

NEW METHODOLOGY FOR EVALUATING LOGISTICS CHAINS IN INTERNAL LOGISTICS

Abstract. In a globalized economy, effective management of international logistics chains is a key factor for maintaining competitiveness and successful trade. The present study updates the methodology for evaluating logistics chains based on the Logistics Performance Index (LPI) data developed by the World Bank, focusing on the Visegrad Four countries (Czech Republic, Poland, Slovakia and Hungary). The aim of the new methodology is to identify trends and changes in the field of modernization of transport infrastructure, efficiency of customs processes and implementation of digital technologies, including the application of Industry 4.0 solutions. In addition, the study also addresses the impact of environmental measures, such as the European Green Deal, on reducing the carbon footprint and supporting the sustainable development of supply chains. The results obtained indicate that investments in modernization technologies and digitalization of logistics services are essential for increasing efficiency and competitiveness logistics subjects in the international market. The proposed recommendations aim to strategically improve infrastructure and digital capacities, which has the potential to contribute to the sustainable development of logistics chains in a globalized economy.

Keywords: Logistics performance index, Logistics chain, Internal logistics, Evaluating logistics chains.

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Introduction

In a globalized world, logistics chains play a key role in ensuring the efficient movement of goods between countries. The Logistics Performance Index (LPI), developed by the World Bank, provides a comparison of logistics quality across different nations. This article updates data on the logistics performance of the Visegrad Group (V4) countries (Czechia, Slovakia, Poland, and Hungary), focusing on the years 2007, 2010, and 2023. It also highlights the top-performing countries in 2023, as evaluated using this methodology. The Logistics Performance Index is an interactive tool created by the World Bank to assess the performance of logistics chains in various countries. The latest edition of the LPI from 2023 allows for the comparison of 139 countries based on pre-defined key indicators (www.lpi.worldbank.org).

Updating data and analyzing trends in logistics are essential for understanding the dynamics of global supply chains and identifying areas for improvement. The World Bank updates the LPI every two years, enabling the tracking of long-term trends. The LPI evaluates countries on a scale from 1 to 5 based on six criteria (www.tradingeconomics.com):

1. *Efficiency of customs processes* – The speed and predictability of border control formalities.
2. *Quality of trade and transport infrastructure* – Assessment of the quality of ports, railways, roads, and information technologies.
3. *Ease of arranging international shipments* – The ability to secure competitive transport prices.

4. *Competence and quality of logistics services* – Evaluation of transport operators and customs brokers.
5. *Ability to track and monitor shipments* – The capacity for effective shipment tracking during transport.
6. *Timeliness of deliveries* – Adherence to planned or expected delivery times.

1. LPI ranking of the Visegrad group countries in 2023

In 2023, significant changes occurred in the LPI rankings. Singapore ranked first with an overall score of 4.3, followed by Finland with a score of 4.2. Germany, the Netherlands, Switzerland, and Denmark shared third place, each with a score of 4.1. At the bottom of the ranking, Afghanistan had the lowest rating at 1.9. (www.lpi.worldbank.org).

India showed notable improvement, moving up six places to secure the 38th position in 2023. This progress is attributed to initiatives such as the PM GatiShakti National Master Plan and the National Logistics Policy, which focus on enhancing logistics efficiency and reducing costs. Next table (Table 1) below presents the top 10 countries according to the LPI in 2023 (www.tradingeconomics.com).

Table 1. Ranking of the Top Countries by LPI

Rank	Country	LPI Score
1.	Singapore	4,3
2.	Finland	4,2
3.	Germany	4,1
3.	Netherlands	4,1
3.	Switzerland	4,1
3.	Denmark	4,1
7.	Belgium	4,0
7.	Austria	4,0
7.	USA	4,0
10.	Sweden	3,9

(source: www.tradingeconomics.com)

Regarding Slovakia, the Logistics Performance Index in 2022 was as follows: The quality of trade and transport-related infrastructure (rated on a scale from 1 = low to 5 = high) in Slovakia was reported at 3.3 in 2022, according to the World Bank's collection of development indicators compiled from officially recognized sources. The current values, historical data, forecasts, and projections originate from the World Bank as of February 2025. The given data is illustrated in Fig. 1 (www.tradingeconomics.com).

