021 - 2025), a contrast that is summarized in **Table 2** and is supported by illustrative quotations from participants. The results display a structural reconfiguration of maritime strategy: where the first phase lay in efficiency, compliance, and incremental adaptation, this new later phase focuses on resilience, systemic integration, and capability-building. Further to this, the seven strategic patterns identified in Sections 4.1 - 4.7 do not uniformly apply across all organizations, but rather each pattern represents recurring tendencies found within certain clusters of actors (e.g., shipowners, ports, offshore operators, digital innovators, or classification societies). For the purposes of analytical clarity, therefore, each subsection now specifies which organizational group demonstrated the pattern most strongly, with examples from participants.

Table 2 Temporal contrast of strategic patterns (2018 - 2020 vs. 2021 - 2025).

Strategic Pattern	2018 - 2020 (Pre-2020)	2021 - 2025 (Post-2020)
Niche Expertise	Narrow technical specialization	Strategic differentiation in ESG/digital
Glocal Adaptation	Compliance as burden, fragmented adaptation	Compliance-innovation complementarity
Alliances	Opportunistic, short-term	Long-term, ecosystem-based
Risk Management	Reactive, insurance-based	Predictive, AI-driven, scenario planning
Digital & Sustainability	Peripheral, supportive	Core strategy, integrated ESG-digital
Human Capital	Operational, low emphasis on leadership	Hybrid leadership, crew welfare prioritized
Organizational Learning	Incident-driven, localized	Institutionalized, systemic

4.1 Niche expertise: From technical specialization to strategic differentiation

Pre-2020, this was most apparent among shipowners and offshore operators, who underlined such niche capabilities as specialized vessel classes, ice navigation competence, and offshore support experience. The participants explained that specialization was a means to earn contracts in high-risk environments. “In offshore, you don’t get the job unless you have the backup. Redundancy and technical specialization are not nice-to-haves; they are aspects of survival”, said P01 (Norway, Offshore Services). “Our competitive anchor is our engineering systems”, emphasized P11 (Greece, Marine Engineer). And continued: “We can handle the complex tanker-specific technical demands.

That is how we win contracts in markets that require deep expertise”. The pattern appeared much less strongly among ports and digital innovators.

After 2020, niche expertise was strategically reframed as a differentiator in new domains. Firms increasingly highlighted capabilities in digital maritime services, climate-adapted trade lanes, and energy transition technologies. Niche competencies were not solely technical but became part of value propositions that integrated the sustainability agenda and the demands of global shippers.

A specific example was given by P01 in explaining their strategy for high-risk operations: “redundancy and risk buffers are essential to survival in offshore support”. Almost similarly, P11 (Greek shipowners) emphasized an engineering focus as a differentiator and noted: “We are almost the only ones left around the world so committed and so hands-on in this business”.

4.2 Glocal adaptation: Balancing global compliance with local innovation

Most clearly visible among ports (P08), sustainability departments (P13), and shipowners operating from emission-regulated corridors were a few such as P03 and P10. Between 2018 and 2020, the mindset widely interpreted among these actors was that compliance with global regulatory frameworks, such as the IMO 2020 sulfur cap, is an external burden added on top of all their other obligations. In fact, this mindset was perfectly articulated by P11’s constituent group (Greek Shipowners) who described the impending sulfur cap as “the issue causing the most sleepless nights”, and warned that, without proper preparation, “we may see anarchy on the oceans”. This sense of 'anarchy' was mirrored in fragmented local adaptations, where disparate experiments with scrubbers highlighted a lack of technical and regulatory consensus.

However, in the post-2020 period, glocal adaptation emerged as a deliberate strategy. Organizations synthesized global compliance with local innovation and reframed compliance from constraint to opportunity. As articulated by P13 (Sustainability Director, Germany): “We believe that shipping entering the EU ETS presents an opportunity for shipping the pool from a financing and structural point of view”. A fact added to this logic was articulated by the same interviewee: “without verified ESG performance, financing and insurance become increasingly difficult”.

This approach was described at the practical level by P08 (Port Operations Manager), who explained how their port developed a localized emission-control area in line with global IMO requirements, thereby allowing the tenants to comply through locally tailored solutions.

4.3 Alliances: From opportunistic collaborations to strategic ecosystems

This pattern manifested differently across subsectors. Shipowners (e.g., P04, P10) relied on short-term, commercially driven alliances before 2020. Before 2020, they operated through mostly coincidental and ad hoc opportunistic alliances- such as cost-stabilizing vessel sharing or risk-pooling joint ventures in a cyclical market. Long-term short-term transactional arrangements were reflective of the prevailing logic among most shipowners’ managers regarding insurance and other forms of risk management. Ports and digital innovators (P05, P16) began forming more organized long-term partnerships after 2020. Current maritime strategies prioritize ecosystem-wide alliances over isolated firm responses to achieve decarbonization and intermodal integration. A primary example of this 'innovation-oriented' network is the July 2023 methanol bunkering trial in Singapore. This event, involving Maersk and local stakeholders, demonstrated how multi-actor collaborations are now essential for pioneering green fuels. This is a multi-stakeholder, long-term collaboration, targeting zero-carbon fuels. The organization of P10 (Shipowner/Executive) also described the move toward shared digital platforms, such as the Global Shipping Business Network (GSBN). “CMA CGM, Hapag-Lloyd, Hutchison Ports, Port of Qingdao, PSA International and Shanghai International Port Group signed service agreement... to become partners” was explained as a platform. This is indicative of an evolution from proprietary systems toward shared data governance to improve systemic efficiency.

