

NAVIGATING STRATEGIC ROLES OF NVOCCS IN LCL SHIPPING: A SYSTEMATIC LITERATURE REVIEW.

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Abstract

This study explores the strategic roles of Non-Vessel Operating Common Carriers (NVOCCs) in Less-than-Container Load (LCL) shipping, focusing on the Indonesian maritime logistics sector. Utilizing the PRISMA-guided Systematic Literature Review (SLR) methodology, 25 peer-reviewed articles from the Scopus database were analyzed to identify the critical functions and evolving practices of NVOCCs. The findings highlight the pivotal role NVOCCs play in cargo consolidation, enhancing access to global markets for small and medium-sized enterprises, and improving the overall efficiency of inter-island supply chains. Despite these benefits, the study reveals persistent barriers including regulatory inconsistencies, high logistics costs, and limited technological capacity, particularly for local NVOCCs. It also identifies emerging trends such as digitalization, environmental sustainability, and regulatory reforms that could enhance the strategic positioning of NVOCCs. The study offers valuable insights for policymakers, industry practitioners, and academics by bridging the gap between theoretical literature and operational realities in LCL shipping. The research strengthens Indonesia's maritime logistics ecosystem and supports future innovation in the sector.

Keywords: Non-Vessel Operating Common Carriers, Less-than-Container Load, Maritime Logistics, Systematic Literature Review, Indonesia

INTRODUCTION

The maritime logistics sector has rapidly evolved due to global trade liberalization, fragmented supply chains, and fast-paced technological change (Tijan et al., 2021). NVOCCs (Non-Vessel Operating Common Carriers) have become essential in this shifting landscape, especially in Less-than-Container Load (LCL) shipping, offering cost-effective options for shippers without full container volumes. For countries like Indonesia, with its 17,000 more islands, efficient LCL services are practical and vital for economic inclusion and inter-island connectivity (Pallis et al., 2022; Van Dijk et al., 2015).

NVOCCs help bridge logistics gaps between major ports and underserved regions, enabling MSMEs to participate in global trade. As Indonesia works to modernize its port infrastructure and national logistics ecosystem, understanding how NVOCCs operate and adapt is crucial to strengthening its maritime supply chain (Robinson, 2023; Wolf, 2023).

Despite their growing importance, Indonesia's NVOCC sector faces significant challenges. These include inconsistent regulations, high logistics costs, weak digital infrastructure, and increasing pressure from global players with more resources (Firdiansyah Putra et al., 2023; Iskandar & Arifin, 2023; Pelindo, 2023; The World Bank, 2023). The lack of focused research on LCL-specific strategies also makes it harder to craft effective policies (Bešković & Stojaković, 2019).

This Systematic Literature Review (SLR) addresses that gap by exploring the role of NVOCCs in LCL shipping, with a spotlight in Indonesia. It draws on Scopus-indexed publications to identify

how NVOCCs consolidate cargo, support SMEs, and boost supply chain agility in complex island environments.

Rather than relying on fixed theories, the review extracts practical insights from real-world evidence. It highlights evolving strategies, key barriers, and innovations that shape NVOCC-LCL operations and guides future research, policy, and investment.

The study offers value to logistics providers, policymakers, and supply chain strategists. For NVOCCs, it reveals adaptable service models and digital tools. For regulators, it points to coordination, customs, and port management improvements. And for national planners, it shows how NVOCCs can help meet goals for trade competitiveness and regional integration (Saptati, 2023).

Research Focus

Two key questions guide this SLR:

RQ1: What are the critical roles of NVOCCs in LCL shipping?

RQ2: What trends will shape the future of NVOCCs in LCL shipping, especially in Indonesia?

The review explores NVOCC functions such as cargo consolidation, route planning, and coordination with ports and freight forwarders. It also examines regulatory hurdles, infrastructure gaps, market competition, and technological shifts. Looking ahead, the study examines trends like digital transformation, green logistics, and changes in trade routes, especially how these are emerging in Indonesia's context.

SYSTEMATIC LITERATURE REVIEW

Theoretical background and approach

This study adopts a systematic literature review (SLR) to explore the evolving role of Non-Vessel Operating Common Carriers (NVOCCs) in Less-than-Container Load (LCL) shipping. As noted by Devi et al. (2024) a well-designed SLR compiles and organizes existing knowledge, revealing research gaps and future directions. Following PRISMA guidelines, this review uses tools such as VOS viewer for qualitative analysis and bibliographic mapping to identify key themes in the field.

NVOCCs serve as strategic intermediaries in maritime logistics. Unlike traditional freight forwarders, they function as carriers, purchasing space from shipping lines and reselling it to shippers in smaller volumes. They issue House Bills of Lading (HBL) and often offer value-added services such as cargo consolidation, shipment tracking, and insurance (Robinson, 2023; Wolf, 2023). LCL operations specialize in cargo aggregation, combining shipments from multiple clients into one container, thus improving space utilization and lowering transport costs. This is particularly beneficial for MSMEs entering global trade.

