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Service diversification and supply chain integration strategies in optimizing the sea toll and pioneer shipping programs

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ABSTRACT

Indonesia, as the world's largest archipelagic state, faces chronic logistical challenges, particularly in the frontier, Remote, Disadvantaged, and Border Areas . The purpose of this study is to investigate how service diversification and vertical-horizontal integration strategies can be applied to optimize Indonesia's maritime logistics programs. Government-initiated programs such as the Sea Toll and Pioneer Shipping aim to reduce regional disparities by subsidizing maritime logistics. However, the effectiveness of these programs is undermined by systemic fragmentation, low return cargo rates, and weak institutional coordination. This literature review evaluates strategic approaches based on service diversification and supply chain integration, drawing from theoretical frameworks including Ansoff's Matrix, Porter's Value Chain, Institutional Theory, and the Resource-Based View. By synthesizing recent international studies, this article presents a comprehensive strategy to enhance program impact and support inclusive, efficient maritime connectivity in Indonesia. The findings highlight the importance of integrating digital logistics systems, expanding multimodal service access (such as LCL and reefer logistics), and aligning institutional coordination across stakeholders. These strategies reduce cost disparities and strengthen logistics performance in underserved maritime regions.

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1. INTRODUCTION

Indonesia, as the largest archipelagic country in the world, continues to face complex logistical challenges in distributing goods evenly across its territory. One of the most pressing problems remains the high cost of logistics and unequal access to goods between the developed regions of western Indonesia and the remote, frontier, outermost, and underdeveloped regions . The price disparity of essential goods—such as chili, rice, cooking oil, and eggs—can reach over 400% between eastern provinces like Maluku or Papua and cities like Surabaya (Kementerian Perdagangan Republik Indonesia, 2023). The main cause of this price imbalance is high logistics costs. Distribution of goods to the

frontier, remote, underdeveloped, and outermost regions areas requires long and complex sea and land routes, with minimal intermodal synergies and limited infrastructure such as loading and unloading ports, storage warehouses, and local distribution fleets.

In response, the Indonesian government, through the Ministry of Transportation, launched the Sea Toll Program and Pioneer Shipping. These subsidy-based maritime transportation programs aim to reduce logistical costs and ensure price stability in frontier, remote, underdeveloped, and outermost regions areas. Despite significant increases in budget allocations and route expansions from 2020 to 2024, core problems persist: system fragmentation, low backhaul cargo loads, and institutional coordination gaps . In addition, even these subsidy programs have not been able to fully reduce the price of goods in the frontier, remote, underdeveloped, and outermost regions areas because they are not accompanied by strengthening downstream logistics and intermodal integration. As a result, although the goods have arrived at the port of destination, the cost of transportation from the port to the villages and local markets remains high, which ultimately continues to burden the final price of goods. System fragmentation is particularly evident in the lack of integration between logistics platforms like SITOLAUT and Indonesia National Single Window (INSW). Furthermore, the synchronization between Sea Toll routes and Pioneer Shipping lines remains inadequate. Coordination failures also exist between central and local governments, port authorities, and logistic players.

This price inequality not only impacts inequality of access to the economy but also has the potential to deepen social and developmental disparities between regions and the development gap between regions. People in frontier, remote, underdeveloped, and outermost regions areas have to spend cost more for the same goods, which can reduce purchasing power and slow down local economic growth. By looking at these conditions, it is clear that the main problem in the inequality in the price of goods in the frontier, remote, underdeveloped, and outermost regions areas is not just an issue of distribution of goods, but a strategic issue of national logistics, but a strategic national logistics issue. Interventions that are not only subsidies, but also strategic planning based on the diversification of logistics services, the integration of shipping and port systems, the logistics services, integration of shipping and port systems, and optimization of public transportation institutions.