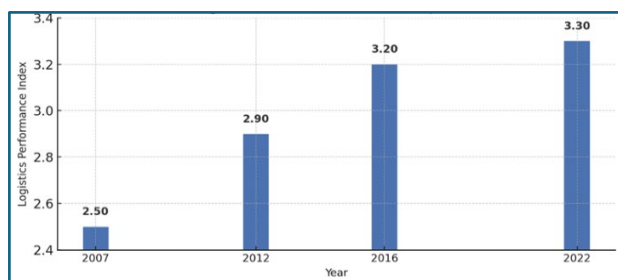


Fig. 1. Logistics Performance Index of Slovakia
(Source: www.tradingeconomics.com)

The data originates from the Logistics Performance Index surveys conducted by the World Bank in collaboration with academic and international institutions, private companies, and individuals involved in international logistics. In 2009, the survey round covered more than 5,000 country assessments by nearly 1,000 international freight forwarders.

Respondents evaluate eight markets across six key dimensions on a scale from 1 (worst) to 5 (best). The markets are selected based on the respondent's most important export and import markets, random selection, and, in the case of landlocked countries, neighboring countries that connect them to international markets¹.

Respondents rated the quality of trade and transport-related infrastructure (e.g., ports, railways, roads, and information technology) on a scale from 1 (very low) to 5

(very high). The scores represent the average rating across all respondents (Majerčák, 2015).

2. Changes in global trends in Logistics

Global logistics trends indicate changes in the warehousing sector. For instance, in the U.S., warehouse construction declined by 43% in the third quarter of 2024 compared to the previous year, marking the largest drop since 2008. This trend is accompanied by an increase in warehouse vacancies, reaching 6.4% (El Yaagoubi, 2022). On the other hand, Prologis reported an increase in profits and revenues in Q3 2024, indicating an improving market for logistics real estate. This growth is attributed to the decline in new warehouse construction, which has led to a limited supply of industrial properties (www.wsj.com). For a current comparison with neighboring countries, the V4 country assessment model was selected. A comparison evaluation of the LPI in 2007, 2010, and 2023 for V4 countries is presented in the next tables (Table 2).

Table 2. V4 Countries' Evaluation in 2007, 2010, and 2023

Country	Year 2007		Year 2010		Year 2023	
	Rank	LPI	Rank	LPI	Rank	LPI
Czech Republic	38	3,13	26	3,51	23	3,67
Poland	40	3,04	30	3,44	25	3,54
Slovakia	50	2,92	38	3,24	45	3,30
Hungary	35	3,15	52	2,99	53	3,22

(Source: www.lpi.worldbank.org)

A comparison by individual criteria of the LPI in 2023 for V4 countries is presented in the next tables (Table 3).

Table 3. V4 Countries' Evaluation in 2023 by individual criteria

Evaluation Criteria in 2023	Czech Republic	Poland	Slovakia	Hungary
Efficiency of customs processes	3,40	3,20	3,00	2,90
Quality of infrastructure	3,80	3,70	3,50	3,40
Ease of shipment organization	3,60	3,50	3,20	3,10
Competence of logistics services	3,70	3,60	3,30	3,20
Possibility of shipment tracking	3,50	3,40	3,10	3,00
Timeliness of deliveries	3,80	3,60	3,40	3,30

(Source: www.lpi.worldbank.org)

3. Analysis of trends and changes in V4 country ratings

The evaluation and analysis of these trends and changes in country ratings can be summarized as follows:

¹ Detailed survey methodology can be found in *Arvis et al.'s Connecting to Compete 2010: Trade Logistics in the Global Economy*.

- Czech Republic maintains a stable upward trend in logistics performance and ranks among the best-performing countries in the region.
 - Poland has improved its logistics infrastructure thanks to extensive investments in roads and railway connections.
 - Slovakia has declined compared to 2010, with the biggest weakness remaining the efficiency of customs processes.
 - Hungary experienced a decline in 2010 but has recently shown slight improvement (Kampf, 2016).
- Key Factors Affecting Logistics in V4 Countries:
- Investments in transportation infrastructure (high-speed railways, highways, smart logistics).
 - Digitalization of customs processes and supply chain tracking.
 - Market liberalization and integration into global supply chains (Kudláč, 2017).