4.4 Risk management: From reactive protection to predictive resilience

This pattern did not appear uniformly across all organizations. In the earlier period, offshore operators (e.g., P01, P09) and several shipowners exposed to volatile routes (P04) approached risk management in a largely reactive manner. Their focus was on immediate hazards such as piracy, weather disruptions, or financial volatility. This hazard-focused mindset was forcefully articulated by P11's constituent group (Greek Shipowners) regarding the 2020 sulfur cap, fearing it would "lead to catastrophes, to loss of life" and wondering how regulators could "sleep at night" given the risks. Classification and compliance professionals (P07) similarly reported that pre-2020 practices centered on incident-driven responses. By contrast, in the post-2020 environment, a more predictive and resilience-oriented logic emerged, most clearly among offshore firms (P01, P09), digital innovators (P12), and ports (P08). These organizations invested in AI-based forecasting systems, structured scenario modeling, and portfolio diversification. The pandemic acted as a catalytic trigger, supporting the move toward integrated advance resilience architectures. This predictive logic was illustrated by the strategy of P13's organization (Tankers International). They explained that joining the "Blue Visby consortium" was done explicitly to "address the 'Sail Fast Then Wait' phenomenon. The project applies "software, data and an innovative contractual framework" to fix optimal time of arrival for a vessel, allowing charterers to slow steam and remove uncertainty. Similarly, P01 (Offshore Services) described a shift to proactive risk mitigation, where "early engagement" with complex projects allows them to "develop a tailored methodology that maximizes efficiencies, minimizes risks, and ensures a safe, cost-effective execution".

4.5 Digital and sustainability: From supportive tools to core strategy

The pattern was most explicit among digital innovators (P05, P16), sustainability directors (P13), and technocratic shipowners (P10). During 2018 - 2020, their functions were also mainly perceived as support ones, rather than strategic. Tools, such as fleet monitoring software or data dashboards and port scheduling systems, were used to optimize daily operations by the tactical implementation of efficiency measures. Sustainability programs could be framed primarily as compliance activities; hence, they are considered cost items, instead of as forming part of a strategy asset. Even the digital actors noted an appetite within organizations for advanced analytics before 2020.

Post-2020, these two areas became core to organizational strategy, particularly among digital innovators and sustainability units and shipowners in regulated markets. Digital transformation was seen as the enabler of predictive maintenance and autonomous navigation projects together with carbon tracking tools. Sustainability was reframed in terms of added value, or a source of added value. Participants explained how competitiveness would be ensured on the basis of ESG performance due to investor expectations and client requirements, accompanied by regulatory pressure. This shift is intensified by the integration of digital and ESG strategies.

This integration was clearly articulated by P13 (Sustainability Director), whose organization (Tankers International) uses digital tools to master ESG compliance: "Tankers International is at the forefront of digitalization... utilizing complex digital data analysis techniques to improve the recording and benchmarking of vessel efficiency... This analysis will ultimately be used to optimize the performance of every vessel... especially in relation to the CII and EEXI standards". P13 also provided a concrete tool example, noting their app has a "new CII feature... to calculate indicative voyage CII scores" which gives "full transparency on how each individual CII rating is calculated to give a clear understanding of how voyage section impacts emissions". This was echoed by P05 (Head of Innovation), who described digitalization as the new core of competitiveness: "The digitalization

of maritime operations is transforming the industry, with a growing emphasis on data-driven decision-making, automation, and connectivity”.

4.6 Human capital: From operational resource to strategic enabler

This pattern was most visible among training institutions (P06), HR units in offshore and shipping companies (P09), and shipowners managing multicultural crews (P02, P03). Human capital was generally framed in operational terms by these actors in the pre-2020 context. Their primary concern was with safe navigation and technical reliability, including adherence to international labor standards. Leadership practices were largely experiential, “based on seafaring traditions, informal mentoring, and accumulated maritime experience” (P06, P09).

After 2020, human capital became a central component of organizational resilience. Participants from HR units and training organizations emphasized crew welfare, psychological safety, and competence development as strategic priorities. This shift included new programs for leadership training, cross-cultural communication, and mental well-being. Across shipowners and offshore firms, hybrid leadership emerged as a distinctive capability that combined technical expertise, digital fluency, and people-focused management.

