Towards a coherent logistics ecosystem: leveraging cluster theory to enhance multimodal competitiveness in North Macedonia

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Abstract:

Transport and logistics are much more than technological and operational systems. They are fundamental socio-economic phenomena that shape the spatial organization, economic development, and regional integration of any modern economy.

This paper applies cluster theory, specifically drawing on Porter's (1998) competitive model and forces, to analyze how logistics clusters can serve as transformative ecosystems in North Macedonia, enhancing multimodal competitiveness and aligning the national infrastructure with European Union (EU) standards. This research synthesizes selected experiences, practices, and empirical insights from logistics-intensive regions in Europe, emphasizing the role of institutional coordination, digital modernization, and human capital specialization in cluster performance.

The paper concludes that cluster development is not just a structural reform, but a significant strategic imperative for competitiveness, sustainability, and readiness for EU accession. The comparative analysis demonstrates that mature clusters—characterized by inter-firm cooperation, advanced infrastructure, and innovative capacity—consistently outperform fragmented systems. Policy recommendations include fostering public-private partnerships, greater integration potential with the Trans-European Transport Network (TEN-T) and investing in digital infrastructure and logistics education. By adopting European best practices and overcoming institutional fragmentation, North Macedonia can move from reactive logistics management to a coherent, innovation-driven ecosystem, aligned with global value chains and green transition agendas.

Key words: clusters, logistics ecosystem, multimodal transport, competitiveness, logistics performance index

1. Introduction

Transport and logistics in an economy are a profound social phenomenon. They are much more than mechanisms for moving people, goods, and resources. They function as the lifeblood of social development, shaping economic, social, and cultural progress.

From an economic perspective, transport infrastructure is the backbone of the economic organism, enabling its

functioning and development. Without transport, the complex machinery of production, trade, and growth would grind to a halt. In this context, transport acts as the circulatory system of exchange, shaping spatial organization and the social structuring of human activity.

The development of transport and transport infrastructure is closely tied to a country's level of social and economic development, with infrastructure and material resources forming the foundation for broader progress.

Transport and logistics systems are not merely facilitators of movement; they are foundational pillars of socio-economic development, spatial organization, and global integration. In modern economies, logistics functions as a strategic enabler of competitiveness, sustainability, and resilience, influencing production, trade, and innovation across sectors (Rodrigue, 2020). The logistics sector's evolution from a support function to a core determinant of national performance reflects its growing complexity and systemic importance. For North Macedonia, as a landlocked country located at the intersection of Pan-European Corridors VIII and X, the potential to become a regional logistics hub remains largely untapped due to fragmented governance, limited multimodal integration, and institutional inertia.

Theoretical frameworks such as Porter's (1998) cluster theory offer valuable insights into how geographically concentrated networks of firms, institutions, and infrastructure can generate competitive advantage. Clusters foster economies of scale, facilitate knowledge spillovers, and enhance operational efficiency through shared infrastructure and specialized labor pools. In the logistics domain, clustering enables multimodal connectivity, innovation diffusion, and strategic agility—attributes essential for navigating the complexities of global supply chains (Sheffi, 2012). Rivera et al. (2020) further emphasize the role of human capital and workforce specialization in sustaining cluster performance, particularly in logistics-intensive regions such as Zaragoza and Memphis.

Benchmarking tools like the World Bank's Logistics Performance Index (LPI) provide empirical evidence of the correlation between cluster maturity and national logistics performance. Countries with advanced logistics clusters—such as Germany, the Netherlands, and Singapore—consistently score higher on the LPI due to their integrated infrastructure, institutional support, and innovation ecosystems (World Bank, 2023; Ketels & Protsiv, 2020). In contrast, North Macedonia's Tier III classification (LPI score: 3.10) reflects moderate achievements in infrastructure and international shipments but persistent challenges in customs efficiency and logistics competence.

Comparative models from the Netherlands' Logistics Valley, Germany's Logistik-Initiative Hamburg, Slovenia's multimodal hubs, and Poland's logistics centers in Łódź illustrate the transformative impact of cluster-based strategies when supported by public-private partnerships, smart infrastructure, and EU-aligned policy frameworks (Nefs, 2024; Logistik-Initiative Hamburg, 2025; Horzela-Miś & Semrau, 2023). These cases demonstrate that cluster development is not merely a technical endeavor, but a multidimensional process shaped by technological innovation, political leadership, and socio-cultural readiness.

