

## The logistics and sustainability in the European Union

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**Abstract:** The paper is focused on the issue of business logistics performance and sustainability of countries in the EU due to their constantly growing importance in the social, economic and environmental field. We assume a significant dependence between the mentioned quantities. To research the relationship between business logistics performance and sustainability, we used the data of the business logistics performance index and the sustainability index across each EU countries. The importance of the selected indices lies in the ability to identify possible opportunities and challenges of business logistics as a benchmarking tool to increase its performance. To assess the relationship of these researched parameters, we applied the correlation coefficient, cluster and geographic analysis to identify relatively homogeneous groups - EU countries - clusters with the greatest possible difference within the clusters. The results proved a statistically significant dependence between the performance of business logistics and sustainability in EU member states. From a geographic analysis perspective, we have identified a tendency to create geographically close groupings of EU countries within the examined parameters.

### 1 Introduction

Sustainability and logistics have been gaining more and more attention in recent years [1]. Logistics as such and activities related to it have several positive socio-economic effects, as it meets the requirements for accessibility and mobility, creation of infrastructure, jobs, reduction of poverty, hunger, etc., thereby enriching society as a nation and satisfying people's demands. Companies began to take global market demand into account in their strategic planning. This has caused the expansion of trade liberalization and globalization. Globalization and the associated potential growth of competitive advantages in the market and development began to require continuous business processes and their innovations to maintain competitiveness. Business logistics began to be considered the most crucial area that requires innovation, because it constituted a successful method of streamlining performance [2-7]. However, recent logistics create multiple negative impacts on the surrounding environment. First, logistics is still heavily dependent on fossil fuels and non-renewable natural resources, which is harmful to an individual's health and safety of the population, causes air, soil, water pollution, noise and other negative externalities negatively affecting the environment [8,9] and societies. Sustainable development is an inspiring element for sustainable logistics to create activities to reduce the

negative impacts of logistics [8] and even increase favourable effects of this sector on the environment and society. The problems lie in the creation of negative externalities, which come from daily operation to long-distance distribution [10] including emissions, congestion, visual disturbance, infrastructure failure, etc. In addition, these disadvantages of logistics further lead to a decline in the performance of the logistics chain at the company level and at the regional level, which, since the need for logistics increases, creates an exponential growth of negative impacts on the economy and the entire ecosystem [11].

The sustainable development of logistics requires activities that result in societal and economic benefits along with reducing adverse effects on the environment. In the long term, however, these activities are not easy at all and represent great challenges associated with various dilemmas and barriers. Developed countries including the European Union emphasize trends, such as mobility, urbanization, aging, but also migration, which pose challenges for their social and economic development. The main environmental challenges are global warming and growing shortage of fossil fuels. All these issues as well as potential future challenges, play an essential role in the management of sustainability. The challenges of environmental sustainability and logistics are elaborated from a supply chain perspective by Abbasi and Nilsson

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[12], classifying them into costs, complexity, mindset changes, operationalization, cultures, and uncertainties. Paradoxes in the field of green logistics elucidated Rodrigue et al. [13] as a result of cost, reliability, time/speed, storage and e-commerce [8,14]. Aspects of many solutions that can lead to effective systems supporting sustainable development play a key role in recent approaches to sustainability. As part of the aspects of sustainability, other approaches and ideas based on and supporting the circular economy are therefore being developed simultaneously. The concept of a circular economy centers on and is predicated on the recycling and use of waste and existing resources. From this point of view, transformation is based on the reuse of existing infrastructures and the facilitation of processes within new infrastructures [15]. Developed countries with regard to demography, social and economic conditions are preparing cities for the inevitable transformation with regard to the circular economy and sustainable development, because the achievement of sustainability goals can support the use of circular economy concepts [16,17]. Sharing and recycling solutions in transport and regeneration of energy resources, waste management, digital transformation and transport systems in various industrial sectors form complementary policies in the framework of sustainable development and improvement of mobility systems. Most studies focus on challenges from the perspective

of sustainability in logistics, but do not focus on measuring their mutual relationship [8,14]. Therefore, the aim of this paper is to determine the relationship between business logistics performance and sustainability in EU countries. Based on the mentioned literature, we set the research question: “We assume a statistically significant dependence between the logistics and sustainability performance in the EU.”

**2 Methodology**

For the statistical investigation of the reserch question, we used data the Logistics Performance Index (LPI) [18] and the Sustainability Development Index (formerly SDG Index & Dashboards) [19].