4. Impact of the Green deal and Carbon footprint in supply chain

The impact of the Green Deal and carbon footprint in supply chains, especially in the EU region, can be specified in these areas:

1. *Legislative Framework and Green Deal Goals*
2. *Impact on logistics*
3. *Measuring Carbon Footprint*
4. *Synergistic Effects*

1. Legislative Framework and Green Deal Goals

The European Green Deal is an ambitious plan by the European Union to achieve climate neutrality by 2050. This framework includes measures to reduce greenhouse gas emissions, support renewable energy sources, enhance energy efficiency, and foster innovation in sustainable transport. The legislative package includes the revised Emissions Trading System (ETS), which incentivizes companies to invest in cleaner technologies, as well as various initiatives promoting electromobility and smart transportation systems (Jensen, 2019).

2. Impact on Logistics

The Green Deal presents multiple challenges and opportunities for logistics, including:

- *Transition to greener fuels:* Adoption of electric or hybrid vehicles, use of biofuels, or hydrogen to reduce emissions.
- *Optimization of transport routes:* More efficient route planning and multimodal transport help minimize distances and, consequently, the carbon footprint.
- *Investment in infrastructure:* Modernization of transportation and storage infrastructure with a focus on energy efficiency.
- *Process digitalization:* Implementation of smart transportation management and shipment monitoring systems, optimizing operations while reducing emissions (Pasagic, 2017).

3. Measuring Carbon Footprint

Measuring the carbon footprint in supply chains is crucial for identifying areas with the highest environmental impact. Various methodologies are used:

- **GHG Protocol and LCA (Life Cycle Assessment):** These standards evaluate CO₂ and other greenhouse gas emissions throughout the entire supply chain from production to transportation and distribution.
- **Software tools and carbon footprint calculators:** Companies utilize specialized tools to monitor and assess emissions, helping them identify the most effective ways to reduce their carbon footprint.
- **Reporting and transparency:** Implementing regular carbon footprint reporting is becoming increasingly important for gaining investor and customer trust (Lekic, 2020).

4. Synergistic Effects

Integrating sustainable measures into logistics chains brings multiple synergistic benefits:

- *Cost savings and emission reductions:* More efficient transportation management and optimized routes lower both the carbon footprint and fuel/operational costs.
- *Increased competitiveness:* Companies investing in green technologies gain a competitive edge and enhance customer trust.
- *Innovation support:* Sustainable solutions drive the adoption of new technologies and processes, which can be applied across industries (www.wsj.com).
- *Environmental and social benefits:* Besides direct economic advantages, these measures contribute to a better environment and improved quality of life (Ashima, 2022).

These aspects collectively provide a comprehensive view of how the Green Deal is reshaping not only the legislative landscape but also logistics itself. Sustainable supply chains are becoming essential not only for reducing the carbon footprint but also as a strategic tool for increasing efficiency and competitiveness in the market.

5. Countries' readiness for changes in supply chains

According to a survey conducted by the Smart Industry Association – Industry4UM on the penetration level of Industry 4.0 in the industry, currently, one-third of companies are implementing their digitalization strategy. While the trend of digitalization is growing, small and medium-sized enterprises (SMEs) and companies with Slovak ownership structure still struggle with a lack of resources and employees' digital skills. The survey was conducted at the end of 2024 on a sample of 99 respondents by the research agency Go4insight (www.industry4um.sk).

Currently, 32 % of industrial companies are implementing their digitalization strategy, representing a 5 % year-on-year increase. However, just like in 2023, nearly a quarter of companies (23 %) have not yet started the digitalization process. The main barriers to digital transformation include financial constraints (60 %), Lack of digital skills among employees (39 %), Poor change management by leadership (38 %), Lack of a digitalization leader within the company (35 %) (www.pib.gov).

