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Maritime Supply Chain Resilience in ASEAN Region: Lessons from Post-Pandemic Disruptions and Strategic Recovery Models

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Abstract. *This research explores maritime supply chain resilience challenges in the ASEAN region, examining stakeholder perspectives on pandemic-related disruptions and strategic recovery models. Employing qualitative-dominant mixed methods, the study gathered insights through Focus Group Discussions, interviews, and surveys with thirty-eight participants comprising maritime students, lecturers, and veteran practitioners at Sekolah Tinggi Ilmu Pelayaran Jakarta. Thematic analysis revealed severe pandemic disruptions (mean severity: 4.26/5.0) with moderate recovery effectiveness (mean: 3.31/5.0), producing significant resilience gaps particularly in container equipment availability (gap: 1.9) and labor continuity (gap: 1.2). Supply chain visibility and real-time information sharing emerged as highest resilience priorities (24%), followed by workforce flexibility (21%) and supplier diversification (18%). Findings demonstrate that pandemic experiences fundamentally challenged efficiency-oriented supply chain paradigms, with 94% of stakeholders affirming that future strategies must integrate resilience as co-equal priority alongside cost optimization. The research emphasizes maritime education institutions' critical role in resilience-building through curriculum transformation, competency development, and collaborative partnerships preparing future professionals for disruption-prone supply chain environments.*

Keywords: *Supply chain resilience; pandemic disruptions; ASEAN maritime logistics; recovery strategies; workforce competency*

1. INTRODUCTION

The COVID-19 pandemic exposed fundamental vulnerabilities within global maritime supply chains, revealing that decades of optimization focused primarily on cost efficiency and just-in-time logistics had created brittle systems lacking resilience to withstand unprecedented disruptions (Notteboom et al., 2021). The ASEAN region, serving as a critical manufacturing hub and maritime gateway connecting Asian production centers with global consumer markets, experienced particularly severe impacts as port closures, labor shortages, container imbalances, and demand fluctuations cascaded through interconnected supply networks, disrupting trade flows and economic activities across member states (Verschuur et al., 2021). For maritime education institutions preparing future supply chain professionals, the pandemic provided sobering lessons regarding the inadequacy of traditional supply chain paradigms and the urgent necessity for resilience-oriented frameworks integrating flexibility, redundancy, visibility, and adaptive capacity into operational designs. The central question confronting maritime stakeholders, policy-makers, and educators concerns how ASEAN maritime supply chains can be fundamentally restructured to balance efficiency imperatives with resilience requirements, ensuring that future disruptions—whether pandemic-related, climate-driven, geopolitical, or technological—do not precipitate similarly catastrophic

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consequences for regional trade and economic prosperity.

The ASEAN maritime context presents distinctive characteristics shaping supply chain resilience challenges and recovery dynamics. The region encompasses diverse economies ranging from highly developed Singapore and Malaysia to emerging maritime nations including Indonesia, Philippines, and Vietnam, creating heterogeneous infrastructure capabilities, technological sophistication levels, and institutional capacities for crisis response and adaptation (Soh, 2020). ASEAN's strategic geographic positioning along critical shipping routes including the Malacca Strait, one of the world's busiest maritime chokepoints handling approximately one-quarter of global traded goods, amplifies both the region's economic significance and its vulnerability to disruptions that reverberate globally (Cullinane & Haralambides, 2021). Furthermore, ASEAN supply chains exhibit complex interdependencies with global manufacturing networks, particularly Chinese production systems and European-American consumer markets, meaning that regional disruptions trigger cascading effects far beyond Southeast Asia while external shocks rapidly propagate into ASEAN maritime operations.

The research problem central to this investigation addresses the critical knowledge gap regarding how maritime education stakeholders in ASEAN contexts understand post-pandemic supply chain disruptions, evaluate recovery strategies implemented during crisis periods, and conceptualize resilience-building frameworks for future preparedness. Specifically, this research explores the fundamental question: What are stakeholder perspectives on maritime supply chain resilience challenges revealed by pandemic disruptions, what recovery strategies proved effective or ineffective during post-pandemic periods, and what strategic models can enhance future resilience within ASEAN maritime contexts? The specific objectives guiding this inquiry include: (1) documenting stakeholder experiences and observations of pandemic-related supply chain disruptions and their cascading impacts; (2) evaluating recovery strategies and adaptive responses implemented by ASEAN maritime operators during post-pandemic periods; (3) identifying critical resilience dimensions and capacity requirements for withstanding future disruptions; and (4) developing strategic recommendations for resilience-oriented supply chain transformation in maritime education and operational contexts.