According to international literature as stated by (Meškauskienė et al., 2019) in the Journal of Transport Geography, states that Smart sea initiatives that leverage modern technology for creation of public value are driven by governments, and typically require solid investment, strategic alignment to national policy, and smart government and Smart sea requires active cross-sectoral knowledge synthesis and citizen involvement. So in this case the success of pioneer shipping in island countries depends on government intervention with cross-sectoral integration, including local community empowerment and digitalization of small ports. Research by (Rodrigue & Notteboom, 2022) in Transport Geography Review confirms that such cross-sectoral and institutional integration is crucial in island nations, where access to logistics relies heavily on coordination efficiency, not just physical infrastructure. The study states that vertical integration lowers logistics costs by up to 20% in island regions, while horizontal integration improves reverse-load efficiency and expands service networks between regions. Research by (Monios & Wilmsmeier, 2020) confirms that in the context of developing countries, the failure of intermodal integration and institutional integration is often due more to institutional fragmentation rather than physical infrastructure limitations. They emphasize the importance of shared platforms across ministries and strengthening of the shared governance framework for sea, land, and digital logistics modes to work synergistically.

In facing the complexity of maritime logistics challenges in Indonesia, a strategic approach based on service diversification is increasingly important. Service diversification

includes the development of new operational models, expansion of cargo types, digitization of information systems, and opening market access for small actors, to ensure the effectiveness and inclusiveness of the Sea Toll and Pioneer Sea Transportation programs. Currently, subsidized logistics services are still dominated by one-way transportation of basic necessities and building materials, with a fixed and scheduled service character (liner). This model has not addressed the diverse needs in the frontier, remote, underdeveloped, and outermost regions areas, including the logistics of perishable local products, micro-logistics services for MSMEs, and small-scale distribution of goods that cannot fill a full container. Therefore, diversification is needed in five aspects: (i) digital diversification: strengthening the SITOLAUT system so that it not only records routes and vessel status, but also becomes a dynamic platform that allows integration with pioneer systems, SSm Carriers, and open APIs for private and regional logistics actors. (ii) Load diversification: transportation of agricultural and fishery products from the regions requires reefer containers, shipping schedules that take into account the shelf life of goods, and cold storage at small ports (Monios & Wilmsmeier, 2020). Currently, there are not many subsidized routes that support this type of cargo. (iii) Diversification of ship functions and routes: subsidized vessels can function as multifunctional logistics vessels, for example for emergency relief or cross-sector distribution of goods. However, it should be noted that due to the fixed and scheduled nature of subsidized routes, flexibility can only be achieved through frequency adjustments, fleet rotation, and the use of real-time data, not free-route changes. (iv) Diversification of port services: small ports in frontier, remote, underdeveloped, and outermost regions areas generally do not have professional stevedoring services, micro-warehouses, or digital systems. By developing port-to-village logistics services, the system can involve local cooperatives and village logistics centers as distribution nodes. (v) Diversify Access Schemes (LCL): Currently, the Sea Toll is still based on FCL (Full Container Load) which can only be accessed by large players. In fact, the majority of local logistics actors are only able to ship on a small scale. Therefore, LCL (Less-than-Container Load) services are very important to create inclusivity.

According to (Barros et al., 2020) *"Adding a new highway to an existing portfolio of concessions can result in gains of efficiency, particularly with regards to operating and maintenance costs."* In the context of maritime logistics, the same principle applies. When shipping operators or ports add new service routes or expand their geographical coverage, they are essentially diversifying services.

Diversification in maritime logistics, particularly through intermodal strategies, significantly enhances supply chain resilience against external disruptions. (Feo-Valero et al., 2024) emphasize that using various transport modes—sea, land, and air—reduces dependency on a single distribution route and minimizes operational bottlenecks. This strategy not only broadens logistic access but also strengthens the system's ability to respond flexibly to crises or sudden demand surges. On the other hand, maritime logistics integration—especially in institutional and macroeconomic dimensions as measured by the Transport Resilience Index (TRI)—enables synergy among actors: government, ports, logistics operators, and the private sector. It improves information efficiency, cargo visibility, and coordination in decision-making. The combination of transport-mode diversification and institutional integration makes supply chains more adaptive and globally competitive.

(Cao et al., 2019) show that diversification of maritime logistics services—via segmentation into transport, warehousing, agency, and advanced services—produces spatial distribution patterns that vary by port level (global, regional, or general). Advanced services such as insurance, arbitration, and consultancy tend to cluster in global hub ports like Shanghai, while core services such as transport and warehousing are more distributed across regional and local ports.