The LCL model is crucial in today's supply chains, enabling cost-effective international shipping for smaller consignments. As Abramova (2020) and Saputra (2020) explain that LCL offers flexibility through shared container usage, but has trade-offs like extended lead times and more complex documentation. These shipments are typically consolidated at Container Freight Stations (CFS) before being loaded for international transport.

By synthesizing this body of research, the SLR supports a clearer understanding of how NVOCCs contribute to cost-effective, flexible, and digitally enabled LCL shipping. These insights help bridge the gap between academic research and practical logistics strategies, informing managerial decision-making and maritime policy.

RESEARCH METHODS

This study employs a Systematic Literature Review (SLR) methodology to investigate the evolving role of Non-Vessel Operating Common Carriers (NVOCCs) in facilitating Less-than- Container Load (LCL) shipping within the maritime logistics industry. SLR is chosen for its rigour and transparency in synthesizing scholarly knowledge across multiple studies. It allows researchers to draw meaningful conclusions from existing literature by systematically collecting, evaluating, and analysing peer-reviewed academic publications (Borrego et al., 2023; Pranckutė, 2021).

The methodology employed follows the approach outlined by Fauzi (as cited in Lestari et al., 2024), which involves four key steps: defining the time frame, selecting the database, selecting the article, and classifying the article.

Time Frame

To ensure the relevance and timeliness of the results, the publication window was not lowered, and the upper limit was set to 2025. Given its relatively limited attention in existing research, no lower date limit was imposed to include all relevant studies on the topic (Aali & Shokraneh, 2021).

Selected Databases

The literature search was conducted using Scopus, a database renowned for its comprehensive coverage and robust citation tracking capabilities (Kumpulainen & Seppänen, 2022). The selected references encompass key developments and emerging perspectives on NVOCCs' influence on efficiency, accessibility, and competitiveness in LCL shipping. The review focuses on uncovering conceptual frameworks, operational approaches, and impact trends that shape the strategic role of NVOCCs in contemporary maritime logistics. Using Scopus ensured access to a diverse set of peer-reviewed journals. This database was selected based on its indexing quality, citation coverage, and relevance for maritime and logistics research. (Kumpulainen & Seppänen, 2022; Pranckutė, 2021).

Search Strategy

A structured multi-phase protocol was developed based on PRISMA guidelines: "LCL" OR [Less* AND than* AND Container* AND Load*] OR "NVOCC" OR [Non* AND Vessel* AND Operating* AND Common* AND Carrier*].

Selecting the article

Articles were retrieved using the search string across Scopus and imported into Zotero for citation management. Once the articles are collected, they are imported into the Covidence application for screening following the PRISMA protocol.

- Screening: Duplicates were removed, followed by title and abstract screening.
- Eligibility: Full-text review based on defined inclusion and exclusion criteria.
- Inclusion: Final selection of studies that met all criteria and were subjected to analysis.

Inclusion and Exclusion Criteria

Table 1 presents the Inclusion and Exclusion Criteria that guided the eligibility assessment. These filters ensured that only high-quality and thematically relevant studies were considered.

Inclusion Criteria	Exclusion Criteria
Peer-reviewed journal and conference articles	Non-peer-reviewed materials (e.g., blogs, opinion pieces)
Articles published in English	Articles in languages other than English
Studies focused on NVOCC and Less than Container Load (LCL) shipping	Studies unrelated to NVOCC or LCL topics
Full-text articles accessible	Abstract-only, inaccessible, or paywalled articles
No restriction on publication year	—
Indexed in Scopus	Not indexed in Scopus
Limited to scholarly journals and conference proceedings	Excludes non-scholarly documents (e.g., book chapters, theses, reports)

Table 1. Inclusion and Exclusion Criteria for Article Selection. Source: Authors' work

Classifying the article

The metadata and key findings of the included studies were extracted into Microsoft Excel. The coding and clustering of themes were further analysed using VOS viewer, a visualization tool for bibliometric and co-word analysis. This allowed identifying common trends, key themes, and influential authors or journals within the NVOCC and LCL shipping research landscape (Devi et al., 2024).

RESULTS AND DISCUSSION

Figure 1 shows the results of the selection process followed by the PRISMA 2020 guidelines. An initial total of 560 records was identified. Following the identification stage, no duplicate was identified by Covidence, resulting in 560 records eligible for title and abstract screening. During the screening phase, 522 studies were excluded due to irrelevance based on the inclusion criteria, leaving 38 studies that were sought for full-text retrieval. Of these, 13 studies were excluded for the following reasons: inappropriate setting ($n = 1$), unrelated subject matter ($n = 4$), unsuitable study design ($n = 5$), and inaccessibility of full-text versions ($n = 3$).

As a result, 25 studies met the inclusion criteria and were incorporated into the final systematic review. At the time of final assessment, no studies were classified as ongoing or awaiting classification.