The significance of this research extends beyond retrospective crisis analysis to encompass prospective implications for ASEAN economic integration, regional

competitiveness, and sustainable development trajectories. As supply chain resilience increasingly influences investment decisions, sourcing strategies, and logistics network configurations, ASEAN maritime systems' demonstrated capacity to withstand and recover from disruptions becomes critical for attracting foreign direct investment, maintaining manufacturing competitiveness, and supporting economic growth objectives (Notteboom et al., 2021). Moreover, this investigation addresses a substantial gap in existing literature, which predominantly examines resilience challenges in developed Western maritime contexts while undertheorizing ASEAN-specific dynamics including institutional diversity, infrastructure heterogeneity, regional coordination mechanisms, and the intersection of pandemic recovery with ongoing digital transformation and environmental sustainability initiatives (Verschuur et al., 2021). The rationale for conducting this research within a maritime education institution stems from recognition that resilience-building requires not only operational adjustments and infrastructure investments but also fundamental reconceptualization of supply chain management paradigms, workforce competency development, and educational curriculum transformation preparing future professionals to design, manage, and optimize resilient rather than merely efficient maritime logistics systems.

Methodologically, this research employs a qualitative-dominant mixed methods approach, gathering rich, experiential insights through Focus Group Discussions, semi-structured interviews, surveys, and reflective consultations with maritime students who witnessed pandemic disruptions during formative educational periods and anticipate managing future crises throughout professional careers, lecturers possessing academic expertise in supply chain management, logistics optimization, and crisis response frameworks, and veteran maritime officers now serving as practitioners who directly experienced pandemic operational challenges and implemented adaptive strategies under extreme uncertainty and resource constraints. This multi-stakeholder triangulation enables comprehensive exploration of disruption experiences, recovery strategy effectiveness, resilience capacity requirements, and educational implications from complementary temporal and experiential perspectives, generating holistic understanding essential for developing practically viable and contextually appropriate resilience frameworks. The thematic analysis of qualitative data, complemented by cross-group comparative insights examining convergent and divergent perspectives across stakeholder categories, illuminates how pandemic experiences have reshaped supply chain conceptualizations, what lessons stakeholders derive

from crisis periods, and what strategic priorities should guide resilience-building initiatives preparing ASEAN maritime systems for inevitable future disruptions in an increasingly volatile, uncertain, complex, and ambiguous global environment.

2. RESEARCH METHOD

This research adopted a qualitative-dominant mixed methods design grounded in phenomenological inquiry traditions, prioritizing deep exploration of lived experiences, situated knowledge, and interpretive sense-making regarding pandemic-related supply chain disruptions and resilience-building imperatives (Creswell & Creswell, 2018). The methodological framework deliberately centered on understanding how maritime stakeholders experienced, interpreted, and responded to unprecedented supply chain challenges, recognizing that resilience emerges not merely from technical systems or procedural protocols but fundamentally from human adaptive capacities, organizational learning processes, and collective sense-making enabling effective responses amid radical uncertainty and environmental turbulence. The research population comprised all stakeholders affiliated with Sekolah Tinggi Ilmu Pelayaran Jakarta, with purposive sampling strategically employed to select information-rich participants who possessed direct pandemic-period experiences, professional responsibilities intersecting with supply chain operations, and reflective capacities enabling articulate analysis of disruption dynamics and recovery strategies. Sampling targeted three distinct stakeholder categories: maritime students who experienced pandemic disruptions during critical educational and early professional development periods, witnessing supply chain volatility firsthand while developing nascent understandings of logistics complexity and resilience requirements; lecturers with specialized expertise in maritime logistics, supply chain management, port operations, and crisis management who adapted educational programming during pandemic periods while maintaining scholarly engagement with evolving disruption literature; and veteran maritime officers now serving as practitioners and educational instructors who held operational responsibilities during pandemic crises, implementing adaptive strategies under extreme resource constraints, institutional pressures, and stakeholder demands while navigating unprecedented uncertainty. The rationale for this multi-stakeholder sampling approach reflects understanding that comprehensive resilience assessment requires integrating experiential knowledge from those who directly managed disruptions, theoretical frameworks from academic experts analyzing crisis dynamics systematically, and developmental