To determine company logistics possibilities and challenges, the Logistics Performance Index, as an interactive benchmarking tool to increase logistics performance, was used. The Logistics Performance Index evaluates 160 countries to identify business experience in the global logistics-business environment. It represents a benchmarking tool not only for comparing these qualitative-quantitative indicators, but also for sharing experiences in this area. The logistics components of each country are captured by the Logistics Performance Index from the perspective of six different elements, see figure 1.

The logistics components	Customs
	Infrastructure
	International shipments
	Logistics quality and competence
	Tracking and tracing
	Timeliness

Figure 1 Basic elements of the Logistics Performance Index

The Sustainable Development Report (the term “SDG index” is used for the purpose of this study) assesses the progress of all 193 UN Member States on the SDGs: In 2023, Finland, Sweden and Denmark top the rankings. The SDG Index is a worldwide evaluation that assigns equal

weight to each of the 17 SDGs and assesses how well a country has performed overall. The number represents the country's position between the goal (score of 100) and the worst-case scenario (score of 0). The figure 2 shows the short titles of the 17 SDGs.

The short titles of 17 SDGs	SDG 1 - No poverty
	SDG 2 - Zero hunger
	SDG 3 - Good health and well-being
	SDG 4 - Quality education
	SDG 5 - Gender equality
	SDG 6 - Clean water and sanitation
	SDG 7 - Affordable and clean energy
	SDG 8 - Decent work and economic growth
	SDG 9 - Industry, innovation, and infrastructure
	SDG 10 - Reduced inequalities
	SDG 11 - Sustainable cities and communities
	SDG 12 - Responsible consumption and production
	SDG 13 - Climate action
	SDG 14 - Life below water
	SDG 15 - Life on land
	SDG 16 - Peace, justice, and strong institutions
	SDG 17 - Partnerships for the goals

*Figure 2 The short titles of the 17 SDGs*

The SDGs emphasize the interconnected environmental, social and economic aspects of sustainable development by putting sustainability at their center [7,20,21].

The secondary data provided are the basic inputs of this study. Collected secondary data were for 27 countries of the European Union. The obtained secondary data were processed using Microsoft Excel and Statistic software. Correlation, cluster and geographic analysis was used for the analysis of the obtained secondary data. Correlation analysis, which identifies how strongly the research variables are related to one another, was used to determine the relationship between sustainability and the performance of corporate logistics in EU countries within the research question. The research question was transformed into a hypothesis:

H1 “Between the Logistics Performance index and the Sustainability Development Index there is a statistical significant dependence”. The strength of the relationship identified through the correlation coefficient within the performed correlation analysis is interpreted as follows:

- especially strong, when the variables are highly dependent on one another - the range of values for the correlation coefficient is 0.8 to 1, respectively -0.8 to -1,

- moderately strong - when there is a moderately strong interdependence between the variables - the range of values for the correlation coefficient is 0.4 to 0.8, respectively from -0.4 to -0.8,
- weak, when there is a weak interdependence between the variables - the range of values for the correlation coefficient is 0 to 0.4, respectively from -0.4 to 0.

Correlation coefficient values represent the dependence between the variables under study, so that if one variable changes, it affects the other variable. For further analysis of the relationship between the studied variables, we used cluster and geographic analysis to identify the EU countries with the most significant possible similarity among the group of countries (clusters), and at the same time with the greatest possible difference between the groups [22,23]. Through the method of induction and deduction, we drew up conclusions of our research.

### 3 Result and discussion

By processing secondary data, evaluating them through correlational, cluster and geographical analysis, we reached the following conclusions. Table 1 displays the components of the logistics performance index, the SDG Index, and correlation indicator data.

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Table 1 Sustainability and business logistics performance in the EU – primary data [18,19]

