Designing a national logistics corridor authority under the coordinating ministry for infrastructure: Strengthening disaster resilience for better LPI (through the TSTR and Sitinjau Lauik flyover)

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Abstract. Disaster resilience is essential to strengthening Indonesia's logistics system, given its high vulnerability to natural hazards that disrupt transportation and supply chains. Without resilient infrastructure, efforts to improve the Logistics Performance Index (LPI) remain fragile. This study examines the establishment of a National Logistics Corridor Authority (NLCA) under the Coordinating Ministry for Infrastructure to integrate disaster resilience, sustainable financing through the Multi-Source Value Capture (MSVC) scheme, and strategies for improving LPI. Using a normative-empirical approach with SmartPLS testing, the findings show that governance and disaster resilience have a significant positive impact on LPI, while MSVC, though statistically significant, has a negative effect due to regulatory and coordination barriers. Dynamic systems analysis highlights the importance of cross-sectoral governance to ensure resilience and financing sustainability. Within this framework, PT Hutama Karya (Persero) and Hutama Karya Infrastruktur (HKI) play a central role, ensuring technical delivery and operations, reflecting Sendai Framework principles for a resilient, sustainable, and competitive logistics corridor.

1 Introduction

Indonesia continues to face serious challenges in improving national logistics performance. According to the Logistics Performance Index (LPI), Indonesia still lags behind other ASEAN countries despite massive infrastructure development such as the Trans-Sumatra Toll Road (JTTS) and the Sitinjau Lauik Flyover. In the 2023 LPI, Indonesia dropped to 63rd out of 139 countries, whereas in 2018 it ranked 46th.

The Sendai Framework for Disaster Risk Reduction 2015–2030 emphasizes four global priorities, including strengthening disaster risk governance and investing in resilience. In this context, the development of JTTS and the Sitinjau Lauik Flyover strategic infrastructure located in megathrust-prone areas requires not only sustainable financing but also institutional innovation to ensure disaster-resilient logistics corridors. The proposed establishment of a National Logistics Corridor Authority (NLCA) under the Coordinating Ministry for Infrastructure reflects Sendai's governance priority by creating a dedicated body to orchestrate cross-sectoral and cross-regional corridor development.

At the same time, the use of the Multi-Source Value Capture (MSVC) scheme aligns with Sendai's investment priority by ensuring sustainable financing for resilient infrastructure. Within this framework, PT Hutama Karya (Persero) serves as the JTTS toll road enterprise (BUJT), while Hutama Karya Infrastruktur (HKI) acts as the main contractor and technical operator, including through their joint role as Special Purpose Vehicle (SPV) in the Sitinjau Lauik PPP project. The synergy between the Coordinating Ministry for Infrastructure, NLCA, HK, and HKI ensures that corridor development is financially sustainable, disaster-resilient, and contributes directly to enhancing Indonesia's LPI, thereby translating the global principles of Sendai into a practical national framework [1]. This indicates that infrastructure development alone is not sufficient if institutional capacity and policy integration are not simultaneously strengthened [2].

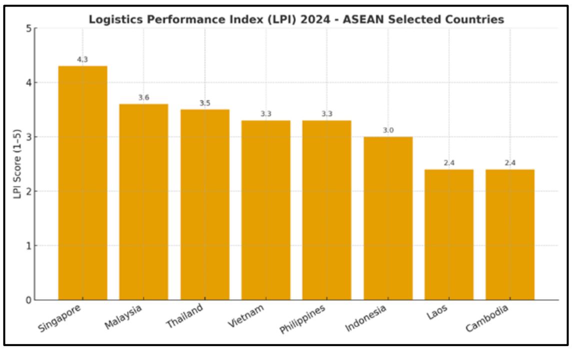

Fig. 1. Comparative data of LPI scores 2024 (Source: World bank – LPI 2024)

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Figure 1 illustrates the comparison of *Logistics Performance Index* (LPI) 2024 rankings and scores in the ASEAN region. Singapore occupies the top global position (ranked 1 out of 139 countries) with a score of 4.3, making it the global benchmark for logistics performance. Malaysia (rank 26; score 3.6) and Thailand (rank 34; score 3.5) demonstrate relatively strong performance, while Vietnam (rank 42; score 3.3) and the Philippines (rank 43; score 3.3) fall within the middle group with consistent improvements. Conversely, Indonesia lags behind at rank 63 with a score of 3.0, lower than both Vietnam and the Philippines, despite significant infrastructure projects such as the Trans-Sumatra Toll Road (JTTS) and the Sitinjau Lauik Flyover. Laos and Cambodia remain at the bottom with a score of 2.4 (rank 115), reflecting the weakest logistics capacity in the region [1].

Designing a disaster-resilient logistics corridor authority for Indonesia requires not only a strong institutional framework under the Coordinating Ministry for Infrastructure but also comparative insights from international practices. Several countries have established dedicated corridor authorities or similar institutions to manage logistics, infrastructure financing, and regional development in an integrated way. By examining how India, the United States, Malaysia, Singapore, Vietnam, China, and Japan organize their corridor governance, mandate core functions, and link them with spatial and land-use planning, Indonesia can identify strategic lessons for shaping its own National Logistics Corridor Authority. Table 1 presents a comparative overview of these institutions [3].

Table. 1. Comparative table: Logistics corridor authorities in several countries

Country	Agency / Authority	Core Mandate	Link to Corridor Development / Land-Use Planning
India	National Industrial Corridor Development Corporation (NICDC)	Development of industrial corridors and industrial townships (nodes) along with supporting infrastructure	Conceptual Development Plans (CDP) and node planning; orchestrating land and industry at corridor nodes (e.g., VCIC) to align growth with multimodal networks
	Dedicated Freight Corridor Corporation of India (DFCCIL)	National SPV for planning, financing, constructing, and operating freight rail corridors (EDFC/WDFC)	Development of freight terminals and logistics hubs; promotes modal shift to rail and connectivity to ports/industries
	National Highways Logistics Management Ltd. (NHLML) – MMLP Bharatmala	Development of Multi-Modal Logistics Parks (MMLPs) along national corridors through PPP	MMLPs located near NH/DFC/ports; directs logistics and industrial clusters to align with corridor functions
United States	Metropolitan Washington Airports Authority (MWAA) – Dulles Corridor	Manages Dulles Toll Road and funds/implements the Dulles Corridor Metrorail Silver Line	Strong interagency coordination; drives TOD and tech corridor development; land use remains with counties but corridor governance centralized at MWAA
	Eastern Transportation Coalition (I-95 Corridor Coalition)	Multi-state coalition for corridor management (TSMO, freight, data sharing)	Aligns cross-state policies and operations; not a land-use authority, but a coordination platform for corridor investments
	Appalachian Regional Commission (ARC) – ADHS	Expansion of Appalachian Development Highway System (ADHS) with FHWA for economic development	Coordinates 13 states; sets corridors and financing; stimulates regional development along ADHS (land-use remains local)
	North Texas Tollway Authority (NTTA)	Develops and operates regional tollway networks (Dallas–Fort Worth)	Coordinates with MPO (NCTCOG); tollway development fosters growth along the corridor (e.g., Dallas North Tollway) though NTTA does not control land use
Malaysia	East Coast Economic Region Development Council (ECERDC)	Regional economic corridor development (ECER) including logistics, infrastructure, and industries	Directs investment, spatial planning, and industrial clusters along the east coast corridor
	Iskandar Regional Development Authority (IRDA)	Development authority for Iskandar Malaysia (Johor)	Oversees land-use planning, investments, and logistics connectivity in the regional corridor
Singapore	Jurong Town Corporation (JTC)	Development of industrial estates and strategic logistics hubs	Manages Jurong Port and Tuas Megaport as global corridor nodes
	Maritime and Port Authority (MPA)	Regulates and manages Singapore's ports as a global logistics hub	Integrates maritime governance with adjacent industrial zones; creates centralized logistics ecosystem
Vietnam	Vietnam Expressway Corporation (VEC)	Development and operation of national expressways as logistics backbones	Supports corridor development within ASEAN Connectivity & Greater Mekong Subregion (GMS) framework
	Vietnam Maritime Administration (Vinamarine)	Oversees national ports and maritime transport	Develops major ports (Hai Phong, Cai Mep–Thi Vai) as logistics corridor nodes
China	National Development and Reform Commission (NDRC) – Belt and Road Initiative (BRI) Corridors	Oversees international land-sea corridors under BRI (Silk Road, Economic Corridors)	Directs inter-provincial/ international corridor planning, infrastructure financing, and industrial zone development
	China Railway Corporation	Development of domestic and international freight rail corridors	Operates China–Europe rail freight services as key international logistics corridors
Japan	MLIT (Ministry of Land, Infrastructure, Transport and Tourism) & Japan Logistics Systems Association (JLSA)	National logistics policy & freight corridor development	MLIT's Comprehensive Logistics Policy includes National Freight Corridors and port-hinterland integration
	Hanshin Expressway Public Corporation & Metropolitan Expressway Co.	Construction and operation of metropolitan tollway corridors (Tokyo, Osaka)	Integrates metropolitan transport and logistics; supports directed urban and regional growth