Concrete examples of this new strategic focus were common. P06’s constituent group (the Singapore Shipping Association) described this new training mandate: “Organizing training programs, workshops, and seminars on maritime security and crisis management can help enhance the preparedness of shipowners and their crews to respond effectively to security threats and emergencies”. Similarly, P09’s counterpart (Columbia Shipmanagement) illustrated a structured welfare initiative: “Columbia aims to change the conversation on seafarer’s mental health by tackling the stigma, which is why we have put all our efforts to become the first shipping company offering its crew and staff psychological support... one-on-one support in the strictest of confidence 24/7, 365 days a year”.

4.7 Organizational learning: From incident-specific memory to embedded knowledge systems

This pattern appeared across all organizations but in different ways. Before 2020, offshore operators (P01) and several shipowners (P03, P11) described organizational learning as incident driven. They emphasized that lessons learned from accidents, near-misses, or compliance breaches were documented, but usually remained confined to individual vessels, departments, or local teams. Classification and compliance professionals (P07) reported similar experiences, noting that insights from audits or inspections were not consistently shared across units.

After 2020, organizational learning became more systematic. Offshore firms (P01, P09) explained that they institutionalized structured debriefing protocols and formal post-incident reviews. Ports (P08) made feedback a standing component of their integrated standard operating procedures, and ensured the same documentation was available to all operations units. Classification bodies (P07) upgraded knowledge-sharing platforms with more uniform reporting structures. The change reflected a common understanding that resilience is based on institutional memory, not ad hoc, individual learning. A Port Operations Manager exemplified the systematic approach by describing an implemented mandatory review system: “We found out that incident reports were just sitting in a file somewhere; hence we institutionalized a mandatory ‘post-incident learning’ after every operational deviation...the key is not in the report but rather establishing a constant flow between finding results back into our standard operating procedures so that next shift makes sure same mistake does not happen.” P07 (Compliance Officer) also describes the evolution of knowledge sharing within their classification organization: “An audit finding in Singapore could prevent a near-miss in Rotterdam only if the knowledge was shared. After 2020, we heavily invested in expanding our global knowledge-sharing portal. Now all audit findings and corrective actions and best practices are

codified and accessible across all regional offices. The aim is to make sure that there are no repeated mistakes by providing institutional memory available to everyone.”

4.8 Country and region-specific strategic insights

Norway, Denmark (Scandinavia): The aggregate themes appear in a path-dependent manner from the Scandinavian respondents. Particularly strong were those related to sustainability, risk, and human capital.

- *Risk Management (Theme 4.4):* A very advanced proactive approach to risk was displayed and proposed as the matured version of this theme. P01 (Fleet Manager-Offshore Services) considered it a key strategic capability: “redundancy and risk buffers are essential to survival in offshore support”.

- *Human Capital (theme 4.6):* Apart from an aspect of operation, this theme was systemic. P09 (HR Manager, Offshore vessels): “Crew retention and structured leadership development emphasized placing human capital directly in resilience.”

- *Digital & Sustainability (theme 4.5):* This came out as a policy-backed innovation ecosystem; P15 (R&D Manager, Green maritime tech) said there is a “Hybrid propulsion and decarbonization focus.”

Cluster Insight: Scandinavian firms appear to be oriented both toward technological innovations in green tech and systemic investments in people. This reflects broader findings that Nordic maritime actors frequently merge ESG, human capital, and digitalization logics as composite evolving strategies (Poulsen et al., 2018).

Western Europe (The Netherlands, Germany): Dutch and German participants demonstrated a “compliance-innovation hybrid”, where powerful institutional infrastructures (for example, engineering traditions, EU policy) mold the application of the main strategic themes.

- *Human Capital (Theme 4.6):* This theme was expressed through highly structured, formal systems. P06 (Director of Training, Germany) stressed “leadership pipelines and competence building, consistent with Germany’s dual vocational training system”. This was echoed by P03 (Technical Superintendent, Netherlands), who “linked compliance and training, emphasizing the professionalization of seafarer skills”. This reflects a regional logic where human capital is systematically developed, not just experientially acquired.

- *Glocal Adaptation (Theme 4.2) & Digital/Sustainability (Theme 4.5):* This theme was manifested as structured, high-stakes reporting. P13 (Sustainability Director, Germany) highlighted this pragmatic, institutionally driven logic, stating that “without verified ESG performance, financing and insurance become increasingly difficult”. This demonstrates how national governance models mediate the operationalization of ESG integration.

- *Alliances (Theme 4.3):* This theme was not opportunistic but was highly institutionalized. P16 (Project Coordinator, Netherlands) highlighted “participation in European-funded innovation consortia, showcasing how Dutch firms embed themselves in EU-level collaborative governance”.

- *Organizational Learning (Theme 4.7):* Learning was framed as steady, incremental progress, rather than disruptive change. P10 (Shipowner, Netherlands) embodied this, representing that the “legacy of family-owned firms with a long-term strategic orientation, prioritizing continuity and steady incremental innovation”.