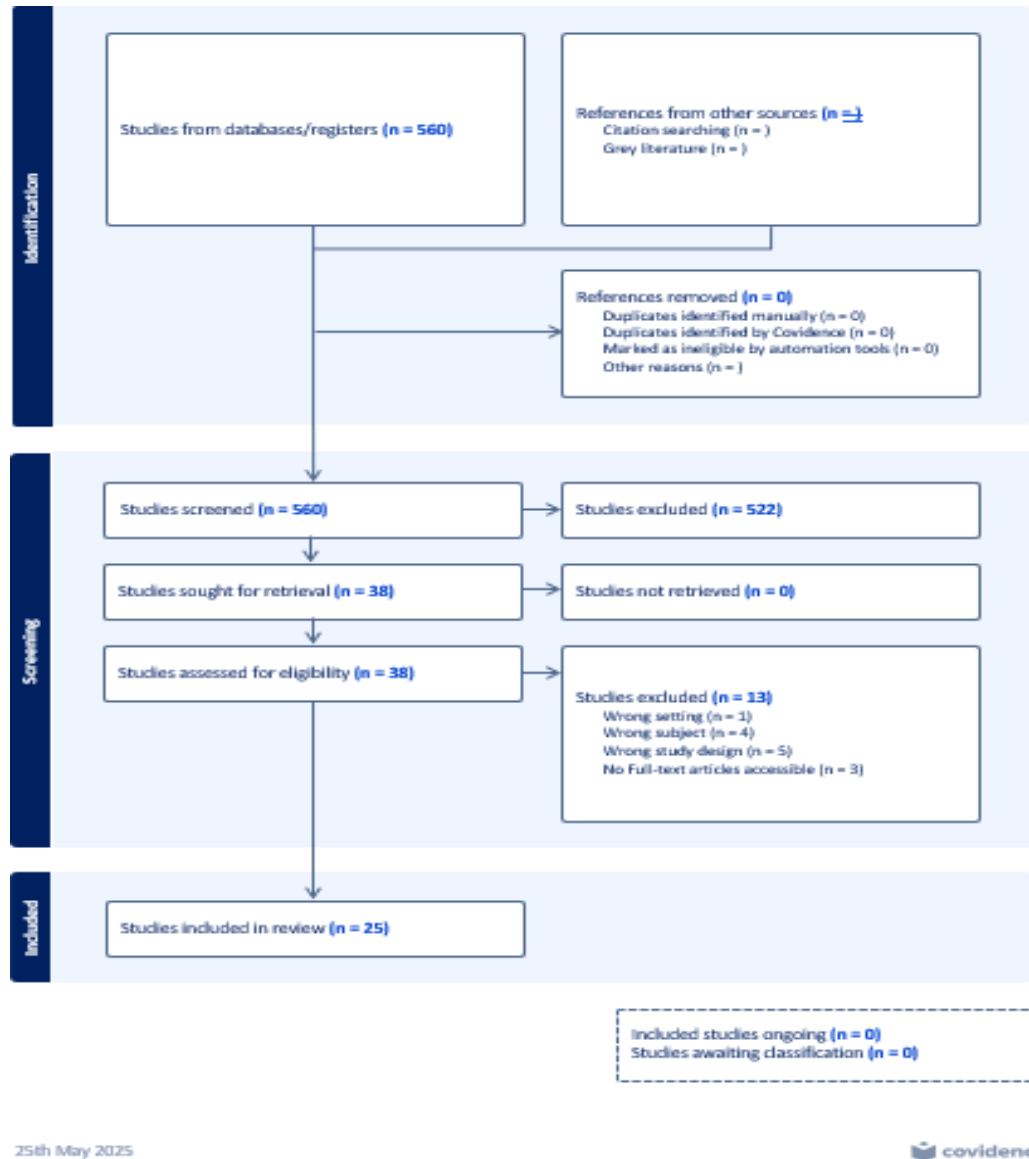


Figure 1. Screening Protocol by Covidence
 Source: Authors' Work

These studies were published across various academic journals and conference proceedings, reflecting the interdisciplinary nature of research on Non-Vessel Operating Common Carriers (NVOCC) and Less-than-Container Load (LCL) logistics. Regarding publication quality as shown in Table 2, 14 studies (56%) appeared in Q1-ranked journals based on Scimago Journal & Country Rank, representing the highest tier of scholarly impact. These included two articles each from the International Journal of Production Economics and Transportation Research Part E: Logistics and Transportation Review, and single contributions from Complex and Intelligent Systems, Flexible Services and Manufacturing Journal, Operational Research, and Journal of Financial Crime. The presence of multiple high-quality sources reinforces the academic credibility and methodological rigour of the included literature.

Beyond the Q1 tier, two studies were published in a Q2 journal, and another two in a Q3 journal, contributing to a broader but still relevant range of publication quality. Meanwhile, six studies (24%) were published in unranked sources; these reflect emerging or applied research that, while potentially valuable, may not yet be indexed in leading bibliometric systems.

Most journals in the dataset contributed only one study, highlighting scholarly discourse's fragmented and nascent nature on NVOCC and LCL logistics. However, the fact that two leading journals each contributed multiple articles—International Journal of Production Economics and Transportation Research Part E—suggests some consolidation of research activity in high-impact publication venues. This distribution underscores the growing interest in logistics optimization, risk management, and supply chain integration within the container shipping sector. The diversity in journal ranking and spread across publication sources reflects the field's multidisciplinary appeal and evolving maturity, signaling opportunities for more focused, high-quality research in the future.