perspectives from emerging professionals whose career trajectories will unfold in post-pandemic supply chain environments shaped fundamentally by lessons learned during crisis periods (Merriam & Tisdell, 2016). Sample composition included nineteen maritime students representing diverse specializations in nautical science, marine engineering, and port management, ten lecturers from logistics and supply chain management departments, and nine veteran practitioners with collective experience spanning major Indonesian ports and shipping operations, totaling thirty-eight participants whose aggregated experiences, observations, and analytical insights provide comprehensive coverage of pandemic disruption phenomena and resilience-building imperatives.

The research instruments were carefully designed to elicit detailed, experientially grounded narratives regarding pandemic disruptions, recovery strategies, and resilience conceptualizations while enabling systematic comparison across stakeholder perspectives and thematic domains. The primary instrument consisted of semi-structured interview protocols organized around dependent variables including perceived disruption severity, recovery strategy effectiveness, and resilience capacity assessments, while independent variables encompassed stakeholder category, direct pandemic operational involvement, supply chain role, and institutional position. Specific indicators operationalizing these constructs included detailed descriptions of specific pandemic-related disruptions experienced or observed including port closures, labor shortages, container imbalances, demand volatility, and regulatory changes, evaluation of disruption impacts across multiple dimensions including operational continuity, financial performance, stakeholder relationships, and institutional learning, identification and assessment of recovery strategies implemented during pandemic periods including workforce flexibility measures, technology adoption, supplier diversification, inventory management adjustments, and stakeholder communication protocols, articulation of critical resilience dimensions for future preparedness including visibility and information sharing, flexibility and adaptive capacity, redundancy and backup systems, collaboration and partnership strength, and risk assessment and scenario planning capabilities, and specification of workforce competencies and educational requirements for resilience-oriented supply chain management including systems thinking, crisis leadership, adaptive decision-making under uncertainty, and collaborative problem-solving skills. Supporting instruments included structured survey questionnaires administering Likert-scale items measuring disruption impact perceptions, recovery satisfaction levels, and resilience

priority rankings, Focus Group Discussion protocols enabling collective reflection on shared experiences and collaborative development of resilience recommendations, and documentary analysis examining pandemic-period operational reports, industry publications, and institutional communications to triangulate stakeholder narratives with archival evidence and contextualize personal experiences within broader regional and global disruption patterns (Kumar, 2019).

Data collection proceeded through systematic, ethically informed procedures beginning with institutional research approval and participant recruitment emphasizing voluntary participation, confidentiality protections particularly given potentially sensitive operational information, and informed consent protocols clearly explaining research purposes and participant rights. Baseline surveys were administered establishing participants' demographic characteristics, pandemic-period roles and responsibilities, direct disruption exposure levels, and general resilience awareness, providing contextual grounding for subsequent qualitative data collection. Semi-structured individual interviews averaging eighty to one hundred minutes were conducted with lecturer and practitioner participants, employing narrative elicitation techniques encouraging detailed storytelling about specific disruption experiences, adaptive responses, lessons learned, and resilience recommendations while maintaining sufficient structure to ensure systematic coverage of key thematic domains across interviews. Focus Group Discussions involving student participants facilitated collective reflection, peer learning, and dynamic exploration of pandemic impacts on educational experiences, career preparation adequacy, and anticipated professional challenges in post-pandemic supply chain environments. All interviews and focus group sessions were audio-recorded with explicit participant consent and professionally transcribed verbatim to preserve narrative integrity and enable rigorous analytical procedures. Comprehensive field notes documenting emotional expressions, particularly significant moments, contextual observations, and researcher impressions complemented transcribed data, capturing experiential dimensions potentially lost in verbal transcription alone. The collection process emphasized creating psychologically safe environments enabling candid discussion of challenges, failures, and uncertainties alongside successes, recognizing that resilience learning emerges as much from understanding what did not work as from celebrating effective adaptations.