Cluster Insight: Dutch and German actors attain resilience by means of well-organized governance, EU partnership, and institutionalized adherence. This is in line with the findings that were made earlier (Miller, 2012).

Southern Europe (Greece):

The Greek respondents explained a different strategic logic that has been developed from a history of family businesses in unstable freight markets. They narrated the same aggregate themes

but emphasized the maneuverability and opportunistic flexibility, instead of the structured long-term planning as seen among Western Europeans.

- *Risk Management (Theme 4.4) & Niche Expertise (Theme 4.1)*: The relationship between risk management and niche expertise was that risk would be managed by running lean, adaptive operations while experts focused on technical safety and engineering. “Lean operations and rapid adaptation are our comparative advantage,” (P04, Operations Manager, Tanker operations). He was a little more explicit, but essentially made the same point, as another respondent who emphasized marine engineering systems plus safety- in other words, consistent with Greece’s reputation for technical seamanship (P11, Marine Engineer).

- *Glocal Adaptation (Theme 4.2)*: Strongly themed through a ‘safety first’ and ‘cost/risk optimization’ logic, particularly in the pre-2020 period, as evidenced by interview data (P11’s constituent group, Union of Greek Shipowners), new regulations were primarily viewed as related to operational risk and safety; thus, compliance was framed as a critical challenge to be adapted safely, rather than as some institutional reporting exercise.

Cluster Insight: Greek firms’ strategies are based on cost discipline and family networking. They maintain their adaptability by being responsive to market needs. The findings of the previous literature validate this result by stating that the strategizing innovation of Greek shipping companies lies more in opportunistically flexible forms (a manifestation of Theme 4.4) than in long-term structured forms (Theme 4.7).

Asia (Singapore):

There is strong state-industry coordination in Singapore; therefore, the contextual logic was future-oriented “technology-driven and state-supported” strategic logic, which meant proactive systemic imperatives, rather than just firm-level responses, articulated the core themes.

- *Digital & Sustainability (Theme 4.5)*: This was the dominant theme, expressed as a “defining element of long-term competitiveness”. P05 (Head of Innovation, Maritime tech) was unequivocal: “digitalization is not optional, it defines competitiveness”. This represents the most advanced form of this theme, where “state-led enablers and firm-level agility co-evolve” to sustain strategic advantage.

- *Human Capital (Theme 4.6)*: Also oriented to the future, this theme emphasized “that leadership development should be a forward-looking process” towards digitalization. P12 (Strategy Analyst, Logistics) “represented the data-driven perspective of the young generation and insisted on automation and artificial intelligence,” an example par excellence of hybrid leadership through one of its digitally fluent forms, as identified among core capabilities for 2020 and beyond.

- *Alliances (Theme 4.3)*: Strong state-industry coordination turns out to be the systemic, mature form of this theme itself, creating the innovation ecosystems within which participants such as P05 and P12 operate.

Cluster Insight: Clearly technological and state-supported, Singapore’s strategy is to become a first mover in smart ports, AI shipping, and carbon-neutral trade. Literature has highlighted Singapore’s role as a policy entrepreneur in maritime digital governance (Boadu et al., 2025), corresponding well with findings from primary data that Singapore is pushing to be among the first countries allowing fully automated vessels within its waters through legislative reforms.

United Kingdom (UK):

The UK respondents displayed a particular strategic logic, formed by London’s institutional role in global maritime finance and governance. Strategic context or background resulted in the emergence of a hybrid strategy, wherein the themes of compliance and risk management are closely interwoven.

- *Glocal Adaptation (Theme 4.2)*: For UK-based actors, this theme was expressed as a core business enablement. “We do not see compliance as any kind of hindrance or burden... compliance

gives us operational legitimacy and reputational capital” (P07, Compliance Officer, Classification), emphasizing IMO regulation and standard setting as core to legitimacy in obtaining banking relationships and correspondent banking relationships throughout the global financial system.

- *Risk Management (Theme 4.4) & Alliances (Theme 4.3)*: These came out as a “pragmatic response to geopolitical and economic volatility”. Risk was not just managed or construed through internal buffers, as in the Scandinavian model, but also through an external market positioning one. This was clearly articulated by P14 (Business Development Lead, Services), who emphasized global commercial alliances and market expansion: “Our diversification across markets is our hedge against volatility”.

Cluster Insight: The UK sits at the crossline of themes on market outreach (Theme 4.3/4.4) and institutional compliance (Theme 4.2), with strong tendencies toward international legitimacy. This supports other findings that show how maritime actors in the UK balance a portfolio of global services, with an adherence to compliance, as a means of maintaining credibility (Stopford, 2008).

4.9 Sub-sector-specific strategic insights

Besides all the differences by theme and region, the analysis also found that there are differences between maritime sub-sectors which include ship owners, ports, offshore operators, digital innovators, training providers, and compliance/classification institutions. This further explains how strategic priorities should be guided by organizational missions and operating environments.