Journal	Rating	Total	%
2011 International Conference on Computer Science and Service System, CSSS 2011 - Proceedings	Unranked	1	4%
Balkan Social Science Review	Q2	1	4%
Brodogradnja	Q1	1	4%
Chemical Engineering Transactions	Q3	1	4%
Complex and Intelligent Systems	Q1	1	4%
Computers and Industrial Engineering	Q1	1	4%
Environment Systems and Decisions	Q2	1	4%
European Journal of Operational Research	Q1	1	4%
Flexible Services and Manufacturing Journal	Q1	1	4%
ICTE 2015 - Proceedings of the 5th International Conference on Transportation Engineering	Unranked	1	4%
International Journal of Production Economics	Q1	2	8%
IOP Conference Series: Earth and Environmental Science	Unranked	1	4%
Journal of Asian Finance, Economics and Business	Unranked	1	4%
Journal of Coastal Research	Unranked	1	4%
Journal of Financial Crime	Q1	1	4%
Journal of Maritime Research	Q4	1	4%
Journal of Marketing Channels	Unranked	1	4%
Maritime Economics and Logistics	Q1	1	4%
Operational Research	Q1	1	4%
Research in Transportation Business and Management	Q1	1	4%
Transportation Journal	Q3	1	4%
Transportation Research Interdisciplinary Perspectives	Q1	1	4%
Transportation Research Part E: Logistics and Transportation Review	Q1	2	8%
Total		25	100%

Table 2. Journal Sources and rating

Source: Authors' work

Table 3 shows the article distribution. Regarding research design, literature is predominantly quantitative, with 20 out of 25 studies (80%) employing statistical, computational, or modelling approaches. Only 5 studies (20%) used qualitative methods, such as case studies or interview-based analysis. This indicates a clear empirical orientation, focusing on measurable outcomes, optimization models, and decision-support frameworks related to NVOCC and LCL operations.

Regarding geographical representation, China is the most frequently studied or involved country, appearing in 7 studies (28%). The USA follows with 5 studies (20%), reflecting its central role in global shipping and logistics systems. Several other studies involved countries such as the Netherlands, India, Indonesia, Italy, Vietnam, and various multi-country analyses (e.g., combinations involving the UK, Belgium, Singapore, the Czech Republic, and Pakistan), each accounting for one study (4%). This broad geographical spread supports the global relevance of the

research area. However, the dominance of China and the USA aligns with their strategic positions in international trade routes and logistics infrastructure.

The journal quality, methodological trends, and geographical diversity confirm the academic depth and international scope of the existing literature on NVOCC and LCL logistics, while also revealing opportunities for more diverse methodological approaches and regional studies in future research. This regional distribution reflects the global relevance of NVOCC and LCL operations and provides a balanced foundation for cross-contextual insights.

Journal	1994-2018	2020	2021	2022	2023	2025	Total	%
Qualitative	5						5	20%
Quantitative	8	3	3	1	2	3	20	80%
Total	13	3	3	1	2	3	25	100%
Belgium; Netherlands	0					1	1	4%
China	4	1		1		1	7	28%
China; Denmark; Singapore	0					1	1	4%
Czech; Malaysia; UK, Netherland, Belgium and Poland	1						1	4%
India	0		1				1	4%
Indonesia	0				1		1	4%
Italy	0		1				1	4%
Macedonia	1						1	4%
Netherlands	0		1				1	4%
Netherlands.	1						1	4%
Pakistan; China	0				1		1	4%
Slovenia; USA; China; UK, Northern Ireland	0	1					1	4%
Taiwan	1						1	4%
USA	5						5	20%
Vietnam	0	1					1	4%
Total	13	3	3	1	2	3	25	100%