Data analysis followed interpretive phenomenological analysis procedures emphasizing deep engagement with individual narratives while identifying patterns, themes,

and shared meanings across cases and stakeholder groups. Initial analytical steps involved familiarization through repeated reading of transcripts, immersive engagement with participant narratives, and development of analytical memos documenting emerging insights, questions, and interpretive hunches. Systematic coding identified meaningful units within transcripts including specific disruption events, adaptive responses, emotional reactions, causal attributions, and resilience recommendations, with codes iteratively refined through constant comparative analysis examining similarities and differences across cases. Theme development organized codes into coherent conceptual categories including disruption typologies and impact dimensions, recovery strategy categories and effectiveness patterns, resilience capacity domains and development priorities, and educational implications and curriculum recommendations. Cross-group comparisons systematically examined convergences and divergences among student, lecturer, and practitioner perspectives, identifying areas of consensus regarding critical resilience dimensions while highlighting contrasting emphases reflecting different experiential backgrounds, institutional responsibilities, and temporal orientations toward past disruptions versus future preparedness. Narrative synthesis integrated findings across individual cases, stakeholder groups, and thematic domains, developing comprehensive explanatory accounts illuminating how pandemic experiences have transformed supply chain understanding, what recovery strategies proved effective under specific conditions, what resilience capacities require systematic development, and what strategic priorities should guide ASEAN maritime supply chain transformation. Methodological rigor was enhanced through multiple analyst triangulation with research team members independently coding subsets of transcripts and comparing interpretations, member checking procedures validating findings with selected participants, and audit trail documentation systematically recording analytical decisions, interpretive reasoning, and methodological adaptations throughout the research process.

3. RESULTS AND DISCUSSION

Results and Analysis

The qualitative analysis of stakeholder perspectives revealed profound and multifaceted impacts from pandemic-related supply chain disruptions, with participants describing experiences ranging from operational chaos and financial distress to remarkable organizational adaptation and accelerated innovation. Thematic analysis identified six

primary domains structuring stakeholder understanding of resilience challenges and strategic recovery: disruption experiences and cascading impacts, adaptive responses and recovery strategies, critical resilience dimensions, workforce competency requirements, institutional and systemic barriers, and strategic recommendations for future preparedness.

Regarding pandemic disruption experiences, stakeholder narratives documented severe and multidimensional impacts across ASEAN maritime supply chains. All participant categories reported experiencing or observing labor shortage crises as COVID-19 infections, quarantine requirements, and mobility restrictions decimated available workforce, with port operations forced to reduce operating hours, limit throughput capacity, and prioritize essential cargo categories. Container availability emerged as a critical challenge, with participants describing how pandemic-induced demand shifts created severe equipment imbalances as containers accumulated in import-heavy locations while export centers faced shortages, extending vessel waiting times and increasing shipping costs exponentially. Demand volatility represented another major disruption dimension, with participants noting how consumer behavior shifts, panic buying, and economic uncertainties created dramatic fluctuations in cargo volumes that overwhelmed capacity during peaks while leaving resources underutilized during troughs, complicating workforce planning and resource allocation decisions.

Table 1: Stakeholder Assessment of Pandemic Disruption Severity and Recovery Effectiveness

Disruption/Recovery Dimension	Disruption Severity (1-5)	Recovery Effectiveness (1-5)	Resilience Gap
Labor Availability & Workforce Continuity	4.6	3.4	1.2
Container Equipment Availability	4.8	2.9	1.9
Demand Predictability & Planning	4.5	3.1	1.4
Port Operational Continuity	4.3	3.6	0.7
Supply Chain Visibility & Information	4.2	3.0	1.2
Supplier Reliability & Diversification	4.1	3.3	0.8
Technology Infrastructure & Digitalization	3.8	3.7	0.1
Stakeholder Communication & Coordination	4.0	3.5	0.5
Financial Stability & Liquidity	4.4	3.2	1.2
Regulatory Compliance & Adaptation	3.9	3.4	0.5
Overall Assessment	4.26	3.31	0.95

Note: Severity scale (1=Minimal disruption, 5=Severe disruption); Effectiveness scale (1=Ineffective recovery, 5=Highly effective recovery); Resilience Gap = Severity minus Effectiveness