Shipowners:

Shipowners (e.g., P01, P03, P04, P10, P11) were concerned with cost control and risk management, added with fleet optimization, before 2020; after this year, the trend in core strategies has been to integrate ESG and digital tools. This point of view gives an understanding of how hard it is to keep a business profitable while dealing with all the rules-and-regulations, plus reputation matters, in global freight markets.

Ports:

Port-related participants, e.g., P08, highlighted infrastructure driven sustainability initiatives and ports as facilitators of green corridors and intermodal logistics. Ports emphasized the importance of digital scheduling, emission monitoring, and stakeholder partnerships as strategic enablers.

Offshore:

Offshore-focused participants (e.g., P01, P09, and P15) emphasized resilience redundancy, crew welfare, and investment in hybrid propulsion research and alternative fuel research. Sustainability and innovation are construed by offshore companies as a means of fulfilling compliance requirements, as well as of differentiating their offerings in the market.

Digital Innovators:

Innovation leaders (e.g., P05, P12, and P16) emphasized digital transformation through artificial intelligence and smart logistics. Their discussions provide a clear view of how maritime ecosystem organizations with high levels of digitization drive the entire industry to transform itself.

Training and Education:

Training providers emphasized leadership pipelines, competence-based education, and cross-cultural management (e.g., P06). Human capital investment is central to resilience and adaptation, as organizations such as theirs underline.

Compliance and Classification:

Compliance officers and classification professionals emphasized the growing importance of ESG reporting and legitimacy through IMO alignment, while also emphasizing the challenges of

harmonizing global and local regulatory frameworks (e.g., P07, P13, and P14.). Their role demonstrates how compliance functions play both constraining and enabling roles on innovation.

Synthesis:

These specific findings by sub-sectors show that, even though all the actors within maritime are under global pressures for digitalization, ESG integration, and resilience, the challenges in prioritization and the way of enactment varies through sectoral missions and institutional positions within the maritime ecosystem. A detailed summary of these sub-sectoral priorities, contrasting their pre-and post-2020 focus and orientation toward risk, digital/ESG, and human capital, is provided in **Table 5**.

Table 3 Strategic patterns in maritime organizations (2018 - 2025).

Strategic Dimension	Past	Present	Future
1. Strategic Positioning through Niche Expertise	Emerged from generalized operations; deregulation in the 1990s - 2000s led to niche survival strategies.	Defined market segments, actively maintained via relationships and reputation.	Exploration of hyper-specialization (e.g., digital maritime services, Arctic trade routes).
2. Globalization with Local Adaptation	Standardized global expansion often clashed with local contexts; learning through compliance crises.	Glocal strategies adopted- global values with localized operations, hiring, and compliance.	Anticipated rise in region-specific decarbonization demands (e.g., zero-emission port zones).
3. Strategic Alliances and Partnerships	Opportunistic or crisis-driven (e.g., recession-era joint ventures); many failures due to poor alignment.	Strategically curated partnerships supporting digitalization, R&D, and market access.	Growing interest in intermodal and public-private green port alliances.
4. Dynamic Risk Management and Flexibility	Reactive strategies in response to piracy and financial crises; lacked real-time analytics.	Risk embedded in decisions; use of predictive models and scenario planning is increasing.	Focus shifting to climate risk modeling, cyber resilience, and AI-supported decisions.
5. Digital Transformation and Sustainability	Slow, fragmented tech adoption; environmental focus limited to regulatory compliance.	Digital systems and ESG seen as strategic assets (e.g., carbon tracking, digital twins).	Strategic focus on autonomy, AI optimization, and carbon-neutral operations by 2040.
6. Human Capital and Leadership Strategy	Leadership was informal and experience-based; minimal crew welfare beyond compliance.	Emphasis on training, diversity, and crew retention through career development.	Movement toward hybrid leadership (technical + digital + cultural fluency), with AI support.
7. Strategic Learning and Institutional Memory	Learning from incidents was ad hoc; knowledge often lost as staff retired.	Structured debriefs and integration into SOPs and e-learning now common.	Use of learning platforms and knowledge graphs for long-term, global institutional memory.

Besides the themes which emerged across the data set, important differences appeared when strategies were analyzed by national and regional context. These findings add to the understanding of how maritime strategy is shaped by institutional environments, cultural traditions, and rules and regulations, in addition to organizational imperatives. Institutional theory has provided useful insight into this aspect through its proposition on differential adaptation of organizations under varying institutional logics (DiMaggio & Powell, 1983; Oliver, 1997). The literature on maritime clusters contains a similar message but expressed as path-dependencies at a more regional level- in terms of both innovation practice and regulation governance (De Langen, 2002; Midoro et al., 2005).

Seven strategic patterns were matched with three temporal stages to capture how maritime organizations have developed across those three temporal stages of earlier legacy approaches, current practice, and intended future direction. This was done through an inductive analysis of the interview data (see **Table 3**). The pattern is reflective of a sector in transition; therefore, it enables a move from reactivating and fragmented strategies toward proactive integrated adaptive configurations. Among other key trajectories are moves from generalist to niche operations, glocal ESG strategy deepening, partnership redefinition via digital AI-enabled tools, and risk management.