Source: Compilation from official websites and reports of NICDC, DFCCIL, MWAA, Eastern Transportation Coalition, ARC, NTTA, ECERDC, IRDA, JTC, MPA, VEC, Vinamarine, NDRC, China Railway, MLIT, Hanshin Expressway, 2025.

Table 1 presents a comparative overview of various logistics corridor authorities across countries, each with distinct mandates yet interconnected in managing infrastructure, logistics, and spatial planning. India has established specialized bodies such as NICDC, DFCCIL, and NHLML focusing on industrial corridors, freight rail, and multi-modal logistics parks. The United States applies diverse institutional models, ranging from airport authorities (MWAA) to multi-state coalitions (Eastern Transportation Coalition) and regional development commissions (ARC). Malaysia and Singapore emphasize investment integration and the management of industrial zones and ports, while Vietnam prioritizes expressway expansion and strategic port development through VEC and Vinamarine. Meanwhile, China leverages NDRC and China Railway to coordinate land–sea corridors within the Belt and Road framework, and Japan, through MLIT, JLSA, and metropolitan expressway authorities, highlights national logistics policy and urban transport integration. These varied institutional models provide valuable insights for Indonesia in designing a National Logistics Corridor Authority that is resilient, effective, and globally competitive.

This condition highlights that infrastructure development alone is insufficient without stronger institutions and policy integration. Previous studies emphasize that although Indonesia has improved in customs and infrastructure indicators, it has declined in other areas, reflecting fragmented coordination across ministries and agencies [3]. Therefore, the establishment of a National Logistics Corridor Authority is essential to integrate governance, LPI improvement strategies, and sustainable financing mechanisms. The concept of *value capture* becomes crucial to reduce dependence on the state budget (APBN), as supported by international literature and ADB studies on innovative infrastructure financing [4-6]. Moreover, the Sitinjau Lauik area, located only ±20 km from an active fault, underscores the need to incorporate disaster resilience into the institutional design of national logistics corridors [7].

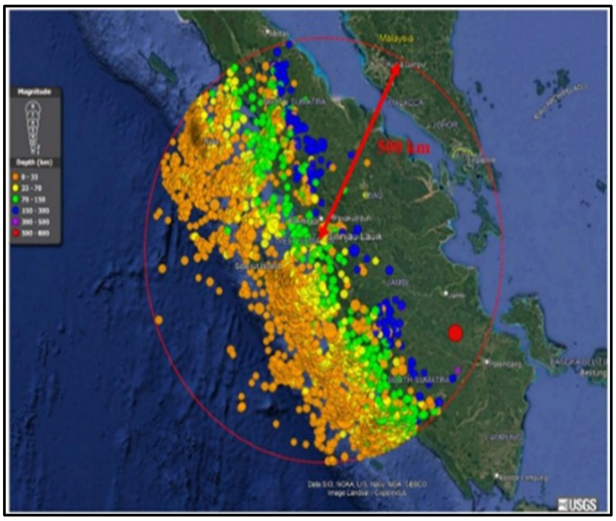

Fig. 2. Seismic history around the project site (Source: HK-HKI KSO, presentation of panorama I JTTS Padang, Jakarta, 2025)

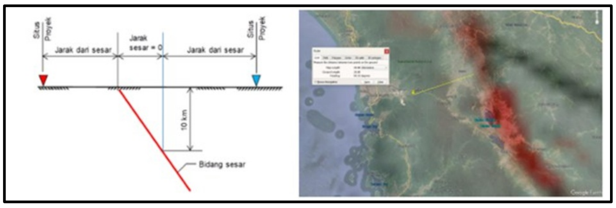

Fig. 3. Fault distance for various project sites (SNI 1726:2019). (Source: HK-HKI KSO, presentation of panorama I JTTS Padang, Jakarta, 2025)

Seismic history data in Sumatra (Fig. 2) indicates that the region has historically been prone to earthquakes of significant intensity, while the fault distance map (Fig. 3) shows that the Sitinjau Lauik Flyover project site is located only about 20 km from an active fault. These two pieces of evidence confirm that the area has a high level of seismic vulnerability; therefore, every infrastructure planning process must integrate disaster mitigation aspects from the outset. This integration is essential not only to ensure functionality and logistical efficiency but also to guarantee structural resilience against potential large-scale seismic events in the future. Infrastructure designed with disaster resilience in mind is expected to remain operational and minimize losses during major earthquakes or extreme tectonic phenomena [8].

From a technical perspective, the Panorama I Sitinjau Lauik Flyover is designed with four main bridges and an inspection route of 2,025 meters [9]. The project layout illustrates the complexity of connectivity that requires cross-agency integration. Its structural design refers to earthquake target spectra with return periods of 100, 1000, and 1500 years [7], showing that engineering has considered disaster mitigation in its physical design. However, institutional arrangements for project governance remain inadequate. Without a strong authority, the integration of disaster mitigation, maintenance, financing, and logistics operations risks becoming fragmented [10].

Financing also poses a major challenge. The Multi Source Financing approach, particularly through the Multi-Sector Value Capture (MSVC) scheme, has been introduced to reduce reliance on state equity (PMN). However, without a solid institutional design capable of executing MSVC effectively, this mechanism risks remaining merely a concept without concrete implementation [11]. This institutional gap emphasizes the urgency of establishing a national authority under the Coordinating Ministry for Infrastructure that can orchestrate technical, mitigative, financing, and operational aspects in a coherent framework.

Accordingly, this study departs from a primary research problem: the absence of a national institutional design capable of integrating disaster resilience, sustainable financing (MSVC), and LPI improvement strategies in the management of JTTS and Sitinjau Lauik. Indonesia's position in the LPI remains behind several ASEAN countries, demonstrating that strategic infrastructure development has not yet translated into greater competitiveness in logistics.

From this problem, the central research question arises: How should the institutional design under the

Coordinating Ministry for Infrastructure be structured to support the establishment of a National Logistics Corridor Authority that integrates disaster resilience, sustainable financing through the MSVC scheme, and strategies for improving Indonesia's LPI, particularly through the management of the Trans-Sumatra Toll Road (JTTS) and the Sitinjau Lauik Flyover? This question is critical as it explores the national policy direction in realizing a logistics corridor that is not only economically efficient but also disaster-resilient.

The objective of this study is to formulate an institutional model of a National Logistics Corridor Authority under the Coordinating Ministry for Infrastructure. This model is expected to orchestrate three major agendas: (1) ensuring sustainable financing through MSVC, (2) developing disaster-resilient logistics corridors, and (3) systematically improving Indonesia's position in the LPI so that it can match or surpass other ASEAN countries.

The hypothesis is that the establishment of a National Logistics Corridor Authority under the Coordinating Ministry for Infrastructure will significantly strengthen the resilience of JTTS and Sitinjau Lauik against disasters, guarantee sustainable infrastructure financing without dependence on PMN, and drive improvements in Indonesia's logistics performance. In this way, Indonesia has the potential to achieve or even surpass the LPI achievements of its ASEAN peers.