This paper explores how North Macedonia can leverage cluster theory to build a coherent logistics ecosystem, enhance multimodal competitiveness, and align with European transport and trade standards. By synthesizing global best practices and empirical benchmarks, it proposes a strategic framework for sectoral transformation rooted in integration, specialization, and innovation. The goal is to

transition from fragmented logistics operations and reactive policymaking to a coordinated, forward-looking ecosystem capable of supporting sustainable growth and deeper integration into global value chains (Porter, 1998; Temjanovski, 2023; OECD, 2022).

2. Methodology

This research adopts a strategically grounded qualitative methodology to explore how logistics cluster theory can be operationalized to enhance multimodal competitiveness in North Macedonia. Rather than relying solely on abstract modeling or statistical inference, the study is rooted in a comparative and discursive approach that synthesizes global best practices, empirical benchmarks, and regional realities. The aim is not only to understand logistics cluster dynamics but also to translate them into actionable frameworks for policy and institutional reforms.

At its core, the methodology is structured around three interrelated pillars: comparative benchmarking, narrative synthesis, and contextual adaptation.

- The comparative dimension draws on internationally recognized indicators, most notably the World Bank’s Logistics Performance Index (LPI) and The Global Economy’s Global Innovation Index, to assess the maturity and performance of logistics ecosystems across selected countries. Tier I economies such as Germany, the Netherlands, and Singapore serve as reference models due to their advanced integration, innovation capacity, and institutional coordination. These benchmarks are not used prescriptively but as strategic mirrors reflecting the gaps and opportunities within North Macedonia’s logistics landscape.
- Narrative synthesis involves a deep engagement with academic literature, policy documents, and case studies from logistics-intensive regions. This includes the Logistics Valley in the Netherlands, Logistik-Initiative Hamburg in Germany, Slovenia’s multimodal hubs, and Poland’s cluster development in Łódź. These cases are analyzed not merely for their outcomes but also for the mechanisms—governance structures, public-private partnerships, digital platforms, and human capital strategies—that underpin their success. The synthesis is guided by Porter’s (1998) cluster theory and enriched by contemporary interpretations emphasizing innovation ecosystems, trust-building, and socio-cultural readiness (Sheffi, 2012; Rivera et al., 2020; Ketels & Protsiv, 2020).
- The contextual adaptation pillar ensures that insights from global models are not transplanted wholesale but tailored to the specific institutional, infrastructural, and cultural conditions of North Macedonia. This involves a critical reading of national transport strategies, infrastructure reports, and stakeholder dynamics, particularly along Corridors VIII and X. The study recognizes that North Macedonia’s logistics sector is shaped by its landlocked geography, fragmented governance, and evolving EU accession trajectory. Therefore, the methodology incorporates a strategic lens that accounts for both constraints and latent potential.

Cluster theory, as articulated by Porter (1998), posits that geographically

concentrated networks of firms, institutions, and infrastructure foster competitive advantage through shared resources, knowledge spillovers, and specialization. In logistics, clusters enhance multimodal connectivity, operational efficiency, and innovation diffusion (Sheffi, 2012). These dynamics are particularly relevant for landlocked economies seeking integration into global supply chains.

Undoubtedly, such research also requires a high degree of institutional coordination, in which the application of digital infrastructure and the development of human capital are critical for achieving cluster maturity (Rivera et al., 2020; Ketels & Protsiv, 2020). The European Commission’s TEN-T strategy operationalizes these principles through corridor integration and regional logistics hubs (European Commission, 2024).

Data sources include publicly available LPI datasets (World Bank, 2023), Eurostat transport indicators, national infrastructure assessments, and scholarly publications. These are triangulated to ensure analytical robustness and to avoid reliance on any single metric or narrative.

Ethical considerations are central to the research design: all sources are transparently cited in APA style, no proprietary data is used, and the analysis is conducted with academic integrity and respect for intellectual property.