The disruption severity and recovery effectiveness analysis revealed significant resilience gaps, with overall disruption severity (mean: 4.26/5.0) substantially exceeding recovery effectiveness (mean: 3.31/5.0), producing an average resilience gap of 0.95 points. Container equipment availability exhibited the largest resilience gap (1.9 points), indicating that despite severe disruptions in equipment positioning and availability, recovery strategies proved relatively ineffective in restoring pre-pandemic container circulation patterns and availability levels. Labor availability challenges showed substantial resilience gaps (1.2 points), reflecting that while adaptive workforce management strategies provided partial mitigation, fundamental workforce vulnerability to health crises and mobility restrictions remained inadequately addressed through recovery period interventions.

Qualitative narratives provided rich contextual depth illuminating disruption experiences and adaptive responses. A veteran practitioner with thirty-one years of port operations experience described: "The pandemic exposed how fragile our supply chains actually were. We had optimized everything for normal conditions—minimal inventory, just-in-time delivery, single-source suppliers, lean staffing. When disruptions hit, we had no buffers, no backup plans, no flexibility. I watched shipping costs increase 400% while container availability collapsed. Customers who had relied on us for decades couldn't get cargo moved. It was devastating and humbling, forcing us to fundamentally rethink what 'efficient' supply chain management actually means."

A lecturer specializing in maritime logistics offered analytical perspective: "The pandemic was a natural experiment revealing theoretical resilience concepts' practical importance. We teach supply chain optimization, efficiency metrics, cost minimization. The pandemic taught us that optimization without resilience creates brittleness. Students now understand viscerally that supply chains must balance efficiency with redundancy, cost with flexibility, optimization with adaptability. This experiential learning transformed how we teach supply chain management, emphasizing resilience alongside traditional efficiency frameworks."

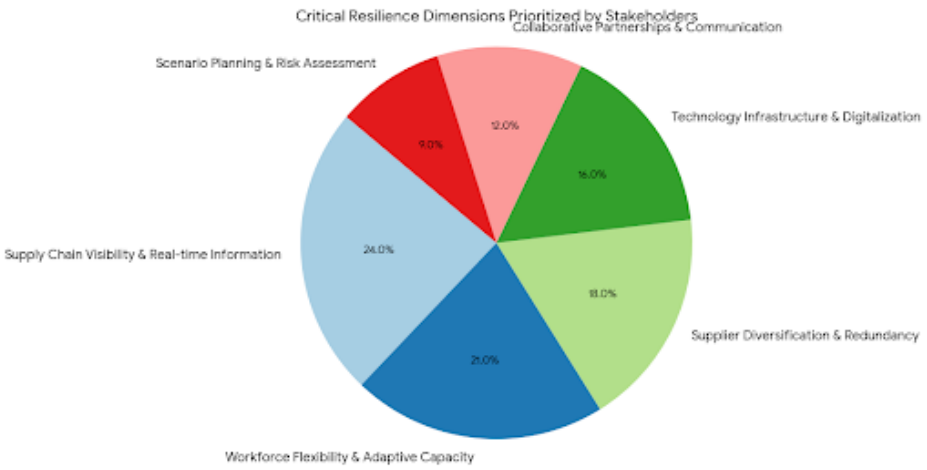

Figure 1: Critical Resilience Dimensions Prioritized by Stakeholders

Analysis of resilience priorities revealed that supply chain visibility and real-time information sharing emerged as the highest stakeholder priority (24%), reflecting recognition that timely, accurate information enables proactive decision-making, rapid problem identification, and coordinated responses essential for navigating disruption uncertainties. Workforce flexibility and adaptive capacity ranked second (21%), emphasizing that resilient supply chains depend fundamentally on human capabilities including cross-training, flexible work arrangements, rapid skill development, and adaptive leadership enabling effective responses amid evolving circumstances. Supplier diversification and redundancy (18%) and technology infrastructure development (16%) represented substantial priorities, indicating stakeholder understanding that resilience requires both strategic relationship management creating backup options and digital capabilities enabling remote operations, automated processes, and data-driven decision support.