The novelty of this research lies in its integration of three key aspects disaster resilience, sustainable financing through MSVC, and LPI enhancement into a single national institutional design. Previous logistics studies in Indonesia have tended to focus on fragmented aspects, such as physical infrastructure or supply chain efficiency. This study, however, proposes a comprehensive institutional approach rooted in disaster resilience and innovative financing. Thus, the research contributes not only conceptually to the literature on logistics governance but also practically by offering a model of a new authority that the government can adopt to strengthen national logistics competitiveness. The presence of a National Logistics Corridor Authority is projected to serve as a strategic solution to bridge policy gaps and as a first step toward establishing a national logistics corridor that is resilient, efficient, and competitive at both regional and global levels.

2 Research methodology

The research methodology serves as the framework for addressing the research problem, achieving the research objectives, and testing the proposed hypotheses. In this study on the formulation of the institutional design of the National Logistics Corridor Authority under the coordination of the Coordinating Ministry for Infrastructure, a qualitative method with a normative-empirical approach was applied, enriched with quantitative analysis using SmartPLS software to test the model of inter-variable relationships.

1. Type and Approach of Research
   This study employs a *policy legal research* and institutional analysis approach, combining normative studies (analysis of regulations, literature, and planning documents) with empirical studies (field data on the geology of Sitinjau Lauik, technical project documents, and Indonesia's logistics performance data). This approach was chosen as the research problem involves cross-sectoral integration: governance law, infrastructure engineering, financing, and disaster management.
2. Object and Subject of Research
   a. The object of research is the institutional design of the National Logistics Corridor Authority, which integrates disaster resilience, sustainable financing (MSVC), and LPI improvement.
   b. The subjects of research include official government documents (Prolegnas, RPJMN, Presidential Regulation on National Logistics System), technical project data from JTTS and Sitinjau Lauik Flyover (HKI Presentation, 2025), and seismic analysis documents (Summary of Sitinjau Lauik Seismic Study).
3. Sources and Data Collection Techniques
   A. Primary data:
      a. Technical analysis results of *Probabilistic Seismic Hazard Analysis* (PSHA) and target earthquake spectra from the Seismic Study.
      b. Infrastructure project data from the Dekom Presentation, including bridge layouts, construction progress, and land acquisition status.
      c. In-depth interviews (planned) with infrastructure policy experts, logistics planners, and officials from the Coordinating Ministry for Infrastructure.
   B. Secondary data:
      a. Academic literature (SINTA-indexed and international journals, 2021–2025) related to logistics, institutions, MSVC, and disaster resilience.
      b. Regulatory documents: Law No. 38/2008 on Roads, Presidential Regulation on the National Logistics System, and SNI 1726:2019 on earthquake resilience.
      c. International reports (World Bank, ADB) on LPI and innovative infrastructure financing.
4. Data Analysis Techniques
   The analysis was carried out through both descriptive-qualitative and statistical-quantitative methods.
   a. Descriptive-qualitative analysis was used to examine the existing conditions of institutions, regulations, and logistics governance.
   b. Technical document analysis (geology, seismicity, infrastructure layout) was used to identify disaster resilience requirements.
   c. SmartPLS (*Partial Least Square–SEM*) was applied to test the relationships among research variables:
      i. X1: Governance/Institutional Framework
      ii. X2: Sustainable Financing (MSVC)
      iii. X3: Disaster Resilience

iv. Y: Logistics Performance (Indonesia's LPI)

The tests included reliability, validity, and hypothesis testing to determine whether the National Logistics Corridor Authority model has a significant impact on improving national logistics performance.

5. Research Model

The analysis results were formulated in the form of a causal loop diagram using Vensim, illustrating the interconnections among financing, disaster resilience, governance, and LPI improvement. This model was then operationalized in SmartPLS to empirically test the inter-variable relationships (Fig. 4).

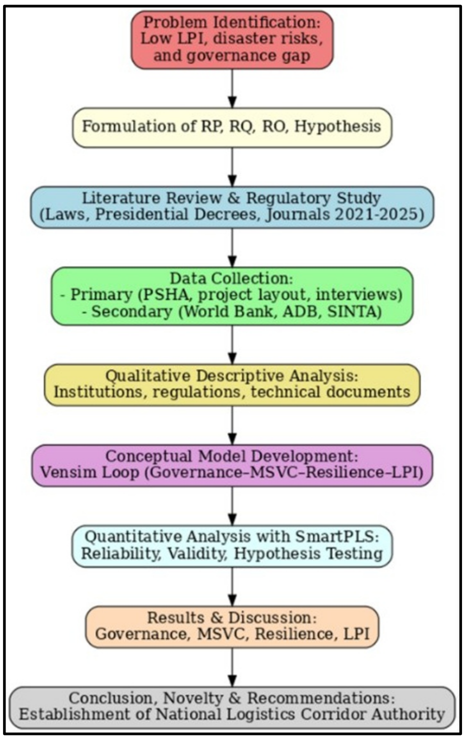

Fig. 4. Research Flowchart
(Source: Processed by Researcher, 2025)

3 Results and discussion

3.1 Research findings

3.1.1 Seismic analysis results

Before presenting Fig. 5, it is important to emphasize that the project site is located in an area of very high tectonic activity, particularly due to its proximity to the Sumatra Fault System. This fault system is one of Indonesia's major seismic sources, extending along the length of Sumatra Island and capable of generating large earthquakes as a result of tectonic plate movements. Seismic analysis indicates that the nearest active segment of the fault lies approximately 13.5 km east of the project site. This condition signifies that the potential earthquake hazard to the infrastructure is highly significant, making resistance to seismic shaking and slope instability a top priority in the project's planning and technical design.

Figure 5 illustrates the regional tectonic setting of the project site in relation to the Sumatra Fault System. The nearest active segment of the fault lies approximately 13.5 km to the east, making it a critical seismic source that must be considered in the design and safety evaluation of the infrastructure. The map also shows the presence of multiple thrust and strike-slip fault lines along the western coast of Sumatra, which indicates a high level of tectonic activity. These conditions highlight the potential for significant seismic events, including strong ground shaking that can affect both structural stability and operational safety of the project.

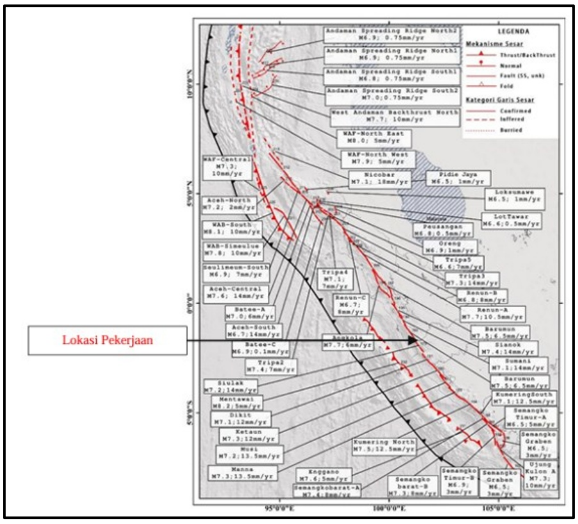

Fig. 5. The Sumatra Fault System is the nearest active fault to the project site, located approximately 13.5 km to the east. (Source: National Earthquake Study Center, 2017)

Given this proximity, the seismic hazard for the site is classified as relatively high. The design of toll roads, bridges, and supporting infrastructure in this region must therefore account for earthquake-resistant standards and slope stability against landslides. This includes structural reinforcements, flexible foundations, and geotechnical monitoring systems. By integrating these considerations, the project can enhance resilience against megathrust and strike-slip events, ensuring that transportation and logistics functions remain reliable even under seismic stress. Thus, seismic risk management becomes a fundamental part of ensuring both the safety of users and the long-term sustainability of the corridor.

3.1.2 Infrastructure analysis results

Based on the 2025 *Dekom Presentation*, the Panorama I Sitinjau Lauik Flyover is designed with four main bridges (135 m, 120 m, 427 m, and 367 m) and an inspection road with a total length of 2,025 m. The project layout (Fig. 6) illustrates the complexity of this strategic project in supporting connectivity between Padang and Solok. The design and construction progress (Fig. 7) show that the foundations and main structures were developed in accordance with earthquake-resistant standards, utilizing high-strength concrete (fc' 30–45 MPa). These specifications underline the role of the flyover as a vital logistics hub in West Sumatra.

