

INTEGRATION OF LOGISTICS AND TRANSPORT SERVICES INTO GLOBAL SUPPLY CHAINS

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Annotation. This scientific article analyzes the integration of logistics and transport services into global supply chains. The study examines key drivers such as international trade expansion, digital transformation, green logistics, geopolitical fragmentation, and institutional governance. Based on data from the World Bank, UNCTAD, and WTO, the relationship between logistics performance and economic development is evaluated. Moreover, digital technologies are identified as a crucial factor in improving logistics efficiency and supply chain resilience in the global economy.

Keywords: logistics, transport, global supply chain, digital transformation, green logistics, international trade, economic integration

Annotatsiya. Ushbu ilmiy maqola logistika va transport xizmatlarining global ta'minot zanjirlariga integratsiyasi jarayonini tahlil qiladi. Tadqiqotda xalqaro savdoning kengayishi, raqamli transformatsiya, yashil logistika, geosiyosiy fragmentatsiya va institutsional boshqaruv kabi omillar yoritilgan. Jahon banki, UNCTAD va WTO ma'lumotlariga asoslanib, logistika samaradorligi va iqtisodiy o'sish o'rtasidagi bog'liqlik tahlil qilingan. Shuningdek, raqamli texnologiyalar logistika tizimlarining samaradorligini oshirishda muhim rol o'ynashi aniqlangan.

Kalit so'zlar: logistika, transport, global ta'minot zanjiri, raqamli transformatsiya, yashil logistika, xalqaro savdo, iqtisodiy integratsiya

Аннотация. Данная научная статья анализирует интеграцию логистических и транспортных услуг в глобальные цепочки поставок. В исследовании рассматриваются такие ключевые факторы, как расширение международной торговли, цифровая трансформация, «зелёная» логистика, геополитическая фрагментация и институциональное регулирование. На основе данных Всемирного банка, ЮНКТАД и ВТО оценивается взаимосвязь между эффективностью логистики и экономическим развитием. Также установлено, что цифровые технологии играют важную роль в повышении эффективности логистических систем.

Ключевые слова: логистика, транспорт, глобальные цепочки поставок, цифровая трансформация, зелёная логистика, международная торговля, экономическая интеграция

INTRODUCTION

Global supply chains have undergone profound transformation over the past three decades, driven by technological innovation, trade liberalization, and increasing interdependence among economies. Logistics and transport services now constitute the backbone of international trade, enabling the efficient movement of goods, services, and information across borders. In the contemporary globalized economy, the integration of logistics and transport services into global supply chains is no longer a competitive advantage but a structural necessity for economic development and participation in international markets. According to the United Nations Trade and Development (UNCTAD), global trade reached approximately \$35 trillion in 2025, marking a 7% increase compared to the previous year, with both goods and services trade contributing significantly to this growth. Services trade, which heavily depends on logistics-enabled digital infrastructure, accounted for nearly 27% of global trade flows, growing faster than merchandise trade in many regions. These figures highlight the increasing centrality of logistics systems in shaping global economic integration.

At the same time, global supply chains are facing unprecedented disruptions due to geopolitical tensions, climate-related risks, pandemics, and regulatory fragmentation. The World Bank's Logistics Performance Index (LPI) emphasizes that logistics systems determine not only the speed of trade but also its reliability and resilience, particularly in developing economies where infrastructure gaps remain significant.

This paper examines the integration of logistics and transport services into global supply chains, analyzing structural trends, technological innovations, regulatory frameworks, and challenges affecting global logistics systems. It also explores how digital transformation, sustainability policies, and geopolitical fragmentation are reshaping global logistics integration.

MAIN BODY

The integration of logistics and transport services into global supply chains has become one of the most critical determinants of economic globalization in the twenty-first century. In modern international trade, logistics is not merely a supporting infrastructure but a strategic system that governs the efficiency, reliability, and resilience of global production and distribution networks. The increasing fragmentation of production, rapid technological advancement, and expansion of international trade flows have collectively elevated logistics into a central position within global economic systems. This section provides a detailed empirical and analytical discussion of global logistics integration, supported by recent statistical data, academic research findings, and institutional reports from international organizations.

The expansion of global trade over the past two decades has significantly increased the demand for efficient logistics systems. According to UNCTAD estimates, global trade in goods and services reached approximately 35 trillion USD in 2025, reflecting continued growth despite global economic uncertainty and recurring disruptions in supply chains. Merchandise trade remains dominant; however, services trade has expanded at a faster pace, particularly in digitally enabled sectors such as financial services, IT services, and e-commerce logistics platforms. In many developing economies, services trade has grown by more than 7–9% annually, indicating a structural shift toward service-oriented globalization.

A key factor driving logistics integration is the fragmentation of production processes across multiple countries. Contemporary global value chains are characterized by geographically dispersed production stages, where raw materials, intermediate goods, and final assembly are distributed across different regions. Empirical evidence shows that intermediate goods now constitute more than half of global trade flows, reflecting the complexity of cross-border production networks. This fragmentation increases the dependency on efficient logistics systems capable of coordinating synchronized flows of goods, information, and capital across long distances.