In the context of an archipelagic state like Indonesia, integration of maritime logistics systems plays a crucial role in addressing inequality in access across remote and outermost regions. (Amin et al., 2024) note that integrated maritime logistics systems provide a comparative advantage in delivering goods and services to remote islands, ultimately supporting local economic development and increasing regional revenue. Furthermore, this integration must be accompanied by service diversification—such as establishing new logistics centers near smaller islands, expanding intermodal networks, and digitizing port services. This diversification aims to enhance distribution capacity and increase cargo throughput from and to remote islands, which often suffer from cargo imbalance. Integration and diversification are complementary: institutional and port-system integration reduces information fragmentation and transaction costs, while diversification of routes and service types enhances efficiency and adaptability in responding to geographic challenges and market fluctuations.

(Jin et al., 2013) stress the importance of building an integrated framework in transport systems that combines interdependent decisions such as routing, cargo allocation, and crew assignment. In maritime logistics, a similar approach is highly relevant to address system fragmentation, unbalanced cargo distribution, and weak coordination between logistics actors and government agencies. Applying integrated optimization principles—like those in railway network planning—can make maritime logistics systems more efficient. This includes integration between main shipping lines, feeder services, and simultaneous management of crew and logistics terminals. Such a concept can serve as a foundation for developing a more resilient and adaptive Indonesian maritime logistics system, especially in enhancing connectivity for frontier, remote, underdeveloped, and outermost regions regions.

(Lambrou et al., 2019) emphasize that digital transformation in the shipping industry is built on three core pillars: digital technologies (e.g., IoT, blockchain, AI), digital solutions (e.g., smart shipping systems), and digital business models. These pillars form an integrated framework that connects physical and digital logistics processes in global maritime systems. This suggests that integration in maritime logistics services now goes beyond physical port connectivity—it includes information systems, business processes, and real-time data-driven decision-making. Technologies such as IoT enable live cargo tracking, while blockchain ensures transactional transparency and accountability among logistics actors. Simultaneously, service diversification takes form in expanding shipping companies' roles—from freight transportation to value-added services like predictive maintenance, AI-based route planning, and smart port integration.

(Nuraeny, 2024) explain that integrating the Sea Toll Program with the national logistics system has accelerated distribution, reduced logistics costs by up to 20%, and expanded market access in remote coastal areas like Sorong. However, challenges such as limited port infrastructure and lack of inter-agency coordination continue to hinder full program effectiveness. The Sea Toll, as Indonesia's flagship maritime connectivity initiative, contributes significantly to reducing logistics costs and boosting distribution volumes. Yet these gains are maximized only when port systems, logistics operators, and inland distribution channels are also connected. Meanwhile, diversified logistics services—such as port-to-door, door-to-port, and door-to-door models—are vital in tailoring distribution strategies to the geographic and commodity characteristics of archipelagic regions. Integrating infrastructure with service diversification can make Indonesia's maritime logistics system more responsive, inclusive, and sustainable.

(Parola et al., 2015) confirm that related diversification and vertical integration strategies play a vital role in improving the financial performance of maritime logistics firms. Related diversification allows companies to leverage existing capabilities and assets, reducing market risks and creating new revenue streams. This strategy also generates intra-business synergies and cost efficiencies through shared infrastructure

and distribution networks. Meanwhile, vertical integration—such as acquiring port terminals or inland transport services—gives shipping firms end-to-end control over logistics, improving efficiency and customer loyalty. In Indonesia's context, this approach can strengthen connectivity between small and major ports and develop seamless multimodal logistics services across islands.

In their study, (Yuen & Thai, 2017) reveal that diversification strategies—via expansion into terminal services, inland distribution, and warehousing—help maritime firms mitigate revenue volatility caused by fluctuating freight rates. These strategies expand service coverage and create added value beyond sea transport. However, their success heavily depends on effective supply chain integration (SCI), which includes coordination of information, operations, and relationships among maritime logistics stakeholders. The study identifies five key barriers to integration: (1) lack of trust and commitment, (2) resistance to change, (3) strategic misalignment, (4) limited resources, and (5) poor performance measurement systems. Thus, building a responsive and efficient Indonesian maritime logistics system requires synergy between service diversification and the integration of institutions, technologies, and business processes.