Fig. 6. Construction Layout of Panorama I Flyover Development (Sitinjau Lauik I) (Source: HK-HKI KSO, Presentation of Panorama I Sitinjau Lauik Flyover Project, Jakarta, 2025)

Fig. 7. Construction Progress of Panorama I Flyover Development (Sitinjau Lauik I) (Source: HK-HKI KSO, Presentation of Panorama I Sitinjau Lauik Flyover Project, Jakarta, 2025)

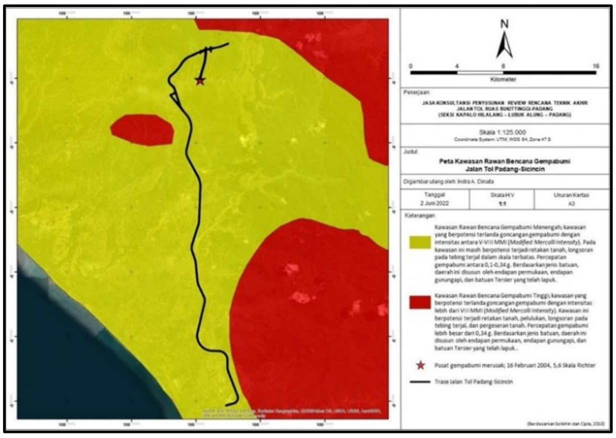

Fig. 8. Map of earthquake hazard-prone areas at the project site (based on Solikhin and Cipta, 2010). Integration of smartpls, system dynamics, and the sendai framework

Before looking at the comparison table, it is important to highlight that the integration of SmartPLS (SEM-PLS), System Dynamics, and the Sendai Framework provides a complementary analytical framework for designing the National Logistics Corridor Authority (NLCA). SmartPLS serves to quantitatively test the relationships among variables such as governance, sustainable financing, disaster resilience, and logistics performance. System Dynamics enriches the analysis by illustrating dynamic interactions in the form of loops, revealing feedback mechanisms that determine system sustainability. Meanwhile, the Sendai Framework offers normative legitimacy and global policy direction on disaster risk reduction, which is especially relevant for logistics corridors located in earthquake-prone areas such as the Trans-Sumatra Toll Road (JTTS) and the Sitinjau Lauik Flyover. By integrating all three, the NLCA can be designed not only on the basis of empirical data and systemic simulations but also aligned with international standards on resilience and risk governance (Fig 8).

Table 2. Integration of smartpls, system dynamics, and the sendai framework

Aspect	SmartPLS (SEM-PLS)	System Dynamics	Sendai Framework
Main Focus	Testing quantitative relationships between variables using the SEM-PLS model. Key variables: Governance (X1), Sustainable Financing/MSVC (X2), Disaster Resilience (X3), and LPI (Y).	Illustrating interactions among variables in the form of loops that influence one another, highlighting positive feedback (reinforcing cycles) and critical leverage points in the system.	Serving as a global guideline for disaster risk reduction (2015–2030) with four priorities: (1) disaster risk governance, (2) investment in resilience, (3) preparedness, and (4) building back better.
Analytical Approach	- Outer model: validity & reliability (loading factor, AVE, CR, Cronbach's Alpha)- Inner model: path coefficient, R², hypothesis testing- Quantitative database (SmartPLS 3.3.3).	- Causal loop diagrams (Vensim)- Loop 1: Governance → MSVC → LPI- Loop 2: Governance → Resilience → LPI- Loop 3: LPI → Investment → MSVC → LPI- Systems analysis basis (structure, feedback, long-term interactions).	- Normative (soft law, not statistical)- Functions as an international framework- Provides legitimacy for policy direction and strategic guidance on disaster risk governance and resilient infrastructure development.
Key Findings	- Governance (X1) → LPI (+0.916; significant)- Resilience (X3) → LPI (+0.546; significant)- MSVC (X2) → LPI (-0.519; significant but negative due to regulatory and coordination barriers)- R² = 0.959 (strong model, explains 95.9% of LPI variance).	- Demonstrates the dynamic interaction of factors: strong governance → effective MSVC → improved LPI → attracts new investment → strengthens MSVC (reinforcing loop)- Governance also embeds resilience into institutional design → disaster-proof infrastructure → higher LPI.	- Confirms that projects like JTTS & Stinjau Laut, located in mega-thrust prone areas, must integrate disaster resilience- Promotes cross-sectoral governance, innovative financing (MSVC), and resilience integration.
Strengths	- Provides empirical, data-driven evidence- Can be replicated, producing statistically significant results- Quantifies the magnitude of effects among variables.	- Offers a comprehensive and visual overview of complex systems- Useful for policy simulation and long-term impact prediction.	- Provides global legitimacy and normative grounding- Acts as a legal/policy umbrella for national strategies- Aligns with SDGs and Indonesia's RPJMJN.
Limitations	- Only explains correlations/effects among variables, does not show long-term dynamics.	- Does not provide statistical significance; more qualitative and systemic in nature.	- Does not yield quantitative results or operational models; serves as a general guideline.
Relevance to NLCA	- Statistically proves that the NLCA model (integrating governance, MSVC, resilience) significantly affects LPI- Serves as empirical evidence that establishing NLCA will have a positive impact.	- Shows NLCA's role as a catalyst connecting governance, resilience, and financing- Positions NLCA as a "loop manager" ensuring positive cycles remain unbroken.	- Acts as NLCA's normative foundation, aligning with global mandates on cross-sectoral governance, sustainable financing, and resilience integration- Provides international legitimacy, strengthening NLCA politically and institutionally.

Source: Data Processing, 2025

Table 2 illustrates how SmartPLS, System Dynamics, and the Sendai Framework complement each other in analyzing and designing the National Logistics Corridor Authority (NLCA). SmartPLS provides strong empirical evidence by statistically proving the relationships among governance, sustainable financing (MSVC), disaster resilience, and logistics performance (LPI). System Dynamics adds a systemic lens, showing how these variables interact over time through reinforcing loops that highlight the importance of governance in sustaining positive cycles. Meanwhile, the Sendai Framework delivers global normative legitimacy, aligning NLCA with international standards on disaster risk governance, resilience, and sustainable infrastructure. Together, these three approaches create a comprehensive foundation: empirical validation (SmartPLS), systemic simulation (System Dynamics), and normative alignment (Sendai), ensuring that NLCA is both evidence-based and internationally recognized.

3.1.3 Sendai framework result

Before presenting the figure on Sendai Framework Result, it is essential to emphasize that the framework serves as a global benchmark for disaster risk reduction, guiding nations in strengthening governance, investing in resilience, enhancing preparedness, and ensuring sustainable recovery (Fig. 9). In the context of the National Logistics Corridor Authority (NLCA), the Sendai Framework highlights the critical importance of embedding disaster resilience into infrastructure planning and financing models, particularly for strategic projects such as the Trans-Sumatra Toll Road and the Sitinjau Lauik Flyover, both located in megathrust-prone regions. The result underscores how aligning NLCA with Sendai's four priorities not only enhances infrastructure reliability but also legitimizes Indonesia's efforts on an international stage, bridging governance, financing, and resilience into a cohesive institutional design.

Fig. 9. Sendai Framework Result (*Source: Data processed using PLS, 202)5*

The establishment of a National Logistics Corridor Authority (NLCA) under the Coordinating Ministry for Infrastructure is a strategic step to strengthen disaster resilience and improve Indonesia's Logistics Performance Index (LPI), particularly through the management of the Trans-Sumatra Toll Road (TSTR) and the Sitinjau Lauik Flyover. By integrating strong governance, sustainable financing through Multi-Source Value Capture (MSVC), and disaster risk reduction principles aligned with the Sendai Framework for Disaster Risk Reduction 2015–2030, especially its four priorities for action (1) understanding disaster risk, (2) strengthening disaster risk governance, (3) investing in disaster risk reduction for resilience, and (4) enhancing disaster preparedness for effective response and "Build Back Better" NLCA can ensure that logistics corridors remain reliable even in megathrust-prone areas. This institutional design not only provides empirical justification through SmartPLS analysis and systemic reinforcement via dynamic feedback loops but also secures normative legitimacy from global frameworks such as the Sendai Framework, positioning Indonesia to achieve both resilience and competitiveness in its logistics system.