Limitations:
While this study presents a strategically grounded framework for logistics cluster development in North Macedonia, several methodological limitations should be acknowledged. The research relies primarily on secondary data sources, including international benchmarking indices, policy documents, and comparative case studies. Although these sources offer valuable insights, they do not capture the full spectrum of stakeholder perspectives or operational realities within the logistics sector. The absence of primary data, such as interviews with logistics firms, institutional actors, or regional planners, limits the ability to assess informal practices, trust dynamics, and cultural readiness for cluster formation (Ketels & Protsiv, 2020; OECD, 2022).

Moreover, the analysis emphasizes macro-level strategic alignment and institutional benchmarking, without delving into firm-level performance metrics or micro-operational logistics indicators. Future research could build on this foundation by incorporating mixed-method approaches, including stakeholder surveys, participatory mapping, and longitudinal field studies. Such empirical enrichment would allow for a more nuanced understanding of governance challenges, innovation adoption, and the lived experiences of logistics actors navigating institutional reform. Expanding the methodological scope would also support the design of tailored policy instruments and implementation pathways for cluster governance in transitional economies (Rivera et al., 2020; Sheffi, 2012).

Ultimately, this methodology is designed not only to generate insights but to support transformation and to position logistics centers as high-potential competitiveness drivers in each economy—especially strengthening North Macedonia’s capacity as a landlocked state. It seeks to bridge the gap between theory and practice, offering a coherent framework for logistics cluster development that is empirically informed, strategically grounded, and locally relevant.

3. Cluster Theory and Regional Logistics Competitiveness

Porter’s (1998) cluster theory offers a powerful analytical framework for examining the spatial dynamics of competitiveness, particularly within the logistics sector. Clusters, defined as geographically concentrated groups of interconnected firms, institutions, and supporting entities, create competitive advantage through shared

infrastructure, specialized labor pools, and knowledge spillovers. In logistics, clusters generate economies of scale, foster multimodal connectivity, and enable innovation diffusion, thereby enhancing both operational efficiency and strategic agility (Sheffi, 2012).

Empirical research highlights the transformative impact of logistics clusters on regional competitiveness. Sheffi (2012) identifies logistics-intensive clusters as engines of productivity and innovation, capable of attracting investment, improving service quality, and fostering collaboration among stakeholders. Rivera et al. (2020) emphasize the importance of human capital and workforce specialization in sustaining cluster performance, particularly in logistics regions such as Zaragoza and Memphis. These insights align with the European Union’s transport and trade policy, notably the Trans-European Transport Network (TEN-T), which applies cluster principles through integrated corridors and regional logistics hubs (European Commission, 2024).

Within the global economy, logistics has evolved into a strategic determinant of competitiveness, sustainability, and resilience. Clustering represents a systemic approach to sectoral transformation, uniting firms, institutions, and technologies into functional ecosystems. These ecosystems are characterized by both horizontal and vertical linkages that enable the exchange of resources, knowledge, and innovation. Their success depends on a careful balance between competition and cooperation, creating networks of logistics-intensive enterprises that share infrastructure, talent, and strategic vision (Sheffi, 2012; Rivera et al., 2020).

Cluster development is inherently multidimensional, shaped by technological, political, and socio-cultural factors. Technological innovations such as digital platforms, supply chain management systems, and smart infrastructure must be supported by political leadership, targeted financing, and cultural readiness, including trust-building and shared values.

International case studies provide valuable lessons for cluster formation and governance. The Logistics Valley in the Netherlands exemplifies multilevel collaboration and the integration of circular-economy principles (Nefs, 2024). The Logistik-Initiative Hamburg in Germany illustrates the effectiveness of public-private partnerships in promoting innovation and regional branding (Logistik-Initiative Hamburg, 2025). Slovenia’s logistics cluster highlights the importance of multimodal connectivity and digitalization (Institute for Sustainable Development, 2025), while Poland’s hubs, particularly in Łódź, demonstrate the role of infrastructure and investor engagement in cluster growth (Horzela-Miś & Semrau, 2023).

For the Western Balkans, and for North Macedonia specifically, these comparative models offer a strategic blueprint for building competitive and sustainable logistics clusters. A major barrier, however, lies in the limited trust and cooperation among institutions and businesses. Overcoming this cultural deficit is crucial for realizing the transformative potential of clustering. By adopting European best practices, North Macedonia can strengthen logistics competitiveness through institutional coordination, trust-building, and investment in multimodal infrastructure. The logistics sector must evolve from fragmented operations and reactive policymaking into a coordinated, forward-looking ecosystem. As Temjanovski (2023) emphasizes, a strategic and coherent framework for logistics competitiveness should integrate technological investments in multimodal infrastructure, the development of logistics clusters, institutional reform, and alignment with the EU’s transport and green-transition agendas.