4.10 Cross-regional patterns

These findings reinforce that maritime strategy is path-dependent and contextually embedded. **Table 4** provides a summary matrix that maps these distinct regional logics against the core strategic themes. Across regions, certain contrasts stand out:

1) *Scandinavia vs. Southern Europe*: While Nordic actors invest in systemic sustainability and leadership, Greek firms rely on agility and opportunism.

2) *Western Europe vs. Asia*: Dutch/German actors focus on structured compliance and incremental innovation- contrast this with the Singaporean actor, who is a tech-first disruptor.

3) *UK as a hybrid case*: Balancing between global diversification and legitimacy through compliance.

Table 4 Country/regional patterns vs. strategic themes.

Region/ Country	Niche Expertise	Risk Management	Digitalization	ESG/Sustainability	Human Capital
<i>Scandinavia (Norway, Denmark)</i>	Green technology, offshore specialization	Risk buffers, redundancy	Moderate adoption	Strong ESG integration, green corridors	Crew welfare, leadership development
<i>Western Europe (Netherlands, Germany)</i>	Family business continuity, engineering expertise	Compliance-based risk control	EU digitalization clusters	Structured ESG reporting	Vocational training, leadership pipelines
<i>Southern Europe (Greece)</i>	Tanker operations expertise	Lean risk-taking, flexibility	Limited digital uptake	Operational compliance focus	Traditional seamanship
<i>Asia (Singapore)</i>	Innovation-driven logistics	Forward-looking risk systems	Strong AI, smart port leadership	Policy-supported ESG	Young digital strategists
<i>United Kingdom</i>	Diversification of services	Compliance-oriented risk	Selective digital adoption	Compliance-driven ESG	Global leadership skills

Some organizations expressed their strategy through the introduction of new programs. Most narratives emphasized internal leadership pipelines and cross-functional ESG-digital roles. Notably, post-2020 resilience narrative is less dependent on elasticity, and more on well-being and cultural intelligence as drivers of resilience. **Table 5** provides a summary.

Table 5 Sub-sectoral priorities vs. strategic themes.

Sub-sector	Pre-2020 Focus	Post-2020 Focus	Risk Orientation	Digital/ESG Integration	Human Capital
Shipowners	Cost control, fleet optimization	ESG & digital integration	Insurance-based	Shift to strategic core	Operational → strategic
Ports	Infrastructure management, scheduling	Green corridors, emission monitoring	Local compliance	Strong ESG-digital link	Stakeholder partnerships
Offshore	Redundancy, technical expertise	Hybrid propulsion, R&D	Safety-first	Sustainability as differentiator	Crew welfare priority
Digital Innovators	Niche solutions	AI, smart logistics	Forward-looking	Disruptive core logic	Tech-oriented teams
Training	Basic competence training	Leadership pipelines, cross-cultural	Limited risk role	Support for ESG adoption	Central to resilience
Compliance/Classification	Technical standards, safety checks	ESG reporting, harmonization	Legitimacy focus	Compliance as enabler	Professional expertise

This framework demonstrates the strategic reorganizations that organizations across the maritime sector experienced between 2018 to 2025. In particular, the idea of “glocal ESG adaptation” exemplifies how firms negotiated global regulatory obligations with local adaptive strategies for innovation. This data architecture allows for theorizing the relationship between digital, environmental, and human capital strategies in developing organizational resilience.