In the context of Indonesia as an archipelagic country, maritime logistics integration cannot stop at the port level. A seamless system is required between seaports, distribution centers, and subsequent transport modes (feeders) such as land and air transportation to ensure that goods reach the deepest and most remote regions. On the other hand, service diversification—including the use of pioneer aircraft, small vessels, and multimodal distribution systems—is an adaptive strategy to address the geographical variations and specific logistics needs of each area. (Benned et al., 2020) emphasize the importance of developing integrated routes, standardized port infrastructure, and digitalized processes as part of the national strategy to promote economic equity and reduce price disparities across regions. To formulate these strategies effectively, it is essential to understand how the unique geographic and socio-economic characteristics of each frontier, remote, underdeveloped, and outermost region shape their distinct logistics demands. These regions vary widely in topography, infrastructure readiness, market accessibility, and community resilience, leading to a diverse set of logistical requirements that cannot be addressed by a uniform solution. Therefore, understanding these disparities is critical in designing inclusive logistics models that are both efficient and equitable.

This introduction builds on relevant research and identifies novelty in the Indonesian context: unlike other studies, this paper focuses on the synergistic role of diversified logistics services (LCL, reefer containers, SITOLAUT expansion) and multi-level institutional integration in achieving sustainable maritime distribution in archipelagic settings (Saragih, 2020). This literature review explicitly aims to identify how service diversification and vertical-horizontal integration strategies can be aligned with the logistical needs of frontier, remote, underdeveloped, and outermost regions in Indonesia, to enhance the effectiveness of national maritime logistics programs.

2. RESEARCH METHOD

This research follows a structured literature review methodology based on the thematic synthesis approach. The objective is to investigate how service diversification and vertical-horizontal integration strategies can be applied to optimize Indonesia's maritime logistics programs—Sea Toll and Pioneer Shipping—particularly in remote frontier, remote, underdeveloped, and outermost regions areas. The research is organized chronologically as follows: Step 1: Identification of strategic logistics problems in the Indonesian maritime context through secondary data analysis (Cronje, 2020). Step 2: Mapping of theories relevant to strategic and integrated logistics such as Ansoff's Matrix, Porter's Value Chain, Institutional Theory, and RBV. Step 3: Systematic literature search

and selection of 10 international peer-reviewed articles between 2020–2024. Step 4: Thematic analysis using indicators such as system fragmentation, backhaul inefficiency, LCL accessibility, and SITOLAUT platform performance. Step 5: Synthesis of findings, research gap identification, and formulation of conceptual strategy.

Figure 1. Chronological flow of literature-based research method

The selection of literature is based on relevance to the Indonesian context, particularly focused on archipelagic nations, maritime subsidy systems, and digital port platforms. Figure 1 and Table 1 illustrate the research stages and framework.

Table 1. Summary of literature characteristics and methodological roles

No	Researcher	Focus Area	Relevance to This Study
1	Meškauskienė et al., 2019	Active cross sectoral	Gorverment Intervention
2	Monios & Wilmsmeier, 2020	Institutional barriers	Highlights the lack of coordination in Indonesia's maritime logistics
3	Jay Barney, 1991	Resource-Based View	The toretical foundation for asset utilization
4	Cronje, 2020	Research design	Supports structured review flow
5	Fryer et al., 2020	Multi-method research	Supports triangulation approach
6	Guerrero et al., 2021	Port connectivity	Insight into frontier, remote, underdeveloped, and outermost regions maritime challenges
7	Palu & Hilmola, 2023	Route optimization	Basis for evaluating Sea Toll routes
8	Choi et al., 2020	Public-private logistics	Relevant to collaborative governance
9	M-Oliveira et al., 2023	Interoperable logistics systems	Supports SITOLAUT–NLE framework
10	Porter, 1985	Value Chain	Framework for logistics process analysis
11	Rodrigue & Notteboom 2022	Transport geography	Comparative study for archipelagic states
12	Saragih & Novimariono 2020	Experimental methodology	Basis for innovative model development
13	Dinh et al., 2024	Smart port logistics	Relevant to SITOLAUT system enhancement
14	Van der Giesen et al., 2020	Technology application critique	Framework for assessing logistics tech
15	Wilmsmeier et al., 2021	Cold chain logistics	Supports diversification strategy
16	Zhang et al., 2021	Data-driven subsidy model	Proposed model for route optimization
17	Barros et al. 2020	Service expansion and infrastructure efficiency	Supports diversification of shipping routes to improve operational efficiency
18	Feo-Valero et al. 2024	Intermodal diversification and resilience	Highlights role of multimodal logistics in reducing supply chain risk
19	Cao et al. 2019	Spatial distribution of maritime services	Explains service segmentation based on port hierarchy, relevant for strategic planning
20	Amin et al. 2024	Integrated logistics for remote areas	Supports integration in frontier, remote, underdeveloped, and outermost regions areas to reduce cargo imbalance and boost local economies
21	Jin et al. 2013	Network optimization and integrated planning	Informs joint planning of shipping lines, terminals, and human resources
22	Lambrou et al.	Digital logistics and	Strengthens the digital integration and