In this context, logistics performance has become directly linked to national competitiveness. The World Bank Logistics Performance Index provides strong empirical evidence that countries with higher logistics efficiency consistently achieve higher trade volumes and stronger economic growth. On average, countries in the top quartile of logistics performance generate export levels that are approximately 40–60% higher than those in the lowest quartile. Moreover, improvements in logistics efficiency are associated with reductions in trade costs ranging from 15% to 25%, depending on sectoral structure and geographic conditions. These findings demonstrate that logistics infrastructure is not merely a facilitator of trade but a core driver of economic development.

The gap between developed and developing economies in logistics performance remains significant. High-income countries typically achieve LPI scores between 3.5 and 4.2 out of 5, while many low-income economies remain below 2.5 points. This disparity reflects differences in infrastructure quality, institutional efficiency, technological adoption, and human capital development. For example, countries such as Singapore, Germany, and the Netherlands

consistently rank among the top global logistics performers due to their advanced port systems, integrated multimodal transport networks, and highly digitalized customs systems. In contrast, landlocked and low-income countries in Sub-Saharan Africa and Central Asia often face logistics costs that are two to three times higher than the global average, limiting their ability to compete in international markets.

Digital transformation has emerged as one of the most powerful forces reshaping global logistics systems. The integration of artificial intelligence, Internet of Things technologies, blockchain systems, and big data analytics has fundamentally changed how supply chains are managed and optimized. AI-based logistics solutions are increasingly used for predictive demand forecasting, automated warehouse management, and route optimization. Empirical studies indicate that AI implementation in logistics can reduce operational costs by approximately 15–20%, while also improving delivery accuracy and reducing delays.

In addition, IoT technologies have enabled real-time monitoring of goods throughout the supply chain. Sensors embedded in transport vehicles, containers, and storage facilities allow continuous tracking of temperature, humidity, and location. This has significantly improved efficiency in industries such as pharmaceuticals and food logistics, where product sensitivity is high. In advanced logistics systems, IoT adoption has been associated with a reduction in inventory losses by up to 20–30%, particularly in cold-chain logistics.

Blockchain technology is also transforming logistics transparency and documentation processes. By creating decentralized and tamper-proof records of transactions, blockchain reduces administrative inefficiencies and increases trust among supply chain participants. Pilot implementations in maritime logistics have demonstrated that blockchain-based documentation systems can reduce customs clearance time by approximately 30–40%, significantly improving cross-border trade efficiency.

Furthermore, the rise of digital logistics platforms has facilitated the emergence of integrated supply chain ecosystems. These platforms connect manufacturers, suppliers, logistics providers, customs authorities, and retailers within a unified digital environment. As a result, coordination costs have decreased significantly, while supply chain visibility has improved substantially. In some cases, digital integration has reduced order processing times by more than 25%, particularly in high-volume e-commerce logistics systems.

Geopolitical fragmentation has also become a major factor influencing global logistics integration. In recent years, trade tensions, economic sanctions, and regional conflicts have disrupted established supply chain networks, forcing firms to restructure their logistics strategies. One of the most visible consequences has been the rerouting of maritime trade flows, leading to longer shipping distances and higher transportation costs. Maritime transport data indicates that average shipping distances on key global routes have increased by approximately 400 to 600 nautical miles since 2018, largely due to avoidance of high-risk geopolitical zones. This has resulted in higher fuel consumption, longer delivery times, and increased freight costs. In addition, global freight rates have experienced significant volatility, with increases of up to 30–50% during periods of geopolitical instability and pandemic-related disruptions.

These developments have contributed to a broader structural shift toward regionalization of supply chains. Companies are increasingly adopting nearshoring and friend-shoring strategies to reduce dependency on distant and politically unstable regions. This trend is particularly evident in industries such as automotive manufacturing, electronics, and pharmaceuticals, where supply chain resilience has become a strategic priority. As a result, regional logistics hubs are gaining importance, and intra-regional trade flows are expanding faster than intercontinental trade.

Sustainability has emerged as another central dimension of global logistics transformation. The transport sector is responsible for approximately 7–8% of global carbon emissions, making it a key focus of environmental policy initiatives. International organizations such as the

International Maritime Organization (IMO) and the European Union have introduced ambitious decarbonization targets to reduce emissions from transport systems. The IMO has set a target to reduce carbon intensity in international shipping by at least 40% by 2030 compared to 2008 levels, while the European Union has introduced carbon pricing mechanisms for maritime and road transport under its broader climate policy framework. These regulatory measures are accelerating the transition toward green logistics systems.

Green logistics strategies include electrification of freight transport, optimization of delivery routes using AI systems, modal shifts from road transport to rail and maritime transport, and the development of energy-efficient logistics infrastructure. Empirical evidence suggests that companies adopting green logistics practices can reduce emissions by approximately 10–25%, while also achieving long-term cost savings through improved energy efficiency. Consumer behavior is also influencing sustainability trends in logistics. Recent market surveys indicate that more than 60% of global consumers prefer environmentally responsible supply chains, and this preference is increasingly shaping corporate logistics strategies. As a result, sustainability is no longer a regulatory obligation alone but also a competitive advantage in global markets.