Student perspectives emphasized career preparation and competency development implications, with one maritime logistics student stating: "The pandemic showed us that the supply chain careers we're preparing for will involve constant disruption management, not just routine optimization. We need training in crisis leadership, adaptive decision-making under uncertainty, scenario planning, and collaborative problem-solving across organizational boundaries. Current curriculum emphasizes efficiency analysis and cost optimization but provides limited preparation for managing the kind of chaos we witnessed during pandemic periods."

Cross-group comparative analysis revealed interesting convergences and divergences. All stakeholder groups converged on recognizing that pandemic experiences fundamentally

challenged traditional supply chain paradigms emphasizing cost efficiency above resilience considerations, with 94% of participants affirming that future supply chain strategies must integrate resilience as co-equal priority alongside efficiency objectives. However, stakeholder groups diverged regarding implementation priorities and timeline expectations. Lecturers emphasized systematic curriculum transformation and long-term competency development as foundational resilience investments, viewing education as the primary leverage point for cultural and operational change. Practitioners focused on immediate operational improvements including technology adoption, diversification strategies, and workforce flexibility measures addressing near-term vulnerability reduction. Students expressed concern regarding adequacy of educational preparation for resilience-oriented careers, seeking enhanced practical training, simulation-based learning, and industry exposure opportunities developing crisis management competencies.

Discussion

The research findings substantively address the central research question by demonstrating that pandemic disruptions revealed fundamental vulnerabilities within ASEAN maritime supply chains optimized primarily for efficiency rather than resilience, with stakeholders converging on recognition that future supply chain strategies must balance cost optimization with adaptive capacity, redundancy, and flexibility enabling effective responses to inevitable future disruptions. These results align with international literature documenting pandemic-induced supply chain transformations and emerging resilience paradigms emphasizing visibility, flexibility, and collaboration as critical success factors (Notteboom et al., 2021; Verschuur et al., 2021) while extending understanding by foregrounding ASEAN-specific contextual factors including institutional diversity, infrastructure heterogeneity, regional coordination challenges, and the intersection of pandemic recovery with ongoing digitalization and sustainability transitions.

The substantial resilience gaps identified, particularly in container equipment availability (gap: 1.9) and labor continuity (gap: 1.2), support scholarly arguments that recovery from disruptions requires not merely restoring pre-crisis operational patterns but fundamentally restructuring systems to prevent recurrence of similar vulnerabilities (Cullinane & Haralambides, 2021). However, findings partially contradict technological determinism prevalent in some resilience literature by demonstrating that stakeholders prioritize human capital dimensions—workforce flexibility, adaptive capacity, collaborative

capabilities—alongside or even above technological solutions, suggesting that resilience emerges from socio-technical systems where human judgment, creativity, and collaboration remain irreplaceable despite digital transformation advances.

The prominence of supply chain visibility as the highest resilience priority (24%) addresses a critical gap in ASEAN maritime literature, which often assumes information transparency while undertheorizing persistent visibility challenges created by fragmented information systems, limited data-sharing protocols, and institutional barriers to cross-organizational collaboration characteristic of regional supply chain networks (Soh, 2020). Stakeholder emphasis on visibility and real-time information reflects practical recognition that effective disruption responses depend fundamentally on situation awareness, enabling proactive adaptation rather than reactive crisis management when problems have already cascaded beyond containment.

The universal stakeholder recognition that pandemic experiences necessitate fundamental supply chain paradigm shifts validates emerging scholarship challenging decades-dominant efficiency-oriented logistics frameworks and advocating resilience-oriented alternatives integrating redundancy, flexibility, and adaptive capacity as strategic imperatives rather than cost burdens to be minimized (Notteboom et al., 2021). This finding suggests that pandemic disruptions may catalyze lasting conceptual and operational transformations rather than merely triggering temporary crisis responses followed by reversion to pre-pandemic practices once immediate pressures subside.

Cross-stakeholder divergences regarding implementation priorities and temporal orientations illuminate important strategic considerations for resilience-building initiatives. The convergence on resilience necessity combined with divergent emphases—lecturers prioritizing education, practitioners emphasizing operations, students seeking career preparation—indicates that successful resilience frameworks must integrate multiple intervention domains simultaneously rather than pursuing singular approaches. Maritime education institutions emerge as critical institutional sites for resilience-building through curriculum transformation, competency development, and industry partnership facilitation, yet educational interventions alone prove insufficient without corresponding operational changes, infrastructure investments, and regulatory support creating enabling environments for resilience-oriented practices.