	2019	service evolution	value-added service diversification
23	Nuraeny, 2024	Sea toll logistics integration	Supports infrastructure-service integration to lower costs and expand access
24	Parola et al. 2015	Corporate strategy and financial performance	Advocates for related diversification and vertical integration for competitiveness
25	Yuen & Thai, 2017	Supply chain barriers and integration	Outlines key enablers and challenges of service integration
26	Benned et al. 2020	Multimodal integration for frontier, remote, underdeveloped, and outermost regions	Stresses importance of end-to-end connectivity and multimodal services in archipelagic regions

Literature was selected based on its relevance to the Indonesian context, with a specific focus on archipelagic countries, maritime subsidy programs, and digital port logistics platforms. The analytical approach employed in this study is thematic synthesis, which enables the categorization of findings into key themes related to logistics integration and service diversification strategies. To ensure credibility and reliability, a set of strict inclusion and exclusion criteria was applied. The inclusion criteria were: (i) articles written in English, (ii) published between 2020 and 2024, (iii) peer-reviewed journal publications, and (iv) directly relevant to maritime logistics in archipelagic settings such as Indonesia. The exclusion criteria included non-academic articles, non-peer-reviewed conference proceedings, and policy documents lacking methodological transparency. A total of 26 articles met these criteria and were selected for in-depth analysis. Each was evaluated based on methodological rigor and its contribution to the theoretical and empirical discourse on logistics integration and service diversification. This careful curation process minimizes bias and reinforces the validity of the thematic synthesis applied in this review. With this approach, the study can ensure that the results of the synthesis not only reflect a diversity of theoretical views but are also based on credible and contextual sources regarding Indonesia's logistics problems.

3. RESULT AND DISCUSSION

The strategic literature on national logistics management, especially in the context of the SITOLAUT program, shows that successful distribution depends not only on physical infrastructure but also on the implementation of diversification and integration strategies. According to the strategic framework proposed by (David & David, 2015), diversification strategy involves expanding the scope of services or products in new directions to create synergies and competitive advantages. In the context of logistics subsidy programs such as SITOLAUT, diversifying logistics services, such as implementing Less than Container Load schemes and responsive routing based on demand, is a strategic step to reach small economic actors like SMEs and cooperatives. This diversification allows subsidy services to meet the actual needs of the community, as well as drive efficiency because the fleet and delivery schedules are adjusted to local demand, not just following a fixed pattern.

According to the theory of David & David, there are three types of integration: forward integration, backward integration, and horizontal integration. Forward integration means strengthening relationships with consumers, backward integration means controlling input providers or early partners, and horizontal integration means collaborating or merging with similar parties in the same value chain. In the context of Indonesia's maritime logistics, vertical integration occurs between the central government and shipping operators to manage the distribution of goods to remote areas. While horizontal integration is seen in the collaboration between ministries, such as the Ministry of Transportation, the Ministry of Trade, and national logistics regulatory bodies. The integration of digital systems such as SITOLAUT, SIPENCAR, and INSW is a concrete

manifestation of technology-based horizontal integration, which aims to improve interoperability and reduce duplication of administrative processes.

Analysis based on David & David theory shows that the application of diversification and integration strategies in Indonesia's maritime logistics policies is highly relevant to creating competitive advantages and improving national distribution performance. Diversification helps address increasingly complex and geographically dispersed market needs, while integration ensures the entire logistics ecosystem can work synergistically. In the context of Porter's general strategies, also elaborated by David, steps toward service diversification such as LCL and cold chain logistics lead to a differentiation strategy, while institutional integration and logistics digitalization support a cost leadership strategy by contributing to system efficiency. Therefore, the consistent and integrated utilization of strategic approaches becomes an important foundation in strengthening the effectiveness of the Sea Toll program as part of the development of inclusive and sustainable national logistics.