Table 3. Articles Distribution

Source: Authors' Work

Bibliographic Mapping

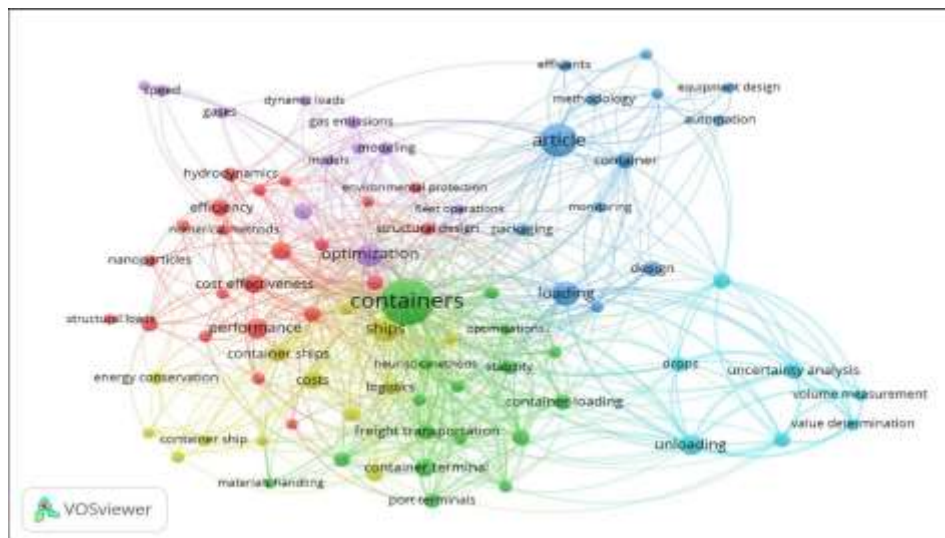


Figure 2. Bibliography mapping for research on NVOCC and LCL

Source: Authors' Work

Figure 2 presents a bibliographic map constructed using VOS viewer based on keyword co-occurrence, applying a threshold of at least one keyword per cluster to ensure a focused yet comprehensive analysis. The green cluster dominates the map and is centered around the keyword “containers,” signifying its fundamental role in container logistics research. Closely connected terms like “ships,” “logistics,” “freight transportation,” “container terminal,” and “port terminals” underscore the cluster’s concentration on physical cargo movement, infrastructure, and terminal operations. This cluster reflects foundational studies that explore how container systems integrate with broader transportation networks and logistics frameworks.

The red cluster is led by “optimization,” which serves as the thematic anchor for literature focused on enhancing system performance. Terms such as “efficiency,” “numerical methods,” “hydrodynamics,” “cost effectiveness,” and “structural load” suggest an emphasis on engineering design, modeling approaches, and resource optimization. This cluster represents efforts to refine technical procedures and system behaviors under various constraints, with practical implications for operational planning and performance improvement.

The blue cluster, dominated by “article” and “loading,” is closely linked to research methodologies and operational practices. The presence of keywords like “automation,” “monitoring,” and “equipment design” indicates a growing interest in technological integration, particularly in automating container handling, improving system reliability, and optimizing equipment functionality within terminals.

The yellow cluster highlights themes of sustainability and economic viability. Keywords such as “container ship,” “energy conservation,” and “costs” reflect studies addressing the trade-offs between environmental impact and operational expenditures. This cluster shows how researchers are exploring ways to make maritime logistics more sustainable without compromising cost efficiency.

The purple cluster includes key terms like “modelling,” “gas emissions,” “dynamic loads,” and “environmental protection,” signaling a strong environmental dimension within the research corpus. This area captures studies aimed at reducing the ecological footprint of container logistics through predictive modeling and emissions analysis.

Finally, the cyan cluster clusters around terms like “unloading,” “uncertainty analysis,” “volume measurement,” and “value determination,” suggesting a research stream focused on risk management, measurement techniques, and operational variability. This reflects interest in improving the accuracy, efficiency, and decision-making processes involved in container handling under uncertain or dynamic conditions.

Overall, the bibliographic mapping reveals a richly interconnected and multi-disciplinary research landscape encompassing operational logistics, technical optimization, environmental sustainability, and digital transformation. This map provides a foundation for deeper exploration in the subsequent literature review, offering insights into how various subfields interrelate within the broader scope of container logistics research.

RQ1: What are the critical roles of NVOCCs in LCL shipping?

In addressing Research Question 1 (RQ1), this section systematically explores the multifaceted responsibilities and contributions of Non-Vessel Operating Common Carriers (NVOCCs) in the global logistics landscape, particularly within Less-than-Container Load (LCL) shipping. Table 4 below categorizes and quantifies the critical roles identified across the literature to provide a clearer picture of their strategic value. These categories reflect the operational strengths of NVOCCs and highlight how their evolving functions align with economic pressures, technological advancement, and sustainability imperatives in modern LCL shipping.

Category	Detailed critical aspects and occurrences	Authors
Cargo Consolidation & Capacity Utilization	Utilization (1), Consolidation (7), Cargo Diversity (2).	(Bedoya-Maya et al., 2025; Geng et al., 2020; Jamrus & Chien, 2016; Malisan et al., 2023; Passas & Jones, 2007; Tushevskaya, 2014; Van Eijs, 1994; Van Fan et al., 2018; Zhou et al., 2025).
Efficiency & Optimization	Technology (2), Optimization (5), Efficiency (7), Cost (1), Strategy (2), Sustainability (1), Integration (1), Decision-making (1), Market (1), Operations (1), Scheduling (1).	(Bedoya-Maya et al., 2025; Clott et al., 2017; Davidson & Leachman, 2012; Jamrus & Chien, 2016; Liu et al., 2015; Passas & Jones, 2007; Rajeswari et al., 2021; Shoukat, 2023; Van Eijs, 1994; Van Fan et al., 2018; Wei et al., 2018; Xiao, 2011; Zhou et al., 2025; Zweers et al., 2021).
Strategic and Operational Adaptability	Eligibility (1), Evaluation/Decision (5), Flexibility (5), Forecasting/Future (4), Integration (5), Inventory Management (2), Legal/Documentation (2), Liability/Risk (6), Location/Service (2), Management (3), Market (5), Modal Shift (2), Multimodal (2), Niche Strategy (1), Operational (7), Order Management (2), Pricing (4), Resilience (3), Resource Allocation (2), Scalability (2), Sharing Strategy (1), Shipment Priority (1), Simplification (1), Tariff/Transparency (2), Two-Sided Market (1), Uncertainty (3).	(Bank et al., 2005; Bedoya-Maya et al., 2025; Bertazzi et al., 2021; Beškovnik & Stojaković, 2019; Clott et al., 2017; Davidson & Leachman, 2012; Geng et al., 2020; Gao et al., 2020; Jamrus & Chien, 2016; Liu et al., 2015; Passas & Jones, 2007; Peng & Wang, 2022; Rajeswari et al., 2021; Shoukat, 2023; Song et al., 2017; Sun et al., 2025; Tushevskaya, 2014; Van Eijs, 1994; Van Fan et al., 2018; Wei et al., 2018; Xiao, 2011; Zhou et al., 2025; Zweers et al., 2021).
Sustainability	Environment (2), Operations (1), Regulation (1), Green/Sustainability (1),	(Bank et al., 2005; Clott, 2001; Malisan et al., 2023; Van Fan et al., 2018)