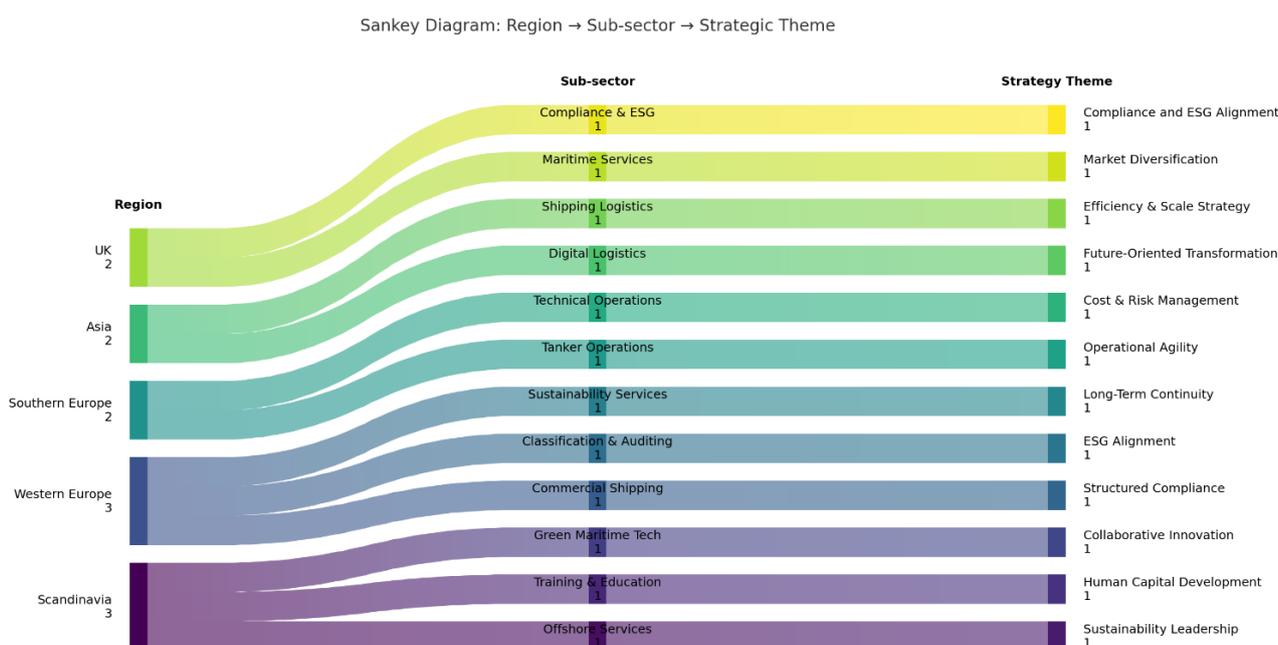


Figure 1 Sankey diagram of Gioia framework results.

To visually synthesize the contextual analysis from Sections 4.8 and 4.9, a Sankey diagram is presented in **Figure 1** showing both flows and clusters of the analytical categories- from connections between (a) participant Region (ex: Scandinavia), through (b) participant Sub-sector (ex: Offshore Services), to (c) contextual dominant Strategy Theme (ex: Sustainability Leadership)- to provide a holistic visualization of how seven aggregate themes are infused within, and flow out from, specific institutional and industry logics.

5. Discussion

5.1 Theoretical contributions

The findings further develop the concept of glocal adaptation. “Glocal ESG adaptation” is defined as a particular form of compliance-innovation complementarity, which is more than simple institutional isomorphism (i.e., passive adoption of global rules) or decoupled local responsiveness (i.e., treatment of local operations separately from global standards), but as an ability to actively use the pressures posed by global regulatory frameworks, such as those imposed by the IMO on enabling platform, to fuel and legitimize contextualized innovation like P08’s port-specific environmental zones. In theoretical terms, this supports arguments about institutional complexity through demonstration of synthesis, rather than tradeoff between them. Compliance gives firms reason/inspiration/context-for-contextual-innovation. The boundaries are sharp around a new capability emerging under ‘AI-augmented hybrid leadership’. This is different both from (1) traditional technical leadership, i.e., seamanship, and (2) generic digital leadership, i.e., using technology. Originality is required in the mandatory integration of all three skills- technical seamanship, digital fluency, and people-centered leadership in a high risk, safety critical, cross-cultural maritime environment. An “augmented” capability, hence, implies a human-machine collaboration at the leadership level to manage modern operational complexity as another specific integrated profile required for resilience which, in this sector, expands leadership theory by definition.

5.2 Managerial implications

For maritime executives, the findings emphasize developing dynamic capabilities specific to resilience (Teece, 2007), rather than an efficiency driven model of management.

- *Building ‘sensing’ and ‘seizing’ capabilities*: The outcomes recommend that supervisors organize interests in advanced frameworks (e.g., prescient examination, computerized twins). This is not simply a functional add-on; this turns into the primary system, through which ‘detecting’ and ‘holding onto’ dynamic abilities are constructed; thus, firms have hazard the executives capacity as well as ESG straightforwardness conveyance ability. For directors, ESG has moved past from being simply a revealing driven cost to being a central part of market detection.

- *Building ‘reconfiguring’ capabilities*: Two essential mechanisms for reconfiguration emerged from the findings.

- 1) *Internal reconfiguration (human capital)*: The evolution toward “hybrid leadership” is an internal reconfiguring capability. Managers must commit to pipelines of leaders who possess technical, digital, and people-centric skills that assist the organization be adaptive with institutionalized learning.

- 2) *External reconfiguration (alliances)*: It is in the evolution of alliances to ecosystems that key external ‘reconfiguring’ capability lies. For managers, this means that alliances are not just tactical tools but become the main mode with which companies co-innovate and respond to systemic pressures such as decarbonization.

5.3 Policy implications

The results have equally significant implications for policymakers and regulators. First, they demonstrate the benefits of incentive-based regulation: policies that enforce compliance requirements alongside financial and institutional support- in green financing, carbon credits, and tax reliefs on

digital-ESG investments- will likely catalyze strategic transformation faster. Second, this research brings out clearly an urgent necessity to harmonize data-sharing standards, so as to make reporting tools interoperable and, thereby, enhance transparency in carbon accounting reports. Thirdly, public-private partnerships are needed with respect to ecosystems wherein alliances evolve into developing green corridors/digital infrastructure/workforce training programs, etc., Recognizing how global frameworks interplay with local realities can help articulate how firms not only comply, but also innovate, thus, sustaining both industry competitiveness and global sustainability objectives.