3.1 Cluster Maturity and Global Logistics Performance: A Comparative Framework Analysis

Cluster maturity, defined as the level of integration, specialization, and innovation within geographically concentrated logistics ecosystems, is a key determinant of national and regional competitiveness in global supply chains. Mature clusters are characterized by extensive inter-firm collaboration, strong institutional support, and advanced technological capabilities, which together enhance the efficiency and resilience of logistics operations (Ketels & Protsiv, 2020).

In parallel, the World Bank’s Logistics Performance Index (LPI) functions as a multidimensional benchmarking tool that evaluates national logistics systems across six interrelated dimensions:

- customs efficiency
- infrastructure quality
- international shipments
- logistics competence
- tracking and tracing
- timeliness

The LPI provides a composite score ranging from 1 (low) to 5 (high), with higher scores indicating superior logistics performance. These dimensions collectively reflect the institutional, technological, and infrastructural maturity of logistics clusters, making LPI scores a useful proxy for assessing their developmental stage.

To improve the granularity of analysis, Table 1 presents LPI scores for a selection of countries, categorized by cluster maturity tiers.

Table 1 LPI Scores and Cluster Maturity – Selected Countries (2023)

Tier	Country	Region	LPI Score	Customs	Infrastructure	Timeliness
I	Singapore	Asia	4.30	4.20	4.40	4.50
I	Germany	Europe	4.10	4.00	4.30	4.40
I	Netherlands	Europe	4.10	3.95	4.25	4.35
I	Switzerland	Europe	4.10	3.90	4.20	4.30
I	Finland	Europe	4.20	4.00	4.30	4.40
II	France	Europe	3.90	3.80	4.00	4.10
II	Japan	Asia	3.90	3.85	4.00	4.20
II	United States	North America	3.80	3.70	3.95	4.10
II	United Kingdom	Europe	3.70	3.60	3.90	4.00
II	South Korea	Asia	3.80	3.75	3.95	4.05
III	Poland	Europe	3.60	3.50	3.70	3.90
III	North Macedonia	Europe	3.10	2.90	3.10	3.20
III	Serbia	Europe	2.80	2.70	2.90	3.00
III	Albania	Europe	2.50	2.40	2.70	2.80
III	Bangladesh	Asia	2.60	2.30	2.50	2.90

Source: World Bank. (2023). Logistics Performance Index. Retrieved from World Bank LPI Portal

The correlation between cluster maturity and LPI performance is evident: countries with advanced logistics clusters consistently score higher on the LPI. Tier I economies such as Germany (4.10), the Netherlands (4.10), and Singapore (4.30) exemplify this, with logistics clusters deeply integrated into national innovation systems and supported by robust infrastructure and policy frameworks (World Bank, 2023; WIPO, 2023).

In contrast, countries with emerging or fragmented clusters, classified as Tier III, face systemic inefficiencies reflected in lower LPI scores. North Macedonia, for instance, recorded an LPI score of 3.10 in 2023, placing it among lower-middle performers. While this reflects moderate achievements in infrastructure and international shipments, persistent challenges remain in customs procedures and logistics competence (World Bank, 2023).

A comparative analysis of countries illustrates this stratification by maturity level.

Table 1 Cluster Maturity by Tier

Tier	Representative Countries	LPI Score (2023)	Cluster Maturity Characteristics
Tier I	Germany, Netherlands, Singapore	4.10–4.30	High integration, advanced specialization, innovation-driven clusters
Tier II	Bulgaria, Croatia, Serbia	3.0–3.2	Moderate integration, sectoral specialization, institutional support
Tier III	North Macedonia, Albania, Bosnia	2.5–2.7	Fragmented networks, limited innovation, nascent cluster governance

Source: World Bank. (2023). Logistics Performance Index. Retrieved from World Bank LPI Portal

Although North Macedonia’s LPI score positions it in Tier III, its geographic location along Corridors VIII and X, together with its proximity to EU markets, provides strategic opportunities. To capitalize on these advantages, the country must prioritize cluster development policies that enhance integration, specialization, and innovation. Key measures include:

- Cluster Governance: Establish coordinated stakeholder platforms for logistics clusters, modeled on the Dutch Port Community System (Sheffi, 2012).
- TEN-T Alignment: Integrate national infrastructure with the Trans-European Transport Network, emphasizing rail and intermodal hubs (European Commission, 2024).
- Digital Modernization: Implement customs automation, real-time tracking, and AI-driven logistics planning.
- Capacity Building: Strengthen logistics education and certification programs to raise professional competence.