Table 4. Categorization article

Source: Authors' work

The critical aspects of the role of Non-Vessel Operating Common Carriers (NVOCCs) in Less- than-Container Load (LCL) shipping encompass a range of operational, economic, and strategic functions. One of the most prominent aspects is cargo consolidation and capacity utilization, where NVOCCs play a pivotal role in optimizing container space and consolidating multiple shipments to maximize efficiency (Geng et al., 2020; Van Fan et al., 2018). This function directly reduces shipping costs and improves sustainability by minimizing underutilized capacity. Their strategic decision- making is increasingly influenced by efficiency and optimization technologies, including automation and data-driven tools, which enhance decision accuracy and service delivery (Zweers et al., 2021). NVOCC pushes for digitalization and transparency, which improves visibility across the shipping process and makes operations more efficient (Zhang, 2021). Additionally, their ability to

adapt to regulations and manage risks supports smoother compliance and minimize disruptions, significant in dynamic pricing and uncertain trade conditions (Bešković & Stojaković, 2019; Geng et al., 2020).

Cargo Consolidation and Capacity Utilization

NVOCCs play a central role in LCL shipping by consolidating shipments from multiple customers into full containers, improving space use, and lowering shipping costs. Van Fan et al. (2018) and Jamrus & Chien (2016) emphasize that optimized container loading enhances energy efficiency and reduces emissions. Bedoya-Maya et al. (2025) highlight that smarter consolidation improves coordination across terminals. Meanwhile, Malisan et al. (2023) and Zhou et al. (2025) show how these strategies support supply chain resilience amid disruptions. Geng et al. (2020) and Passas & Jones (2007) further stress that efficient container use drives operational flexibility. Altogether, consolidation strengthens LCL efficiency, sustainability, and accessibility.

Efficiency and Optimization Technologies

Digital technologies are transforming NVOCC operations in LCL shipping by enabling faster responses to disruptions and more efficient planning. Real-time tracking, predictive scheduling, and digital booking platforms reduce delays and enhance customer service (Liu et al., 2015; Zweers et al., 2021). Zhou et al. (2025) and Xiao (2011) describe optimization systems as improving load planning and boosting operational efficiency. Jamrus & Chien (2016) and Van Fan et al. (2018) add that data-driven coordination allows NVOCCs to handle complex cargo flows with greater reliability. Clott et al. (2017) argue that digital integration positions NVOCCs as agile logistics orchestrators in a rapidly evolving LCL landscape.

Strategic and Operational Adaptability

Adaptability is a defining strength of NVOCCs in LCL shipping. In an industry shaped by fluctuating demand, regulatory changes, and digital disruption, NVOCCs must remain flexible in strategy and execution. Xiao (2011) and Wei et al. (2018) emphasize that this agility enables firms to respond quickly to market swings, port congestion, and geopolitical shifts. Bertazzi et al., (2021) and Geng et al. (2020) highlight that adaptable NVOCCs can reconfigure networks, revise service models, and leverage digital platforms to meet changing client needs. Clott et al. (2017) and Rajeswari et al. (2021) noted that adaptability is not reactive but a proactive capability that keeps NVOCCs competitive and resilient in a volatile logistics landscape.

Sustainability

Sustainability is an increasingly vital focus for NVOCCs in LCL shipping. By consolidating smaller shipments into fewer containers, they help reduce fuel consumption, emissions, and environmental impact. Van Fan et al. (2018) emphasize that improved container utilization cuts logistics costs and significantly lowers carbon emissions across supply chains. Clott et al. (2017) and Bank et al. (2005) highlight how route optimization and inland coordination reduce unnecessary mileage and ease congestion around ports. Malisan et al. (2023) further note that NVOCCs contribute to greener freight through more innovative cargo planning and reduced operational waste. Embracing these practices positions NVOCCs to meet rising regulatory standards and lead the shift toward cleaner global logistics.

RQ2: What trends will shape the future of NVOCCs in LCL shipping, especially in Indonesia?

Exploring Research Question 2 (RQ2) reveals that the maritime logistics landscape is profoundly transformed, driven by digitalization, sustainability imperatives, and evolving market expectations.

This section synthesizes the major trends forecasted to influence the future role of NVOCCs in Indonesia's LCL sector. It highlights their expanding strategic functions: from optimizing cargo consolidation and leveraging digital platforms to adopting sustainable practices and integrating multimodal logistics systems. The emphasis is also on how NVOCCs diversify services and collaborate more closely with stakeholders while adapting to regulatory, technological, and environmental changes.