3.1.4 Measurement Model Test (Outer Model)

The measurement model test (outer model) was conducted to ensure that the indicators used in this study accurately reflect the latent constructs being developed. The analysis was performed using the Partial Least Squares (PLS) algorithm in SmartPLS software, focusing on three main aspects: convergent validity, discriminant validity, and reliability. Convergent validity was assessed through loading factor values (>0.7) and Average Variance Extracted (AVE >0.5) to confirm that the indicators correlate with the construct being measured, while discriminant validity was evaluated using the Fornell-Larcker Criterion and cross-loading to demonstrate that each construct is clearly distinct from the others. Reliability was tested through Composite Reliability (CR) and Cronbach's Alpha values, both of which must exceed 0.7 to confirm that the measurement instrument is consistent. If all indicators meet these criteria, the outer model can be considered valid and reliable, ensuring that the research model has strong stability and can be further applied to the inner model testing and hypothesis examination (Fig. 10).

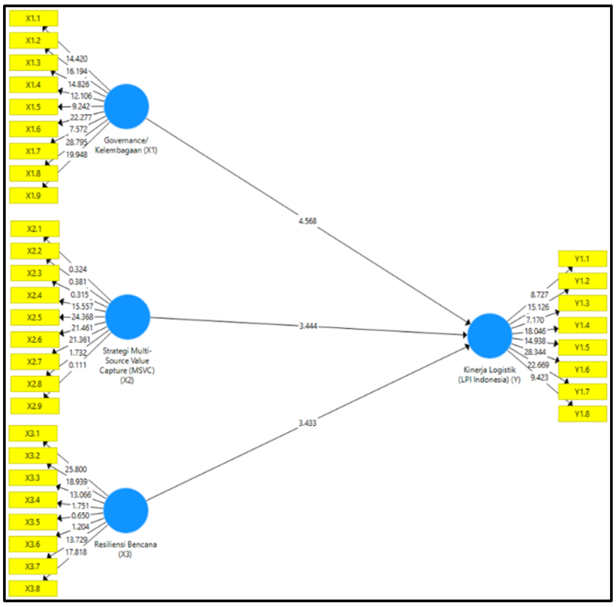

Fig. 10. PLS-SEM Algorithm Model (*Source: Data processed using PLS, 2025)*

3.1.5 Reliability Test

The next stage of instrument testing in this study was the reliability test. Reliability testing was carried out on the research respondents to determine the extent to which the instruments used in data collection were able to provide consistent and dependable results. A reliable instrument will generate stable data even when applied at different times or in similar research contexts.

Reliability testing was conducted using several approaches, namely Cronbach's Alpha, Composite Reliability (CR), rho_A, and Average Variance Extracted (AVE). A construct is considered reliable if the values of Cronbach's Alpha, Composite Reliability, and rho_A are above 0.7, and the AVE value exceeds 0.5 (Hair et al., 2017).

The results of data processing using SmartPLS 3.3.3 showed that all research variables Governance (X1), MSVC – Multi-Sector Value Capture (X2), Resilience (X3), and Logistics Performance Index (LPI) (Y) met the reliability criteria. This was confirmed by the values of Cronbach's Alpha, Composite Reliability, and rho_A for each variable being greater than 0.7, and AVE values exceeding 0.5. Thus, all constructs and indicators used in this study can be considered reliable and suitable for hypothesis testing at the subsequent stage of structural analysis (inner model).

Table 3. Construct reliability

Variable	Cronbach's Alpha	Rho-A	Composite Reability	Average Variance Extracted (ACE)
Governance/ Institutional Framework (Z1)	0,945	0,949	0,953	0,695
Logistics Performance (LPI Indonesia) (Y)	0,938	0,943	0,949	0,700
Disaster Recilience (X3)	0,787	0,922	0,760	0,597
Multi-Source Value Capture (MSVC) Strategy (X2)	0,756	0,884	0,755	0,559

Source: Data processed using PLS, 2025

Based on Table 3, all research variables meet the required reliability criteria, namely Cronbach's Alpha, rho_A, and Composite Reliability values greater than 0.7, as well as Average Variance Extracted (AVE) values above 0.5. The Governance/Institutional Framework variable (X1) shows very high internal consistency with a Cronbach's Alpha of 0.945, CR of 0.953, and AVE of 0.695. The Logistics Performance/LPI variable (Y) is also highly reliable, with a Cronbach's Alpha of 0.938, CR of 0.949, and AVE of 0.700. Meanwhile, Disaster Resilience (X3) and MSVC (X2) also satisfy the criteria, with Cronbach's Alpha values of 0.787 and 0.756 respectively, CR values above 0.75, and AVE values greater than 0.55, although relatively lower compared to X1 and Y. Therefore, it can be concluded that all four constructs Governance, MSVC, Resilience, and LPI are reliable and valid research instruments, making them suitable for use in hypothesis testing at the structural model analysis stage.

3.1.6 Model Test

The R-Square (R^2) test was conducted to determine the extent to which the independent variables explain the dependent variable. The R^2 value indicates the proportion of variance in the dependent construct that can be explained by the independent constructs in the research model.

Table 4. R-Square Test Results (Source: Data processed using PLS, 2025)

Variable	R Square	R Square Adjusted
Logistics Performance (LPI Indonesian) (Y)	0,959	0,955

The results in Table 4 show that the Logistics Performance (LPI Indonesia) variable (Y) has an R Square value of 0.959 and an adjusted R Square of 0.955. This indicates that approximately 95.9% of the variance in LPI can be explained by the independent variables Governance (X1), MSVC (X2), and Disaster Resilience (X3). According to Hair et al. (2017), this value falls into the *strong* category, meaning the research model demonstrates excellent explanatory power and robustness in explaining the dependent construct.

3.1.7 Hypothesis Testing

The data analysis process for all research variables Governance/Institutional Framework (X1), Multi-Sector Value Capture/MSVC Strategy (X2), Disaster Resilience (X3), and Indonesia's Logistics Performance (LPI) (Y) was conducted at the final stage through hypothesis testing. The purpose of hypothesis testing is to define and answer the overall research problems and objectives that were previously established. This test can only be performed once the research model has been declared valid and reliable based on instrument testing (validity and reliability) and model assumption testing (outer and inner model).

Hypothesis testing was carried out by examining the path coefficient values for each causal relationship, including direct effects, indirect effects, and total effects. The statistical hypotheses applied are as follows:

a. $H_0 : \beta = 0 \rightarrow$ No effect exists between variables.

b. $H_a : \beta \neq 0 \rightarrow$ An effect exists between variables.

The testing method used was the t-test through the bootstrapping technique in SmartPLS software, by comparing the significance (sig-t) value against the significance level ($\alpha = 0.05$). The criteria for hypothesis testing are as follows:

a. If sig $t < 0.05$, then H_0 is rejected and H_a is accepted, meaning there is a significant effect between variables.

b. If sig $t > 0.05$, then H_0 is accepted and H_a is rejected, meaning there is no significant effect between variables.

The results of primary data processing using SmartPLS version 3.3.3 produced findings as presented in Table 3. Path Coefficient for Direct Effects. These results will be further elaborated in the following section to analyze the relationships between Governance, MSVC, Resilience, and LPI within the framework of establishing the National Logistics Corridor Authority.

Table 5. Hypothesis Testing

Variable Relationship	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Hypothesis (H)
Governance/Institutional Framework (X1) → Logistics Performance (LPI) (Y)	0,916	0,865	0,2	4,568	0	H1: Effective governance under the National Logistics Corridor Authority strengthens logistics performance (LPI Indonesia).
Disaster Resilience (X3) → Logistics Performance (LPI) (Y)	0,546	0,567	0,159	3,433	0,001	H2: Disaster resilience in logistics corridors (JTTS & Sitinjau Lauik) improves logistics performance (LPI Indonesia).
MSVC Strategy (X2) → Logistics Performance (LPI) (Y)	-0,519	-0,486	0,151	3,444	0,001	H3: The application of sustainable financing strategies through MSVC significantly affects logistics performance (LPI Indonesia), though with challenges.