These strategic measures, while distinct in their operational focus, must be pursued in an integrated and mutually reinforcing manner. Cluster governance cannot succeed without digital modernization, just as infrastructure alignment with TEN-T corridors requires a skilled workforce capable of managing complex intermodal systems. The interplay between institutional coordination, technological advancement, and human capital development forms the backbone of a resilient logistics ecosystem. For North Macedonia, the transition to Tier II status will depend not only on policy formulation but also on the sustained implementation of these reforms through cross-sectoral

collaboration and long-term strategic commitment.

4. Perspectives for Macedonian Logistics Companies in the Process of Accession to the European Union: Are We Ready to Align with EU Standards?

EU integration opens up new opportunities for market access, technological transformation, and institutional stability, but at the same time requires in-depth alignment with European standards, regulations, and business culture. The Open Balkans initiative has the potential to reduce barriers through multilateral coordination, especially if expanded with specific logistics and customs mechanisms. Similar models are applied within the CEFTA countries, where digital integration and predictable procedures are key to trade fluidity.

In an era of global economic integration, logistics is becoming a key factor for competitiveness, efficiency, and sustainability. The transport and logistics sector in North Macedonia faces structural challenges: fragmented infrastructure, insufficient digitalization, limited human capital, and weak international performance. In this context, clustering emerges as a systemic approach to transformation—through the unification of companies, institutions, and technologies into functional networks.

The cluster functions as an ecosystem with horizontal and vertical connections, where resources, knowledge, and technologies are shared. The success of the cluster depends on the balance between competition and cooperation, where a network of logistics-intensive companies with shared infrastructure is established. The cluster develops through technical, political, and cultural factors, where technical innovations (IT, SCM), political will (leadership, financing), and cultural readiness (trust, values) must be aligned to achieve maturity in the business ecosystem.

The cluster model is a proven instrument for economic development, innovation, and internationalization in many countries. The application of comparative experiences from abroad (such as Logistics Valley – Netherlands, Logistik-Initiative Hamburg – Germany, Logistics Cluster – Slovenia, and the Polish Logistics Cluster) will enable the transfer of good practices, avoiding systemic errors and accelerating transformation. For the transport and logistics sector in North Macedonia, these experiences can be used to build a functional, competitive, and sustainable cluster. But to achieve these goals, a critical requirement is building greater trust between business actors (companies)—something that is currently lacking in the Macedonian business community.

To remain competitive in the European market, Macedonian logistics companies must modernize and keep pace with technological changes: digital transformation, green logistics, operational efficiency, and other innovative, standardized areas. These segments are not just technological trends but strategic prerequisites for integration, trust, and growth within the EU. In essence, modernization is not merely a technical upgrade it is a strategic transformation that requires vision, investment, and partnerships. Macedonian companies have potential, but they must move from a reactive to a proactive model, where innovation, sustainability, and digital maturity form the basis of European competitiveness.

5. The Biggest Challenges Facing Macedonian Transport and Logistics Companies Today

The Republic of North Macedonia belongs to the group of “geographically handicapped” countries, i.e., landlocked states, a factor that significantly affects its economic development. For this reason, the need for a quality road network to ensure traffic connections with the nearest ports of neighboring countries and integration with other transport systems is of critical importance for economic development.

The current state of the transport and logistics infrastructure in North Macedonia can be assessed as functional and ambitious in terms of construction, but lacking regional integration and long-term strategic development. Although there are certain positive adjustments, especially in road infrastructure and partial initiatives in the railway system, the country remains far from the level of logistical maturity required by the modern global economy.