The following table categorizes these trends, based on frequency and academic consensus, to provide a clear framework for understanding how NVOCCs are not only reacting to change but actively shaping the future of LCL logistics in Indonesia.

Category	Detailed factors and occurrences	Authors
Cargo Consolidation & Efficiency	Consolidation (6), Efficiency (6), Cost (3), Service(1), Collaboration (1), Pricing (1).	(Bedoya-Maya et al., 2025; Clott, 2001; Davidson & Leachman, 2012; Giao et al., 2020; Jamrus & Chien, 2016; Malisan et al., 2023; Rajeswari et al., 2021; Shoukat, 2023; Van Eijs, 1994; Van Fan et al., 2018; Wei et al., 2018).
Digital Optimization & Automation	Digitalization (3), Optimization (4), Technology (5), Integration (3)	(BeÅkovnik, 2020; Bertazzi et al., 2021; Clott et al., 2017; Davidson & Leachman, 2012; Geng et al., 2020; Giao et al., 2020; Jamrus & Chien, 2016; Liu et al., 2015; Peng & Wang, 2022; Shoukat, 2023; Van Fan et al., 2018; Xiao, 2011; Zhou et al., 2025)
Environmental Responsibility	Sustainability (4), Uncertainty (1), Efficiency (1), Planning (1).	(Bedoya-Maya et al., 2025; Shoukat, 2023; Song et al., 2017; Van Fan et al., 2018; Zweers et al., 2021).
Service Diversification & Adaptability	Customer-Centricity (3), Regulation (2), Services (1), Pricing (1), Collaboration (1), Flexibility (1), Technology (1), Adaptation (1), Quality (1), Market (2), Scalability (1), Resilience (1).	(Bank et al., 2005; Bedoya-Maya et al., 2025; Bertazzi et al., 2021; Clott, 2001; Geng et al., 2020; Giao et al., 2020; Passas & Jones, 2007; Rajeswari et al., 2021; Shoukat, 2023; Tushevskaya, 2014; Van Eijs, 1994; Xiao, 2011; Zhou et al., 2025)

Table 5. Categorization Article

Source: Author's Work

NVOCCs are taking on more strategic roles in Indonesia's evolving LCL shipping sector, especially in terms of efficiency, sustainability, and digital transformation. Cargo consolidation remains a top priority for NVOCCs, helping reduce congestion and emissions by grouping shipments more efficiently. Malisan et al. (2023) point out that using consolidation centres and optimizing container loads brings economic and environmental benefits.

Digital tools are also transforming operations. With intelligent scheduling and automation, NVOCCs gain real-time insights and can plan more effectively. Zhou et al. (2025) note that these systems replace manual work, making logistics faster and more dependable. Digital collaboration is also rising, with blockchain and cloud systems boosting transparency and coordination (Bedoya- Maya et al., 2025).

Sustainability is also gaining ground. NVOCCs are expected to adopt greener practices, such as low-emission routes and energy-efficient planning. Shoukat (2023) and Van Fan et al. (2018) emphasize the growing need to reduce environmental impact, especially in developing regions.

Finally, offering diverse services—like warehousing, consulting, and flexible transport— helps NVOCCs stay resilient and better meet customer needs (Malisan et al., 2023).

Cargo Consolidation and Efficiency

Cargo consolidation is a critical strategy for boosting efficiency and sustainability in Indonesia's LCL shipping sector. With thousands of islands to serve, NVOCCs enhance freight operations by grouping smaller shipments at key coastal and inland hubs, boosting container utilization and lowering emissions and operating costs (Malisan et al., 2023). Strategic consolidation could shift up to 4 million TEUs from road to short-sea routes, easing urban congestion and improving national freight flows.

Digital consolidation tools further amplify these gains. As Shoukat (2023) and Rajeswari et al. (2021) emphasise that real-time data sharing, predictive planning, and dynamic grouping of shipments based on destination and cargo type enable more responsive, cost-efficient operations. This is especially impactful when paired with collaborative coordination among NVOCCs, shippers, and inland agents.

However, Bedoya-Maya et al. (2025) caution that these digital systems risk limited impact without addressing container underutilization and infrastructure mismatches. Jamrus & Chien (2016) and Wei et al. (2018) note that consolidation must be synchronized with strong port access, inland logistics, and enabling regulations to yield full benefits.

As Van Fan et al. (2018) and Clott et al. (2017) argue that advancing toward a more connected and sustainable less-than-container load (LCL) future in Indonesia necessitates operational transformation and integrated planning, underpinned by data, infrastructure, and policy.

Digital Optimization and Automation

Digital tools and automation are revolutionizing how NVOCCs manage LCL shipping, particularly in complex and fragmented logistics environments like Indonesia. Moving beyond manual processes, these technologies address challenges such as inconsistent scheduling, limited cargo visibility, and port inefficiencies (Peng & Wang, 2022; Zhou et al., 2025).