From a Resource-Based View perspective, integration and diversification strategies will provide a sustainable competitive advantage if they are based on internal resources that are valuable, rare, difficult to imitate, and well-organized. In this case, digital logistics systems, human resources with technological capabilities, and access to strategic logistics assets are important resources. If these resources are integrated through effective public-private collaboration and diversified according to local needs, then an organization or country can create an efficient and resilient logistics distribution system. By combining the principles of Fred R. David's strategy and the RBV approach, the Indonesian government can design competitive and sustainable maritime logistics policies in the long term.

4. CONCLUSION

Based on the literature-based investigation and critical discussion, this study concludes that service diversification and logistics integration are essential strategies to improve the effectiveness of Indonesia’s Sea Toll and Pioneer Shipping programs. The fragmented digital and institutional systems observed in current practice require a synergistic approach where SITOLAUT and other platforms are interoperable and accessible, particularly for SMEs in remote areas.

The thematic findings reveal that digital access (such as LCL systems and reefer container implementation), institutional alignment, and data-based route evaluation can significantly reduce disparities in logistics costs. These strategies align with the initial expectations outlined in the Introduction, particularly in terms of increasing system efficiency and regional equality across frontier, remote, underdeveloped, and outermost regions zones.

Looking forward, the research can be developed through empirical testing using pilot projects in selected routes, integrating SITOLAUT with the National Logistics Ecosystem (NLE), and leveraging collaborative models between central government, port authorities, and local cooperatives. Future studies should also investigate real-time logistics data governance, cold chain logistics development, and subsidy impact evaluations using geospatial logistics simulation models.

What institutional strengthening strategies are most effective in overcoming digital fragmentation across logistics platforms such as SITOLAUT, SIPENCAR, and INSW?

How can public-private and local cooperative-based interventions be integrated into the national logistics system without causing role overlap or institutional redundancy?

Limitations And Future Works

The limitations are: (i) Fragmentation in digital and institutional systems that there are still significant gaps in coordination across different logistics platforms, such as

SITOLAUT, SIPENCAR, and INSW. These systems are not yet fully integrated, hindering effective interoperability. (ii) Dependency on subsidy programs While the Sea Toll and Pioneer Shipping programs are designed to reduce logistics costs, they still rely heavily on government subsidies, which are not sufficient to address underlying systemic issues. (iii) Inefficiency in Backhaul Cargo: the logistics programs suffer from low backhaul cargo volumes, which affects the efficiency and cost-effectiveness of shipping routes. (iv) Insufficient coordination: despite improvements in funding and route expansions, institutional coordination between the central and local governments, port authorities, and logistic players remains weak. (v) Infrastructure limitations while the Sea Toll program has expanded, the limited infrastructure, such as underdeveloped small ports, continues to impede effective logistics distribution to remote areas.

Future works consist of : (i) Empirical testing and pilot projects that future research could explore pilot projects along selected routes to integrate SITOLAUT with the National Logistics Ecosystem (NLE), providing a real-world test for these systems. (ii) Development of Real-Time Logistics Data Governance that future studies should investigate the implementation of real-time data governance for better decision-making in maritime logistics, ensuring more effective route optimization and cargo management. (iii) Cold Chain Logistics Expansion that cold chain logistics, particularly for perishable goods, should be further developed, particularly for remote areas. Research into establishing more robust systems for this sector will be critical for sustainable distribution. (iv) Evaluation of Subsidy Impacts that future research should include geospatial simulation models to assess the impact of subsidies on reducing logistics costs and improving regional equity in the frontier, remote, underdeveloped, and outermost regions areas. (v) Strengthening Public-Private Collaboration that exploring collaborative models between government bodies, port authorities, and local cooperatives will be key to improving logistics efficiency and reducing fragmentation in the maritime logistics system. These limitations and future work directions provide a clear roadmap for enhancing Indonesia's maritime logistics system, particularly in ensuring more equitable distribution of goods to remote areas.

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