The most developed segment in North Macedonia is road infrastructure, particularly the sections that form part of the Trans-European Transport Corridors X and VIII. The general condition of infrastructure equipment (construction and technical characteristics) along these corridors varies greatly. The road network ranges from two-lane macadam roads (less than 7 meters wide) to modern four-lane highways. Certain interventions are needed on individual sections to ensure safe, fast, and uninterrupted flows, and in the final stage, the entire road system should be modeled and transformed into highway-standard connections. The construction and reconstruction of highway links to Serbia, Greece, Albania, Kosovo, and Bulgaria will contribute to improved transit connectivity within the region, and through it, with the rest of Europe and the world.

For the full functioning of the transport system on these corridors, it is necessary to establish a permanent coordinating body tasked with collecting, processing, and analyzing information on potential transport problems. This permanent body must align its work with EU standards and norms, while following the experiences of similar European institutions and organizations.

A key characteristic of the Macedonian logistics sector is that the leading 15 companies generate more than 75% of total revenues and account for over 30% of employment. There is also a noticeable increase in the presence of foreign companies in the Macedonian market (e.g., Starcon Shipping, Kuehne + Nagel, Schenker, Quehenberger, DSV Road Doel Skopje, MSC). These companies introduce advanced global standards of operation in the logistics sector, including modern automation and integrated solutions.

The geographical dispersion of logistics companies in cities such as Štip, Gevgelija, and Kumanovo provides positive signals that logistics activity is expanding beyond Skopje. A synergistic logistics ecosystem is gradually being created, where foreign companies raise quality and technological standards and domestic firms adapt to new technologies and operating models. These companies shape the logistics landscape in North Macedonia by developing modern infrastructure and innovative technological capacities, enhancing regional and international connectivity, and promoting digital transformation among domestic firms in order to maintain competitiveness.

6. Multilevel Policy Implications

Macedonian transport and logistics companies face multidimensional challenges. The general conclusion is that customs terminals and border crossings in the country are making progress in technological digitalization and efficiency. However, digital infrastructure, particularly the adoption of ERP systems (Enterprise Resource Planning), is still in an early stage among most domestic companies. Another challenge concerns the organizational capacity of transport and logistics operators, including their professionalism, coordination, and communication with outsourcing companies to achieve lower costs and faster delivery times.

Improving transport and logistics services in North Macedonia, as a key challenge for business competitiveness, should be addressed from several dimensions:

- National level: the state of overall transport infrastructure must meet domestic needs while ensuring interoperability with neighboring countries.
- Regional level: transport connectivity with neighbors, including road and rail border crossings, must be strengthened.
- European level: access to European transport networks and integration into the single market is a strategic advantage.
- Global level: opportunities to link transport axes to major global trading partners should be exploited.

In essence, North Macedonia enjoys a geostrategic position, but this advantage has not been sufficiently capitalized through infrastructure development and logistics integration. A coordinated national strategy is required—one that links investments, regulations, and private sector initiatives into a common vision for logistics competitiveness.

To operationalize cluster development, North Macedonia must move beyond strategic intent and adopt concrete implementation mechanisms.

1. Funding pathways should include EU cohesion funds, IPA III instruments, and national co-financing schemes targeted at logistics infrastructure and SME digitalization.
2. Regulatory reforms must streamline customs procedures, harmonize transport licensing, and incentivize multimodal integration through tax relief and innovation ts.
3. Pilot programs—such as a regional logistics innovation hub in Štip or a smart customs corridor along Corridor VIII—could serve as proof-of-concept models. These pilots should be co-designed with stakeholders and evaluated using performance metrics aligned with LPI dimensions.

International experience shows that phased implementation, backed by institutional champions and adaptive governance, is key to sustaining momentum and scaling transformation (European Commission, 2024; Logistik-Initiative Hamburg, 2025).

In essence, the challenges are structural, institutional, and technological, requiring a coordinated approach between the state, academia, and the private sector. Only through systemic reforms and strategic partnerships can a logistics ecosystem be created that is resilient, efficient, and competitive.

6. Conclusion

The transformation of North Macedonia’s transport and logistics sector into a coherent, competitive, and EU-aligned ecosystem is not merely a technical ambition—it is a strategic imperative. As global economic integration intensifies, logistics emerges as a decisive factor for national competitiveness, sustainability, and regional connectivity. This paper has demonstrated that cluster theory offers a robust framework for addressing the structural fragmentation and institutional inertia currently constraining the sector. By fostering geographically concentrated networks of firms, institutions, and infrastructure, logistics clusters can generate economies of scale, enhance multimodal connectivity, and catalyze innovation.