Country	Logistics Performance Index 2023							SDG index
	Total	Customs	Infrastructure	International shipments	Logistics quality and competence	Tracking and tracing	Timeliness	
Germany	4.20	4.09	4.37	3.86	4.31	4.24	4.39	83.40
Sweden	4.05	4.05	4.24	3.92	3.98	3.88	4.28	86.00
Belgium	4.04	3.66	3.98	3.99	4.13	4.05	4.41	79.50
Austria	4.03	3.71	4.18	3.88	4.08	4.09	4.25	82.30
Netherlands	4.02	3.92	4.21	3.68	4.09	4.02	4.25	79.40
Denmark	3.99	3.92	3.96	3.53	4.01	4.18	4.41	85.70
Finland	3.97	3.82	4.00	3.56	3.89	4.32	4.28	86.80
France	3.84	3.59	4.00	3.55	3.84	4.00	4.15	82.00
Spain	3.83	3.62	3.84	3.83	3.80	3.83	4.06	80.40
Italy	3.74	3.47	3.85	3.51	3.66	3.85	4.13	78.80
Czech Republic	3.68	3.29	3.46	3.75	3.72	3.70	4.13	81.90
Portugal	3.64	3.17	3.25	3.83	3.71	3.72	4.13	80.00
Luxembourg	3.63	3.53	3.63	3.37	3.76	3.61	3.90	77.70
Poland	3.54	3.25	3.21	3.68	3.58	3.51	3.95	81.70
Ireland	3.51	3.36	3.29	3.42	3.60	3.62	3.76	80.20
Hungary	3.42	3.35	3.27	3.22	3.21	3.67	3.79	79.40
Slovenia	3.31	3.42	3.26	3.19	3.05	3.27	3.70	81.00
Estonia	3.31	3.32	3.10	3.26	3.15	3.21	3.80	81.70
Greece	3.20	2.84	3.17	3.30	3.06	3.18	3.66	78.40
Romania	3.12	2.58	2.91	3.18	3.07	3.26	3.68	77.50
Croatia	3.10	2.98	3.01	2.93	3.10	3.01	3.59	81.50
Bulgaria	3.03	2.94	2.76	3.23	2.88	3.02	3.31	74.60
Slovakia	3.03	2.79	3.00	3.10	3.14	2.99	3.14	79.10
Lithuania	3.02	2.85	2.73	2.79	2.96	3.12	3.65	76.80
Malta	2.81	2.70	2.90	2.70	2.80	2.80	3.01	75.50
Latvia	2.81	2.80	2.98	2.74	2.69	2.79	2.88	80.70
Cyprus	3.15	3.05	2.89	3.15	3.00	3.15	3.62	72.50
Correlation index	0.63	0.66	0.65	0.50	0.60	0.62	0.58	1.00

As the correlation coefficient values of the individual variables show, the relationship between logistics performance and sustainability has a moderately strong dependence between the researched variables – Customs (0.66), Infrastructure (0.65), Tracking and tracing (0.62), Logistics quality and competence (0.60), Timeliness (0.58), and International shipments (0.50). Based on the mentioned results, we can conclude that the dependence between innovations and the logistics performance in the

EU is statistically significant and hypothesis H1 is accepted.

In order to separate the EU countries into groups (clusters) with the greatest similarity in terms of business logistics performance and sustainability, while also having the greatest differences between individual clusters - groups, a cluster analysis was another processed analysis of the investigated issue (see Figure 3).

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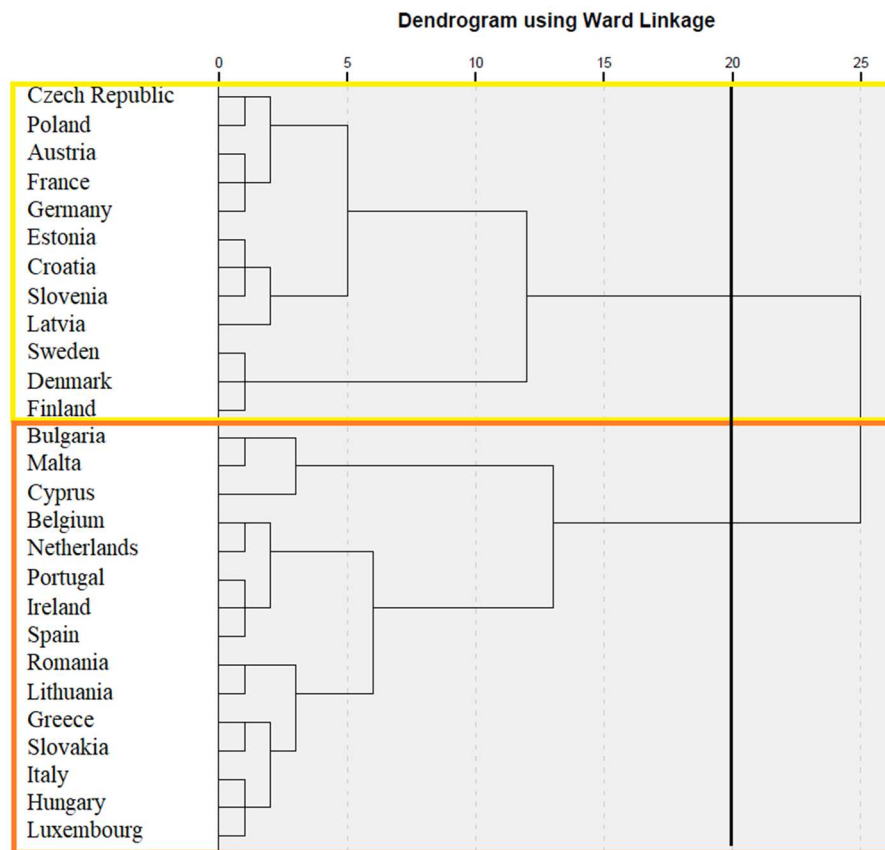