These findings highlight the need to focus on education, strategic management, and leadership

development. Companies would be encouraged to digitalize by greater access to funding (71 %) and examples of successful applications (54 %). The survey also revealed significant differences in the implementation of Industry 4.0 between foreign-owned and Slovak companies. Over the past four years, the share of Slovak firms involved in digitalization has increased from 11 % to 20 %, but they still lag foreign-owned companies, where the adoption rate of Industry 4.0 is more than double (48 % in 2024) (www.industry4um.sk).

Regarding the importance of digital transformation, almost half of the companies consider it very important (2023 – 48 %, 2024 – 46 %). Companies primarily focus on internal process digitalization, which directly affects the production chain, while support areas are less digitalized: Production processes – 55 %, Logistics – 47 %, Maintenance – 34 %, Pre-production – 33 % (www.lpi.worldbank.org).

From the perspective of external processes, the top digitalization priorities are:

- customer communication (28%),
- communication with suppliers and external logistics (both 21%).

A shortage of qualified specialists is most evident in the fields of:

- artificial intelligence (59%),
- programming (36%),
- data analysis (35%).

This situation underscores the need for targeted education, retraining programs, and practical training improvements to ensure the successful implementation of Industry 4.0. The survey also showed that larger enterprises and foreign-owned firms invest significantly more in employee development (www.industry4um.sk).

Conclusions

It is evident that digitalization processes are now a top priority, not only in supply chains but also in the organizational structures of both large multinational corporations and small and medium-sized enterprises. Therefore, it is essential to monitor these developments comprehensively and approach them with seriousness and urgency to deliver practical results.

Another figure (Fig. 2) illustrates the need for Industry 4.0 implementation in external processes. The digitalization of customer interaction is a top priority (28 %), as customer experience directly influences business success. Additionally, digitalizing communication with suppliers and external logistics (21 %) is crucial for improving efficiency and flexibility, according to the survey (www.industry4um.sk).

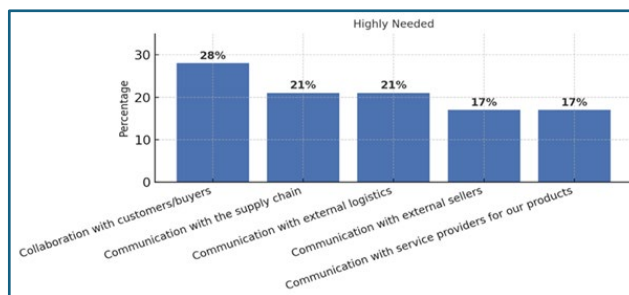


Fig. 2. The need for Industry 4.0 in external processes
(Source: www.tradingeconomics.com, modified by the author)

Based on a comprehensive analysis of the collected data and trends in logistics chain assessment, the following conclusions can be drawn. The development of the LPI in the V4 countries between 2007, 2010, and 2023 confirms that modernizing transport infrastructure and optimizing logistics processes contribute to improving the overall performance of international logistics.

The Czech Republic and Poland show steady growth, indicating successful investments in modernization technologies and processes, while Slovakia and Hungary still face challenges, particularly in customs process efficiency. A key finding is the critical role of digitalization. The integration of smart systems and Industry 4.0 technologies, along with the optimization of both internal and external logistics processes, is emerging as a key factor in enhancing the competitiveness and efficiency of supply chains. However, the lack of investment in digital skills and funding, especially among small and medium-sized enterprises (SMEs), highlights the need for strategic management and targeted educational support in this area.

From an environmental perspective, the implementation of initiatives such as the European Green Deal serves as a significant driver for the transition to sustainable logistics solutions. Measures such as route optimization, the adoption of eco-friendly fuels, and the modernization of storage and transport infrastructure help reduce carbon footprints while also creating opportunities for cost savings and operational efficiency improvements (Kudláč, 2017).

These findings indicate that for the sustainable development of international logistics, continued infrastructure modernization and process digitalization are essential, while simultaneously addressing modern environmental demands. Future research should focus on methodological improvements in evaluation tools and the comprehensive integration of digital and sustainable strategies, contributing to greater competitiveness and efficiency in logistics chains within the globalized economy.

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