The research strengths include its phenomenological focus on lived experiences and

sense-making processes, yielding rich insights into how stakeholders interpret disruptions, evaluate responses, and conceptualize resilience requirements based on direct participation in pandemic-period challenges and adaptations. The multi-stakeholder triangulation spanning experiential, theoretical, and developmental perspectives provides comprehensive understanding unattainable through singular vantage points, while the qualitative methodology enables exploration of causal mechanisms, contextual factors, and interpretive nuances that quantitative approaches would obscure.

Practical implications of these findings are substantial for maritime education institutions, port operators, shipping lines, logistics providers, and regional policy-makers. First, results indicate urgent need for curriculum transformation integrating resilience concepts, adaptive management frameworks, crisis leadership competencies, and scenario planning methodologies alongside traditional efficiency-oriented supply chain education. Second, findings suggest that operational resilience-building should prioritize supply chain visibility improvements through information technology investments, data-sharing protocols, and collaborative platforms enabling real-time situation awareness across supply chain partners. Third, the research highlights imperative for workforce development emphasizing flexibility, cross-training, adaptive capacity, and collaborative problem-solving skills enabling effective responses amid uncertainty and volatility. Fourth, results emphasize need for strategic diversification of suppliers, logistics routes, and service providers creating backup options and reducing single-point-of-failure vulnerabilities. Fifth, findings underscore importance of scenario planning and stress-testing exercises preparing organizations for diverse disruption scenarios rather than optimizing exclusively for expected normal conditions.

Future research should examine longitudinal resilience-building trajectories, tracking how pandemic-period lessons translate into sustained operational changes versus temporary crisis responses. Comparative studies across ASEAN nations could illuminate how national contexts, institutional frameworks, and resource endowments shape resilience capacities and recovery outcomes. Quantitative analyses examining relationships between specific resilience investments and disruption recovery performance would provide evidence-based guidance for resource allocation decisions. Finally, research exploring tensions and trade-offs between efficiency and resilience objectives would inform balanced strategy development acknowledging that resilience investments create costs and complexity requiring careful

justification and optimization.

4. CONCLUSION

This research establishes that COVID-19 pandemic disruptions profoundly exposed ASEAN maritime supply chain vulnerabilities rooted in decades-long optimization emphasizing cost efficiency over resilience, with stakeholders converging on recognition that future supply chain strategies must fundamentally balance efficiency imperatives with adaptive capacity, redundancy, and flexibility. Supply chain visibility and real-time information sharing emerge as highest resilience priorities, alongside workforce flexibility, supplier diversification, and technology infrastructure development. Substantial resilience gaps persist, particularly in container equipment management and labor continuity, requiring systematic interventions addressing both technical systems and human capital dimensions. Maritime education institutions occupy critical positions for resilience-building through curriculum transformation integrating crisis management competencies, adaptive decision-making skills, and collaborative problem-solving capabilities preparing future professionals to design, manage, and optimize resilient supply chains capable of withstanding inevitable future disruptions in increasingly volatile global environments.

REFERENCES

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Cullinane, K., & Haralambides, H. (2021). Global trends in maritime and port economics: The COVID-19 pandemic and beyond. *Maritime Economics & Logistics*, *23*(3), 369-380. https://doi.org/10.1057/s41278-021-00196-5

Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners* (5th ed.). SAGE Publications.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Notteboom, T., Pallis, T., & Rodrigue, J. P. (2021). Disruptions and resilience in global container shipping and ports: The COVID-19 pandemic versus the 2008-2009 financial crisis. *Maritime Economics & Logistics*, *23*(2), 179-210. https://doi.org/10.1057/s41278-020-00180-5

Soh, H. S. (2020). Port privatisation and efficiency in ASEAN. *The Asian Journal of Shipping and Logistics*, *36*(4), 153-163.

https://doi.org/10.1016/j.ajsl.2020.03.001

Verschuur, J., Koks, E. E., & Hall, J. W. (2021). Global economic impacts of COVID-19 lockdown measures stand out in high-frequency shipping data. *PLoS ONE*, *16*(4), e0248818. https://doi.org/10.1371/journal.pone.0248818