Source: Data processed using PLS, 2025

Based on the data analysis in Table 5, all research hypotheses show significant results ($p < 0.05$). This confirms that the research model is consistent with the stated research problems and objectives. The explanation is as follows:

1. Direct Effect of Governance/Institutional Framework on Logistics Performance (LPI Indonesia)

The Governance/Institutional Framework variable (X1) has a significant effect on Logistics Performance (Y), with an original sample value of 0.916, t-statistic of 4.568, and p-value of 0.000. Since $p < 0.05$, H_0 is rejected and H_a is accepted. This means that strong and effective governance under the coordination of the National Logistics Corridor Authority can strengthen Indonesia's logistics performance. With integrated management, strategic infrastructures such as the Trans-Sumatra Toll Road (JTTS) and the Sitinjau Lauik Flyover can contribute more significantly to improving the LPI.

2. Direct Effect of Disaster Resilience on Logistics Performance (LPI Indonesia)

The Disaster Resilience variable (X3) also shows a significant positive effect on LPI, with an original sample value of 0.546, t-statistic of 3.433, and p-value of 0.001. Since $p < 0.05$, H_0 is rejected and H_a is accepted. This finding demonstrates that the application of disaster resilience principles in logistics corridor infrastructure improves the reliability of the transportation system, thereby ensuring the continuity of goods distribution even in the event of a disaster.

3. Direct Effect of MSVC Strategy on Logistics Performance (LPI Indonesia)

The MSVC Strategy variable (X2) is also proven to have a significant effect on LPI, with an original sample value of -0.519, t-statistic of 3.444, and p-value of 0.001. Since $p < 0.05$, H_0 is rejected and H_a is accepted. However, the negative direction of the effect indicates that the current implementation of MSVC still faces various challenges. Regulatory barriers, weak inter-agency coordination, and limited private sector participation may undermine its effectiveness, potentially weaken logistics performance if not manage with strong institutional governance. Therefore, while MSVC remains relevant, it requires a policy-bridging authority such as the National Logistics Corridor Authority to ensure it contributes positively to the LPI.

3.1.8 Research Model Results

In designing the National Logistics Corridor Authority under the Coordinating Ministry for Infrastructure, it is crucial to understand how governance, financing, resilience, and investment interact within a dynamic system. Three main loops illustrate the reinforcing mechanisms between these elements. Loop 1 emphasizes the relationship between governance, sustainable financing through Multi-Source Value Capture (MSVC), and improvements in the Logistics Performance Index (LPI), which in turn further strengthens governance. Loop 2 highlights the role of governance in building disaster resilience, which positively impacts LPI and subsequently reinforces governance and institutional capacity. Meanwhile, Loop 3 explains how an improved LPI attracts new investments, which expand the capacity of MSVC, thereby creating a continuous cycle of sustainable financing that further enhances LPI. By mapping these three loops, it becomes evident that the National Logistics Corridor Authority is not merely a regulator but also a catalyst in creating an efficient, disaster-resilient, and sustainable transportation system (Figs 11, 12, and 13).

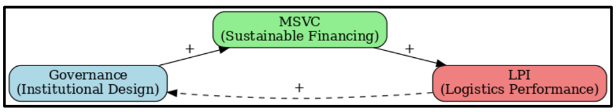

Fig. 11. Governance & MSVC (Source: Processed Data using Vensim, 2025)

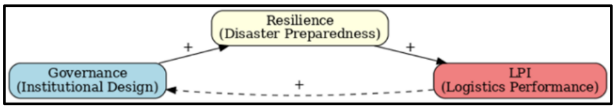

Fig. 12. Governance & Resilience (Source: Processed Data using Vensim, 2025)

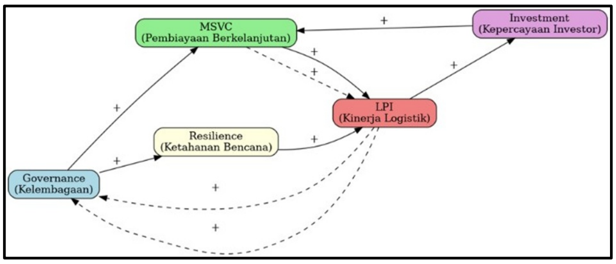

Fig 13. Dynamic System of Governance, Disaster Resilience, Sustainable Financing, and Investment on Improving LPI (*Source: Processed Data using Vensim, 2025)*

Table 6. The relationship between dynamic system loops and institutional orientation in the national logistics corridor authority

Loop	Sequence of Variables	Main Focus	Implications for LPI	Institutional Orientation
Loop 1	Governance → MSVC → LPI → Governance	Governance & sustainable financing	Strong governance ensures that MSVC is implemented effectively, thereby supporting improvements in LPI. The increase in LPI then reinforces the legitimacy of governance.	The Coordinating Minister for Infrastructure and Development orchestrates cross-sector governance (Public Works, Transportation, Bappenas, etc.) to ensure MSVC functions effectively and sustainably.
Loop 2	Governance → Resilience → LPI → Governance	Disaster resilience & institutional strength	Governance drives the application of disaster resilience in infrastructure, which enhances logistics reliability. This reliability improves LPI and further strengthens governance.	The Coordinating Minister for Infrastructure ensures that disaster resilience is embedded in national institutional design so that logistics corridors (JTTS & Sitinjau Lauik) remain functional despite disasters.
Loop 3	LPI → Investment → MSVC → LPI	LPI improvement & investment	Higher LPI attracts more investment, which strengthens MSVC, and the successful implementation of MSVC contributes back to further LPI improvements.	The Coordinating Minister for Infrastructure safeguards the continuity of national strategic projects by fostering investor confidence, enabling new investments to reinforce MSVC and strengthen logistics.

Source: Data Processing, 2025

Table 6 illustrates how the three dynamic system loops interact with institutional orientation under the coordinating minister for Infrastructure and Development. Loop 1 emphasizes the importance of governance and sustainable financing through the MSVC scheme. In this context, strong governance ensures the effective implementation of MSVC, which enables improvements in the LPI and, in turn, strengthens the legitimacy of governance itself. The coordinating minister for Infrastructure acts as a cross-sector orchestrator, ensuring coordination among Public Works, Transportation, Bappenas, and other relevant stakeholders.

Loop 2 highlights the role of governance in strengthening disaster resilience and institutional capacity. By incorporating disaster resilience principles into infrastructure, logistics reliability increases, thereby contributing to improvements in the LPI. Here, the coordinating minister for Infrastructure plays a key role in ensuring that resilience is integrated into national institutional design, so that logistics corridors such as JTTS and the Sitinjau Lauik Flyover remain operational even in the event of disruptions or disasters.

Loop 3 demonstrates the reciprocal relationship between LPI, investment, and MSVC. Improvements in LPI attract new investments, which reinforce MSVC, and in turn contribute further to enhancing the LPI. Within this loop, the coordinating minister for Infrastructure is responsible for maintaining the continuity of national strategic projects while fostering investor confidence, thereby creating a positive cycle of financing and strengthening logistics competitiveness on a sustainable basis.

3.1.9 Recommended Design for Indonesia (NLCA under the Coordinating Ministry for Infrastructure)

Table 7 highlights the key lessons learned from international practices and their relevance for shaping the National Logistics Corridor Authority (NLCA) under the Coordinating Ministry for Infrastructure. The experiences of India, the United States, Malaysia, Japan, and other countries show that effective corridor governance requires an authority that acts as a cross-sector orchestrator, not merely an infrastructure operator. Institutional integration must go hand in hand with corridor development that aligns logistics parks, industrial estates, and TOD to support multimodal connectivity. Financing innovations such as Value Capture and PPPs demonstrate how dependency on state equity can be reduced through multi-source mechanisms like MSVC. At the same time, resilience is crucial, as Japan and the US exemplify with risk-based planning in infrastructure design to withstand disasters. Ultimately, the NLCA should be designed to not only coordinate governance and financing but also to ensure disaster resilience and deliver macroeconomic impacts, particularly by improving Indonesia's Logistics Performance Index (LPI) and reinforcing corridors as the backbone of the national logistics system.