6. Conclusions

The maritime industry has undergone a fundamental structural transformation, shifting from a focus on efficiency and reactive compliance prior to 2020 toward a comprehensive resilience-based strategy in the post-2020 era. This evolution is driven by the dynamic interaction between digitalization (sensing capabilities), ESG governance, and human capital (reconfiguring capabilities).

Key strategic patterns that have emerged to manage this transition include:

- **Glocal ESG Adaptation:** A deliberate synthesis where global regulatory mandates, such as the IMO 2020 sulfur cap, are leveraged to fuel localized innovation rather than viewed as mere operational burdens.
- **Predictive Risk Management:** The transition from reactive, insurance-based protection to proactive, AI-driven resilience architectures that utilize real-time analytics for scenario planning.
- **Hybrid Leadership:** The emergence of a new leadership capability that integrates technical seamanship with digital fluency and people-centric management to address the complexities of a safety-critical, cross-cultural environment.
- **Strategic Ecosystem Alliances:** A move away from ad-hoc, opportunistic collaborations toward long-term, multi-stakeholder ecosystems focused on shared goals like decarbonization and zero-carbon fuels.

While these shifts are globally observable, their enactment is heavily mediated by regional and institutional logics. For instance, while Scandinavian firms prioritize systemic investments in green technology and leadership, Singaporean actors operate as technological pioneers through strong state-industry coordination. Ultimately, building maritime resilience depends on the institutionalization of learning and the continuous alignment of human capabilities with digital and environmental systems.

7. Limitations and future research

This study has potential implications for understanding the strategic transformation of maritime organizations. However, there are also limitations to the study. These limitations leave room for future research and developments.

7.1 Methodological limitations

The Gioia methodology emphasizes depth over breadth or emergent conceptual clarity. Therefore, this sample size would be deemed sufficient: participants from key categories (ports, ship owners, tech providers) were diversified- data saturation had been achieved in the course of fieldwork; clear first-and second-order themes emerged through analysis. However, results cannot be taken as statistically representative of a global maritime sector, since senior professionals' perceptions form its basis interpretations with rigor, by employing large-scale surveys or mixed method designs that test generalizability finding. An additional limitation involves the use of self-reported data from senior professionals, which may be influenced by organizational or individual biases. This method suits the way it describes strategic logics and organizational narratives. However, there is potential for bias or selective memory in response. Future research can develop a more holistic understanding by building on this approach with archival data and performance indicators, as well as digital trace data- for example, from AIS IoT emissions logs, etc.

7.2 Temporal and contextual boundaries

Temporal division delivers comparisons, but it also imposes limitations. There is, indeed, an apparent breakpoint in the pandemic and regulatory tightening around IMO 2020/2023, and the long-term impacts of these changes are still up for debate (Eccles et al., 2020; Baker et al., 2020; Odziemkowska & Henisz, 2021). A future study can analyze how strategies change concerning decarbonization milestones by 2030 and 2050, as relevant technologies, such as autonomous vessels, hydrogen fuels, and carbon capture, move further up the maturity curve.

This means that the geographic scope also includes Northern and Western Europe, Southern Europe, the UK, and Singapore. Apart from being leading advanced maritime hubs, there are dynamics of emerging markets or Global South maritime corridors that these regions do not reflect. Therefore, future research should make a comparative study on strategic reconfigurations in other regions of the world with different institutional pressures and resource constraints and infrastructural limitations.

7.3 Directions for future research

More specifically, and strictly within the above limitations, several immediate avenues of research are opened:

1) Quantitative hypothesis testing- survey based, or econometric, studies could empirically test some of the relationships identified in this study; for example, between digital adoption, ESG integration, human capital investment, and resilience outcomes.

2) Comparative industry studies- future work could compare the maritime sector with other asset intensive industries (e.g., aviation, energy, logistics) to explore similarities and differences in resilience building across sectors.

3) Cross-level analyses- research could combine organizational level strategies with supply chain and ecosystem level perspectives to analyze how alliances and port networks, together with regulatory regimes, shape resilience.

4) Human capital and leadership focus with the emergence of AI-augmented hybrid leadership as a new capability- further studies could examine how such leadership styles influence organizational culture, employee engagement, and performance under turbulence.

5) Big data and digital ethnography- future research could make use of big data analytics, digital ethnography, or even simulation modeling to capture real-time organizational responses to shocks as an addition to the insight provided by interviews.

This paper has provided deep coverage of strategic reconfiguration in maritime organizations; future research should widen its scope, methods, and contexts. Only then will scholars acquire a full understanding of the joint impact through resilience on maritime systems operating within an increasingly unstable global environment that is highly dependent on human capital (digitalization, ESG).

CRedit author statement

Aykut Arslan: Idea generation, Formal analysis, Writing - review & Editing. **Abdülkadir Akturan:** Data curation, Resources, Project administration, Writing - review & Editing.

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