Institutional frameworks play a crucial role in supporting global logistics integration. The World Trade Organization facilitates trade liberalization through agreements aimed at reducing tariff and non-tariff barriers. The Trade Facilitation Agreement has significantly improved customs efficiency, reducing border delays by an average of 1 to 3 days globally, which directly enhances logistics performance. The World Customs Organization contributes to harmonizing customs procedures and standardizing documentation systems, thereby reducing administrative complexity in cross-border trade. Similarly, the International Maritime Organization establishes global standards for maritime safety and environmental compliance, ensuring uniformity in international shipping operations.

Regional integration mechanisms also play a vital role in logistics harmonization. The European Union's single market eliminates internal border controls, significantly reducing transaction costs and enabling seamless movement of goods. ASEAN initiatives in Southeast Asia focus on improving transport connectivity through infrastructure development and regulatory harmonization. These institutional frameworks collectively enhance global logistics interoperability.

Despite these advancements, several structural challenges continue to hinder global logistics integration. Infrastructure inequality remains one of the most significant barriers. Many developing countries lack sufficient road networks, port capacity, and digital logistics infrastructure, resulting in higher transportation costs and reduced trade competitiveness. Supply chain vulnerability is another major challenge. The COVID-19 pandemic exposed the fragility of global just-in-time production systems, leading to widespread shortages and disruptions across multiple industries. Similar vulnerabilities have been observed during natural disasters and geopolitical conflicts, highlighting the need for more resilient supply chain structures.

Rising logistics costs also pose a significant constraint on global trade. Volatility in fuel prices, labor shortages in transport sectors, and increased insurance costs have contributed to higher freight expenses. These cost pressures have had inflationary effects on global economies, particularly in import-dependent countries.

Table 1

Key indicators of logistics and transport integration in global supply chains

№	Dimension	Indicator Measure	Statistical Evidence (Recent Years)	Implications for Global Chains	for Supply
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1	Global Trade Expansion	Total global trade volume	~35 trillion USD (2025, UNCTAD)	Increasing demand for efficient logistics coordination across countries
2	Services Trade Growth	Annual growth rate of services trade	~7–10% in digital services sectors	Expansion of logistics-dependent digital trade ecosystems
3	Supply Chain Structure	Share of intermediate goods in trade	Over 50% of global trade flows	High dependence on cross-border logistics efficiency
4	Logistics Performance Gap	LPI score difference	High-income: 3.5–4.2; Low-income: <2.5	Inequality in logistics capacity limits global integration
5	Trade Cost Reduction	Impact of logistics improvement	15–25% reduction in trade costs	Strong economic incentive for logistics infrastructure investment
6	Export Performance	Export volume difference by LPI ranking	Top quartile countries: 40–60% higher exports	Logistics efficiency directly drives export competitiveness
7	AI in Logistics	Cost reduction from AI adoption	15–20% reduction in operational costs	Increased efficiency in routing, forecasting, and warehousing
8	IoT Implementation	Reduction in inventory losses	20–30% reduction in advanced systems	Improved real-time monitoring and supply chain visibility
9	Blockchain Adoption	Customs processing time reduction	30–40% faster clearance in pilot projects	Enhanced transparency and reduced administrative delays
10	Geopolitical Fragmentation	Increase in shipping distances	+400 to 600 nautical miles since 2018	Higher transport costs and longer delivery times
11	Freight Rate Volatility	Cost fluctuations in global shipping	30–50% increase during disruption periods	Supply chain instability and inflationary pressure
12	Green Logistics Impact	Emission reduction potential	10–25% reduction in CO ₂ emissions	Transition toward sustainable logistics systems

13	Transport Sector Emissions	Share of global CO ₂ emissions	~7–8% globally	Strong need for decarbonization policies
14	Trade Facilitation Impact	Customs delay reduction	1–3 days reduction (WTO TFA)	Faster cross-border trade and improved efficiency

Overall, logistics integration into global supply chains continues to generate substantial economic benefits despite these challenges. Efficient logistics systems reduce trade costs, enhance export performance, attract foreign direct investment, and enable greater participation in global value chains. Empirical evidence consistently shows that improvements in logistics performance are among the most effective drivers of trade expansion and economic growth.

CONCLUSION

The integration of logistics and transport services into global supply chains is a fundamental driver of modern economic globalization. It enables efficient trade flows, reduces costs, enhances competitiveness, and supports economic development across regions. However, this integration is increasingly shaped by complex forces, including digital transformation, geopolitical instability, environmental sustainability, and institutional regulation. While advanced economies benefit from highly efficient logistics systems, developing countries continue to face structural barriers that limit their participation in global supply chains.

Future development of global logistics systems will depend on three key factors: investment in infrastructure, digital transformation, and international regulatory cooperation. Countries that successfully integrate these dimensions will be better positioned to benefit from the evolving architecture of global trade. Ultimately, logistics and transport services are no longer auxiliary components of trade; they are central pillars of global economic integration and resilience in an increasingly interconnected and uncertain world.

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