Figure 3 The sustainability and logistics in the EU – cluster analysis

At the Eudclidean distance of 20, we identified the largest distance between groups (clusters) of EU countries. In terms of the research relationship between business logistics performance and sustainability, this distance indicates the greatest difference between the analyzed groups - clusters and the highest similarity within the groups - clusters of the examined EU countries. Based on the above, we identified two clusters:

The *first cluster* consists of countries with an average higher index of business logistics performance and sustainability: Sweden, Finland, Denmark, Germany, France, Austria, Czech Republic, Poland, Estonia, Slovenia, Latvia, and Croatia.

The *second cluster* consists of countries with an average lower index of business logistics performance and sustainability: Bulgaria, Malta, Cyprus, Belgium, Netherlands, Spain, Italy, Portugal, Luxembourg, Ireland, Hungary, Greece, Romania, Slovakia, Lithuania.

Subsequently, a geographical analysis was carried out. Through geographic analysis, we plotted the average values of business logistics performance and sustainability of individual EU countries on the map, see Figure 2. The figure shows the level of business logistics performance and sustainability according to the intensity of the color. The more saturated the color, the higher the average value of the indices of business performance and sustainability.

The weaker the color, the lower the average value of the business logistics performance and sustainability indices.

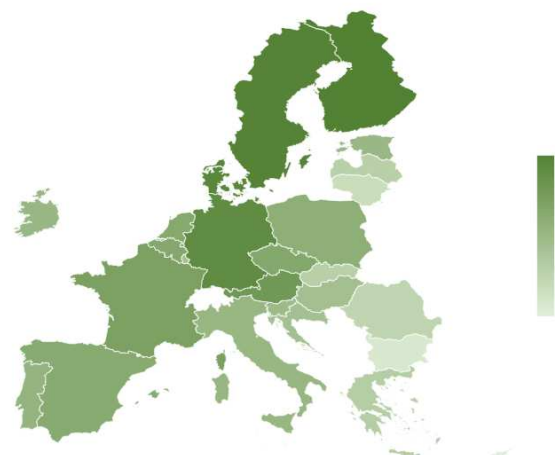


Figure 4 Geographical analysis of the relationship between logistics and sustainability

Drawing from the conducted analyses, we may conclude that countries with a higher value of the sustainability index (SDG index) tend to have a higher performance of business logistics, which confirms the moderate statistical dependence of their relationship

(0.63). Simultaneously, the geographical analysis of the relationship between sustainability and logistics allows us to conclude that the countries with the best performance in business logistics and sustainability tend to form geographically close groups or the well-reformed Nordic countries have a greater implementation of sustainability in practice - the performance of business logistics and sustainability declines with increasing geographical distance from the more efficient countries in the researched area, this finding confirmed the previous studies of Loučanová, Europe Sustainable Development Report [23,24].

The results confirm the facts of the dependence of sustainability and logistics [8], as the identified dependence between the monitored variables is positive (the correlation coefficient of the dependence of the researched variables of logistics and sustainability has a positive value). We assume that logistics has a positive influence especially on the economic-social goals of sustainability, which prevail over the environmental goals of sustainability [4-6]. Business logistics began to be considered the most crucial area that requires innovation, because they represented an effective means of streamlining performance and thus also reducing negative impacts on the environment. Organizations might potentially grow and gain competitive advantages in the market by implementing innovative business processes within logistics and at the same time try to eliminate the negatives associated with logistics. As stated by studies [25,26], the innovations increase performance, economic growth and sustainability by their impact.

#### 4 Conclusions

The study demonstrates a causal relationship between EU member states' sustainability and trade logistics performance. The findings of the analyses that were conducted indicate that:

- countries with a higher value of the sustainability index tend to achieve higher business logistics performance within the medium statistical dependence of their relationship,
- countries that perform best in sustainability and business logistics typically cluster together in close geographical areas.,
- the performance associated with business logistics and sustainability decreases with growing geographical distance from the more efficient countries in the studied area.

Based on the evaluation of the hypotheses and the confirmation of the positive relationship between the selected variables, we can subsequently point to the significant influence of logistics on the successful achievement of the set goals, both economic and social. It is important to respect the need for sustainability, which is also required in the field of business logistics when

fulfilling the stated goals. Through innovative solutions in the field of logistics, which will lead to the elimination of negative impacts on the environment, we can expect positive results that will be reflected not only in the growing performance of the company itself but also in its competitiveness on the global market.

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#### Review process

Single-blind peer review process.