Table. 7. Lessons Learned and Recommended Design for NLCA under the Coordinating Ministry for Infrastructure

Dimension	Lessons Learned (from International Practices)	Recommendations for NLCA
Institutional Role	Corridor authorities in countries such as India, the US, and Malaysia act as cross-sector *orchestrators* rather than mere infrastructure operators.	NLCA should function as a cross-sector *orchestrator* capable of integrating policies, infrastructure, and governance.
Corridor Development	Integration of logistics parks, industrial estates, and TOD has proven to strengthen corridor functions in other countries.	NLCA should guide the development of economic zones (logistics parks, industries, TOD) in line with the national logistics corridor framework.
Financing	Innovative schemes such as Value Capture in India and PPPs in Malaysia reduce dependency on government funds.	NLCA must manage innovative financing through *Multi-Source Financing* (MSVC), reducing reliance on state equity (PMN).
Disaster Resilience	Japan and the US apply *risk-based planning* in corridor design to address earthquakes and other hazards.	NLCA should ensure *disaster resilience* by adopting *risk-based planning* standards in toll roads, bridges, and logistics hubs.
Macroeconomic Outcomes	Enhanced logistics competitiveness is reflected in improved LPI rankings and corridor integration as a national backbone.	NLCA is expected to deliver macro-level outcomes by improving Indonesia's LPI and reinforcing the corridor's role as the national logistics backbone.

Source: Data Processing, 2025

3.1.10 Roadmap National Logistics Corridor Authority (NLCA) 2025–2030

Table 8 outlines the strategic roadmap for the National Logistics Corridor Authority (NLCA) from 2025 to 2030, showing a step-by-step progression from institutional establishment to global positioning. The roadmap begins in 2025 with the legal and organizational foundation of NLCA under the Coordinating Ministry for Infrastructure, followed in 2026 by the drafting of a master plan and identification of priority corridors. By 2027, the focus shifts to financing and integration through the adoption of Multi-Source Financing (MSVC), logistics park development, and PPP initiatives. In 2028, disaster resilience becomes central, with risk-based planning and resilience audits applied to major corridors such as JTTS and Sitinjau Lauik. The expansion phase in 2029 extends NLCA's reach to other national corridors and introduces digitalized LPI monitoring systems to enhance competitiveness. Finally, in 2030, consolidation of institutional and financial mechanisms, international branding, and recognition of Indonesia as a regional logistics hub reflect the culmination of efforts, with the ultimate target of moving Indonesia's LPI into the global Top 40.

Table 8. Roadmap for the National Logistics Corridor Authority (NLCA) 2025–2030

Year	**Key Focus**	**Strategic Actions**	**Output / Deliverables**	**Performance Indicators (KPI)**
2025	Institutional establishment	- Drafting the legal basis for NLCA – Establishing organizational structure under the Coordinating Ministry for Infrastructure – Initial cross-ministerial coordination	- Presidential regulation/legal instrument for NLCA – Organizational structure and SOPs	- NLCA formally established – Presidential/ministerial decree issued
2026	Initial consolidation & planning	- Formulating the *National Logistics Corridor Master Plan* – Identifying priority corridors (JTTS, Sitinjau Lauik, etc.) – Mapping public–private stakeholders	- Master Plan 2026–2030 – Priority corridor map and stakeholder mapping	- Master Plan endorsed – Increased stakeholder engagement
2027	Financing & corridor integration	- Implementing *Multi-Source Financing (MSVC)* scheme – Designating sites for logistics parks and TOD – PPP agreements with private investors	- Pilot MSVC projects – Designation and preliminary design of logistics parks/TOD	- At least 2 pilot MSVC projects launched – 2 logistics park/TOD sites designated
2028	Disaster-resilient infrastructure	- Applying *risk-based planning* to JTTS & Sitinjau Lauik – Conducting resilience audits for corridor infrastructure – Integrating with BNPB/BMKG (disaster & seismic agencies)	- Risk-based disaster mitigation plans – Infrastructure resilience audit reports	- Risk-based planning standards adopted – 100% of corridor projects audited for resilience
2029	Expansion & competitiveness	- Expanding NLCA programs to other national corridors (Trans-Java, Trans-Kalimantan) – Digitalizing LPI monitoring and logistics data	- Digital LPI monitoring system – National expansion plan	- Expansion covers ≥3 national corridors – Upward trend in Indonesia's LPI
2030	Consolidation & global positioning	- Consolidating institutional and long-term financing mechanisms – Promoting Indonesia as an ASEAN logistics hub – Evaluating roadmap achievements	- Final report of Roadmap 2025–2030 – Roadmap 2031–2040 – International branding of Indonesia's logistics corridors	- Indonesia's LPI enters global Top 40 – Indonesia recognized as a regional logistics hub

Source: Data Processing, 2025

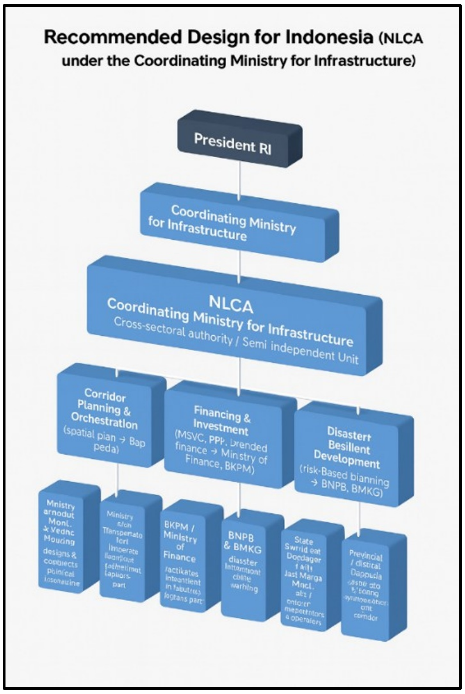

Fig 14. Recommend Design for Indonesia (NLCA Under the Coordinating Ministry for Infrastructure)
Source: Processed Data using, 2025

Figure 14 presents the recommended institutional design for Indonesia's National Logistics Corridor Authority (NLCA) under the Coordinating Ministry for Infrastructure (Kemenko Infrastruktur). In this structure, NLCA is positioned as a semi-independent authority that functions as a cross-sector orchestrator to integrate policy, financing, disaster resilience, and logistics performance improvements. At the highest level, the President provides overarching direction, while Kemenko Infrastruktur serves as the main coordinator of NLCA, directly overseeing the authority's mandate and ensuring cross-sectoral alignment. In parallel, Bappenas (through RPJMN and PSN) acts as the policy director, ensuring that NLCA's strategies are consistent with the National Medium-Term Development Plan (RPJMN) and Strategic National Projects (PSN). This dual arrangement reflects strong central leadership and policy coherence, while provincial and district planning agencies (Bappeda) translate national strategies into local implementation and spatial planning.

At the operational level, NLCA manages coordination among technical ministries and state enterprises that act as implementing partners. The Ministry of Public Works and Housing (PUPR) leads physical infrastructure development, the Ministry of Transportation ensures multimodal integration, and BKPM facilitates logistics and industrial investment. Disaster resilience is embedded through BNPB and BMKG, which provide hazard assessments, risk analyses, and early warning systems. Meanwhile, state-owned enterprises such as HKI, Jasa Marga, and WIKA execute projects on the ground, and Bappeda ensures alignment with regional development priorities. NLCA's scope encompasses corridor planning and orchestration, financing innovation through MSVC and PPP schemes, risk-based planning for disaster resilience, and digitalization to enhance Indonesia's Logistics Performance Index (LPI). The design consolidates governance, secures innovative financing, and builds a logistics backbone that is resilient, competitive, and globally integrated.