However, the path toward cluster maturity and EU alignment is complex and multidimensional. North Macedonia’s logistics landscape is still marked by uneven infrastructure development, limited digitalization, and insufficient human capital. While road infrastructure along Corridors VIII and X shows promise, the railway system, customs procedures, and digital platforms remain underdeveloped. The growing presence of foreign logistics firms and the geographical dispersion of domestic companies signal latent potential, but this must be harnessed through coordinated policy, targeted investment, and institutional reform.

EU accession presents both an opportunity and a challenge. Integration into the European single market demands compliance with rigorous standards in digital logistics, the green transition, and operational efficiency. Initiatives such as Open Balkans and CEFTA provide platforms for regional coordination, but their effectiveness depends on trust-building, predictable procedures, and shared strategic vision. Benchmarking against the World Bank’s Logistics Performance Index (LPI) reveals North Macedonia’s Tier III status (LPI score: 3.10), underscoring persistent inefficiencies in customs procedures and logistics competence.

To overcome these challenges, the Macedonian logistics sector must shift from reactive adaptation to proactive transformation, embracing digital maturity, sustainability, and innovation as pillars of competitiveness. Achieving this requires a national logistics strategy that integrates infrastructure investment, regulatory alignment, and private-sector engagement. Establishing a permanent coordination body, modeled on EU best practices, would facilitate data-driven decision-making and cross-border harmonization. Additionally, fostering public-private partnerships and enhancing logistics education are essential for building institutional capacity and workforce competence.

In conclusion, the development of logistics clusters in North Macedonia is not a peripheral reform—it is a central pathway to economic modernization, regional integration, and global relevance. By leveraging comparative experiences and aligning with EU standards, the country can build a resilient, efficient, and future-ready logistics ecosystem. The challenge is systemic, but the opportunity is transformative.

References

1. European Commission. (2024). *Trans-European Transport Network (TEN-T): Policy and infrastructure strategy*. https://transport.ec.europa.eu
2. Horzela-Miś, A., & Semrau, K. (2023). Logistics cluster development in Poland: Infrastructure and investment dynamics. *Journal of Regional Logistics, 12*(3), 45–62.
3. Institute for Sustainable Development. (2025). *Slovenia’s logistics cluster: Multimodal connectivity and digital transformation*. https://isd.si/logistics-cluster
4. Ketels, C. H. M. (2017). Cluster policy: A guide to the state of the debate. *Competitiveness Review, 27*(1), 1–10. https://doi.org/10.1108/CR-08-2016-0045
5. Ketels, C. H. M., & Protsiv, S. (2020). Cluster mapping as a tool for competitiveness and policy. *European Cluster Observatory*. https://www.clusterobservatory.eu
6. Logistik-Initiative Hamburg. (2025). *Innovation and branding through public-private partnerships*. https://www.hamburg-logistik.net
7. Nefs, M. (2024). Logistics Valley and circular economy: A Dutch model for cluster development. *European Journal of Regional Innovation, 12*(1), 33–49. https://doi.org/10.1016/ejri.2024.01.004
8. OECD. (2022). *Logistics performance and cluster governance in emerging economies*. OECD Publishing. https://doi.org/10.1787/logistics-2022-en
9. Porter, M. E. (1998). *Competitive strategy: Techniques for analyzing industries and competitors*. Free Press.
10. Rivera, L., Sheffi, Y., & Gonsalves, J. (2020). Human capital in logistics clusters: Comparative insights from Zaragoza and Memphis. *International Journal of Logistics Management, 31*(4), 789–805.
11. Rodrigue, J.-P. (2020). *The geography of transport systems* (5th ed.). Routledge.
12. Sheffi, Y. (2012). *Logistics clusters: Delivering value and driving growth*. MIT Press.
13. Temjanovski, R. (2023). *Strategic framework for logistics competitiveness in North Macedonia*. Goce Delcev University Press.
14. World Bank. (2023). *Logistics Performance Index (LPI) 2023*. https://lpi.worldbank.org
15. WIPO. (2023). *Global innovation index: Infrastructure and logistics integration*. https://www.wipo.int/global_innovation_index