Zhou et al. (2025) highlights the value of intelligent scheduling and data-driven planning platforms. These platforms allow NVOCCs to respond to shifting demand by determining cargo type, delivery constraints, and transport modes. These tools support operational speed and effective cargo diversity handling—a necessity in today's dynamic LCL networks.

BeÅjkovnik (2020) and Clott et al. (2017) stress the importance of real-time data integration across stakeholders, enabling accurate tracking, timely adjustments, and minimized idle capacity. In turn, Liu et al. (2015) and Shoukat (2023) demonstrate how automation reduces operational bottlenecks, lowers emissions, and supports multimodal coordination in geographically dispersed systems like Indonesia's.

Digitizing booking, invoicing, and documentation enhances transparency, consistency, and customer trust, especially in fragmented markets (Davidson & Leachman, 2012; Giao et al., 2020).

As Xiao (2011) and Jamrus & Chien (2016) note, this digital backbone enables scalable, adaptive logistics systems that align with future supply chain demands.

Ultimately, Van Fan et al. (2018) and Geng et al., (2020) suggest that, as digital optimization is referred to, NVOCCs are agile logistics orchestrators that can modernize operations and increase resilience across Indonesia's archipelagic terrain.

Environmental Responsibility

Environmental responsibility is becoming integral to LCL logistics, particularly in countries like Indonesia, where efficient, sustainable transport is a growing priority. Reducing lifecycle emissions and improving transport efficiency require a coordinated, multimodal approach. Shoukat (2023) identifies inefficiencies in fragmented intermodal systems as a key source of excess emissions, advocating for more unified routing to minimize environmental impact.

Building on this, Song et al. (2017) and Van Fan et al. (2018) emphasize the importance of integrating sustainability and competitiveness through digital tools that manage demand uncertainty and optimize energy use. Their work supports stochastic planning methods to adapt logistics flows to real-time constraints and minimize fuel consumption.

Zweers et al. (2021) highlight the benefits of lifecycle emissions awareness, recommending that environmental performance indicators—such as carbon intensity per shipment—be embedded in logistics planning. Meanwhile, Bedoya-Maya et al. (2025) argue that harmonizing modal choices and container utilization can boost economic and ecological outcomes.

Together, these approaches enable Indonesian NVOCCs to lead the shift toward a low-carbon logistics model, balancing service reliability with long-term environmental sustainability.

Service Diversification and Adaptability

As global supply chains become more volatile and complex, NVOCCs are increasingly expected to deliver diversified, adaptable services, especially in Indonesia's fragmented LCL shipping market. Rather than acting solely as cargo intermediaries, modern NVOCCs now function as logistics partners offering integrated, value-added solutions.

Bedoya-Maya et al. (2025) highlight the importance of customizable services, such as warehousing, customs clearance, cargo insurance, and consultancy, to support smaller shippers navigating regulatory and operational hurdles. Giao et al. (2020) also emphasize customer-focused communication and flexible service models as drivers of long-term client retention.

Adaptability is essential in a landscape marked by disruptions. Rajeswari et al. (2021) note that pandemic-related volatility, natural disasters, and port congestion require agile transport strategies, such as rerouting, modal switching, and revised scheduling. Tools that support risk-based customer segmentation and dynamic response help maintain reliability even during shocks. Digital platforms enhance this agility further. According to Clott (2001) and Zhou et al. (2025) Tech-enabled systems allow NVOCCs to deliver more personalized, scalable services, tailored to regional market needs and customer priorities.

As Bank et al. (2005) argue diversification and adaptability are not add-ons—they are competitive necessities for NVOCCs to thrive in Indonesia's fast-evolving logistics environment.

CONCLUSION

This systematic literature review reveals that Non-Vessel Operating Common Carriers (NVOCCs) are pivotal to the performance and accessibility of Less-than-Container Load (LCL) shipping, especially in complex maritime economies like Indonesia. NVOCCs enable cargo consolidation, increase container utilization, and offer logistical connectivity for small and medium-

sized enterprises (Malisan et al., 2023; Zhou et al., 2025). These roles are vital for expanding trade inclusion and strengthening inter-island commerce.

The findings confirm that digital transformation, network coordination, and multimodal strategies are emerging as key enablers for NVOCC effectiveness in LCL shipping (Bedoya-Maya et al., 2025; Bertazzi et al., 2021). However, systemic barriers such as inconsistent regulatory frameworks, infrastructure limitations, and the dominance of large multinational logistics providers continue to constrain progress (Malisan et al., 2023; Shoukat, 2023). Addressing these challenges requires synchronized policy intervention, investment in port-hinterland integration, and support for capacity building among local logistics players.

Future directions for NVOCC development include embracing green logistics practices, infrastructure development, and enhancing intermodal efficiency to meet global sustainability standards (Shoukat, 2023). The Indonesian case also underscores the need for technological modernization and data-driven coordination to mitigate delays and inefficiencies across the maritime supply chain.

While this study is grounded in Scopus-indexed literature, expanding the data pool to include regional publications and conducting empirical validations would enrich future research. Thus, this review synthesizes global academic insight and a strategic guide for improving NVOCC-led LCL logistics, contributing to a more inclusive, competitive, and sustainable maritime ecosystem.

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