Table 9. Mapping Disaster Resilience in NLCA (Source: Data Processing, 2025)

Dimension	Role within NLCA	Detailed Implementation	Expected Outcomes
National Policy	Embedding disaster resilience as a mandatory pillar in logistics corridor governance	- Integrating disaster resilience indicators into *RPJMN* and *PSN* planning documents - Including *risk-based planning* requirements in the NLCA Master Plan - Setting national standards for disaster-resilient infrastructure across toll roads, flyovers, and logistics hubs	National logistics corridors developed in alignment with long-term disaster resilience targets; policies ensure infrastructure is safe, adaptive, and sustainable
Coordinating Institution	Coordinating Ministry for Infrastructure ensures resilience is a cross-sector mandate under NLCA	- Forming a dedicated NLCA division/unit for *Disaster Risk Reduction & Resilience* - Coordinating cross-ministerial task forces on disaster risk (PUPR, Transportation, BNPB, BMKG) - Establishing regulatory guidelines to enforce resilience standards in all corridor-related projects	NLCA becomes a central orchestrator that integrates disaster resilience across all sectors, ensuring that no corridor development proceeds without risk assessment
Technical Institutions	National disaster and technical agencies provide scientific data, standards, and audits	- BNPB: disaster risk maps, contingency plans, and emergency response protocols - BMKG: seismic microzonation, early warning systems, climate projections - PUPR: design guidelines for earthquake-resistant bridges, landslide prevention, and flood control - Ministry of Transportation: multimodal resilience strategies and safe evacuation networks	Corridor infrastructure is equipped with resilience measures against earthquakes, floods, and landslides, supported by accurate data and continuous monitoring
Financing Instruments	Ensuring that financing flows are directed toward disaster-resilient infrastructure	- Applying *Multi-Source Financing (MSVC)* with mandatory resilience compliance - Launching *Resilience Bonds* or *Green Infrastructure Bonds* - PPP agreements conditioned on meeting disaster resilience standards - Incentives for private investors adopting disaster-resilient technologies	Infrastructure financing is sustainable, innovative, and directly tied to resilience outcomes, reducing fiscal burden while ensuring safer investments
Implementation & Monitoring	Establishing monitoring systems to measure resilience performance of logistics corridors	- Developing a *Resilience Scorecard* for each corridor segment - Regular resilience audits for toll roads, flyovers, and logistics hubs - Digital dashboard to monitor risk exposure and mitigation measures in real time	Continuous monitoring of resilience performance; measurable benchmarks for LPI improvement and disaster preparedness
Macroeconomic Outcomes	Linking disaster resilience to competitiveness and logistics performance	- LPI improvement through infrastructure reliability and reduced downtime after disasters - Enhanced investor confidence due to resilient infrastructure standards - Stronger positioning of Indonesia as a logistics hub in ASEAN and global supply chains	Indonesia achieves better global competitiveness by combining logistics efficiency with disaster resilience, reflected in higher LPI ranking and sustainable growth

Table 9 illustrates the mapping of disaster resilience within the framework of the National Logistics Corridor Authority (NLCA), emphasizing how resilience must be embedded at every governance level. At the policy level, disaster resilience is integrated into RPJMN, PSN, and the NLCA Master Plan, ensuring national standards for resilient infrastructure in toll roads, flyovers, and logistics hubs. Institutionally, the Coordinating Ministry for Infrastructure plays a pivotal role as the main orchestrator by creating a dedicated NLCA resilience division, coordinating inter-ministerial task forces, and enforcing regulatory guidelines. Meanwhile, technical institutions such as BNPB, BMKG, PUPR, and the Ministry of Transportation contribute by providing scientific data, seismic microzonation, early warning systems, and engineering standards for disaster-resistant infrastructure. Together, these measures establish corridors that are not only efficient but also adaptive and safe, ensuring that resilience becomes a mandatory foundation for national logistics development.

4 Conclusion

This study concludes that strengthening disaster resilience in Indonesia's logistics corridors requires a multidimensional approach. First, toll roads and bridges must be designed to withstand earthquakes and landslides a task already realized by PT Hutama Karya (Persero) and Hutama Karya Infrastruktur (HKI) through their technical expertise in the development of the Trans-Sumatra Toll Road (JTTS) and the Sitinjau Lauik Flyover. Second, sustainable financing and institutional mechanisms are needed to ensure rapid recovery, formulated in this paper as the establishment of the National Logistics Corridor Authority (NLCA) under the Coordinating Ministry for Infrastructure. Third, logistics systems must remain functional during disaster events, representing the ultimate outcome of a resilient corridor framework.

Based on the SmartPLS analysis, Governance/Institutional Framework (X1) and Disaster Resilience (X3) have a positive and significant effect on improving Indonesia's Logistics Performance Index (LPI). Strong governance strengthens institutional effectiveness and ensures more integrated management of JTTS and the Sitinjau Lauik corridor, while disaster resilience improves infrastructure reliability, enabling logistics distribution to continue even during disasters. In contrast, MSVC (X2), though statistically significant, has a negative effect due to regulatory barriers, weak inter-agency coordination, and limited private sector participation.

Dynamic loop analysis reinforces these findings. Loop 1 highlights the importance of governance in orchestrating MSVC so it contributes positively to LPI. Loop 2 demonstrates that consistent governance embeds disaster resilience into institutional design, ensuring corridor operability even under megathrust risks. Loop 3 shows that improved LPI performance attracts new investment, which in turn strengthens MSVC, creating a reinforcing cycle of competitiveness.

Therefore, resilience must be embedded not only in technical design but also in governance, institutional coordination, and financing mechanisms. The establishment of the NLCA under the Coordinating Ministry for Infrastructure is thus urgent as a policy-bridging institution. Such an authority would not only function as a regulator but also as an orchestrator, integrating governance, resilience, and sustainable financing ultimately ensuring that Indonesia's logistics corridors are resilient, efficient, and globally competitive.

References

1. J. L. Kartika, A. Sarjito, and S. A. Purwantoro, Evaluating the effectiveness of Indonesia's military logistics through the 3C's of logistics approach. Formosa J. Multidiscip. Res. **4**(7), 3051–3068 (2025). https://doi.org/10.55927/fjmr.v4i7.273
2. Y. K. Ardha, I. Satyarno, and G. I. Marliyani, Probabilistic seismic hazard analysis assessment in Cianjur following the Mw5.6, 2022 earthquake. J. Civ. Eng. Forum **11**(3), 245–256 (2025). https://doi.org/10.22146/jcef.18988
3. HK-HKI KSO, Paparan Proyek Flyover Panorama I Sitinjau Lauik. Jakarta (2025).
4. A. R. Purwadita, R. F. Kurnia, and Y. Latief, Evaluation of land value capture policy in toll road assignment projects to improve investment performance. Multidiscip. Sci. J. **6**(12), 2024301 (2024). https://doi.org/10.31893/multiscience.2024301
5. A. Anggara and N. Wijaya, Land value capture for sustainable urban development in a developing city: A case of Bekasi City, Indonesia. Indones. J. Plan. Dev. **9**(1), 1–14 (2024). https://doi.org/10.14710/ijpd.9.1.1-14
6. Z. Hasan, Mahidin, A. Achmad, M. Irwansyah, and N. Aufaraihan, Kajian literatur tentang model mitigasi bencana lanskap pesisir di Kota Banda Aceh. J. Lanskap Indones. **17**(2), 239–250 (2025). https://doi.org/10.29244/jli.v17i2.61739
7. H. Irza, Policy strategies for road infrastructure planning and budgeting in West Sumatra. J. Adm. Kebijak. Publik **10**(2), 218–236 (2025). https://doi.org/10.25077/jakp.10.2.218-236.2025
8. C. Anjani and Darto, Financial literacy, income and self-control on financial management behavior of Generation Z. Baskara J. Bus. Entrep. **5**(1), 50–60 (2022). https://doi.org/10.54628
9. World Bank, Logistics Performance Index 2023. Washington DC (2023).
10. V. Maliene, R. Mansberger, J. Paulsson, and T. Köhler, Sustainable and equitable land management. vdf Hochschulverlag AG, Zürich (2024). https://doi.org/10.3218/4172-9
11. Asian Development Bank (ADB), Innovative Infrastructure Financing in Indonesia. ADB (2022).