THE RELATIONSHIP OF INNOVATION AND THE PERFORMANCE OF BUSINESS LOGISTICS IN THE EU
Erika Loucanova; Miriam Olsiakova; Hubert Palus

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Abstract: At present, innovations have a significant impact on the success of the company on the market, and in the case of their correct implementation, they represent a competitive advantage for the company, which significantly differentiates it from the competition. At the same time, we can perceive them as an essential part of business, as the market, consumers and their preferences change dynamically, and through innovations the company can respond more flexibly to these changes and thus gain an advantage over its competition. The paper is dealing with the issue of innovation and business logistics performance in the EU. To examine the relationship between innovation and business logistics performance, we used data on the Innovation Index and the Logistics Performance Index in individual EU countries. The correlation analysis was applied to assess the closeness of the statistical dependence among the investigated variables, and subsequently we applied cluster analysis to decompose the basic set of investigated objects into several relatively homogeneous subsets - clusters. The results confirm the dependence between innovation and business logistics performance in EU countries. Regarding the results of the analysis, we can state that countries with the greatest business logistics and innovation performance tend to form geographically close clusters, and this decreases with increasing geographical distance from more efficient countries.

1 Introduction

Nowadays, innovations are becoming an important success factor, the correct implementation of which can move the company ahead of the competition, increase its competitiveness, respond more flexibly to constantly changing customer requirements and strengthen its position on the market. Innovations represent a means by which it is possible to handle ever more demanding customer requirements, increasing competitive pressure, rapid technological development, and globalization of business [1-3].

Innovations in technologies continue to drive massive changes in logistics and supply chain management, making today perhaps the most exciting time in logistics or supply chain phenomena. Technological innovations lead to new ways of doing business, as well as entirely new business models. Nowadays, the number of technologies affecting logistics and supply chain management is considerable [4].

Logistics ensures that the given objects, such as raw materials, semi-finished products, parts, subcontracts, products, etc., are transported in the specified time, quantity, and quality to the specified place, while observing the required conditions and minimum costs. Logistics includes the processes of operational handling, transport, storage, and their management. Logistics is an area where significant savings can be achieved, it has an impact on the

fulfillment of customer requirements and on the flexibility of production.

By Kováč [5] the main requirements for logistics innovations as stated by are:
- Minimization of material flows. The material flow does not add any value for the customer, so it must be minimized.
- Continuity of material flows. It is related to the requirement of production cycle minimization and shortening
- Optimization in a global environment. New solutions for the global market of component suppliers and customers of final products.
- Use of computer management and electronic commerce technologies.
- New organization of supplier relations based on partnership and network organization.

The expansion of trade and services liberalization has forced companies to consider global market demand in their competitive strategic planning. Therefore, business processes had to become continuous, and innovations for them represent the promise of potential growth, development, and competitive advantages in the market. Business logistics has been considered as the most important area that needs to be innovated, because they

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represented an effective means of improving performance [6-10].

As reported by Jaafar et al. [6], innovation as a term was ignored in logistics research for a long time and was mainly associated with the general product and its innovations or focused on high-tech innovation. By Flint et al. [11,12], innovation represents an important factor for the logistics services and increasing competitive advantage. Flint et al. [12] in accordance with the innovation theory of Schumpeter [13], who defined innovation as the implementation of new combinations of product, process and organizational innovations that would provide new access to supplier or consumer markets, emphasize that innovation is not limited only to technological breakthroughs or products themselves, but the concept of innovation can occur within services, processes, or any social system. By their theory, innovation also includes the conscious application of information, imagination, and initiative in exploiting greater or different value from resources and includes all processes by which new ideas are generated and transformed into useful products but also services. Based on the above, Flint et al. [12] defined the term "logistics innovation" as any service related to logistics that is considered new and useful for customers so innovation represents any internal and external operations to increase operational efficiency.

The evaluation of innovativeness is carried out in terms of the frequency of introduction of new processes related to logistics and the ability to make them more efficient.. Panayides and Lun [14] in the evaluation of innovativeness in logistics concluded that innovations increase the performance of supply chains. Innovations in logistics represent the combined development of information and related technologies with new logistics and marketing practices to increase logistics performance [15]. As stated by Straka et al. [16] or Mansfield et al. [17], innovativeness and its impact on performance and economic growth has long been a subject of interest of economists. Based on the above, the aim of this paper is to identify the relationship between innovation and business logistics performance in the EU.

2   Methodology

The paper's methodology is based on data from The WORLD Bank [18], which evaluates the Logistics Performance Index, and The Global Economy [19], which provides data on the Global innovation index.

The Logistics Performance Index is an interactive benchmarking tool created to identify business logistics opportunities and challenges to increase its performance. The logistics performance index is based on a global quantitative and qualitative survey, and it is evaluated in 160 countries of the world to share business experience in the global business-logistics environment. The logistics Performance Index captures the logistics elements of individual countries from the point of view of:

- Customs,
- Infrastructure,
- International shipments,
- Logistics quality and competence,
- Tracking and tracing,
- Timeliness.

The Global Innovation Index monitors global innovation trends in individual countries of the world, which bring innovative effects of economic growth. The data obtained from these two basic sources represent the secondary inputs of this research and they can be subsequently processed by the SPPSS Statistic software from 27 countries of the European Union - EU 27.

Based on the literature review, we established the hypothesis H1 "We assume a statistically significant dependence between innovations and the logistics performance in the EU."

The correlation analysis was used to determine the relationship between these two monitored factors. The correlation coefficient defines the strength of the relationship between innovations and the performance of business logistics as well as its individual elements. The strength of the correlation coefficient relationship is interpreted according to Hanák [20] as follows - correlation coefficient values of 0.8 to 1 (-0.8 to -1) are particularly strong, so there is a very strong interdependence among the variables. Values from 0.4 to 0.8 (-0.4 to -0.8) are moderately strong, and from 0 to 0.4 (-0.4 to 0) are weak. These values represent findings how the change in one variable affects another variable. Linear correlation dependence means that if one variable grows, then another one also grows, which in our case represents that if the share of innovations grows, the performance of business logistics grows linearly with them.

We used cluster analysis to segment the EU countries from the point of view of the relationship between innovations and business logistics performance and its elements. We divided the EU countries into groups with the greatest similarity within the group and with the greatest possible difference among individual groups by the cluster analysis [21].

Subsequently, based on the findings, we will create conclusions about the solved issue through the inductive-deductive method.

3   Result and discussion

Based on the obtained data of the Logistics Performance Index and its elements, as well as the Global Innovation Index, we calculated the correlation coefficient characterizing the relationship of these variables, see Table 1. As the values of the correlation coefficients of individual variables show, the relationship of logistics performance with innovations shows medium to medium-strong dependence among the investigated variables. A very strong interdependence was shown only between Customs and innovations. This is probably because the Schengen

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area is among the EU countries. The members of the Schengen area are mainly the states of the European Union. Within it, persons and goods can freely cross borders at any point of the contracting states without border control [22]. This fact significantly affects logistics and its performance. The other investigated variables have a moderately strong dependence with innovations, which also points to the dependence of logistics performance on innovations in connection with infrastructure (0.78), with Logistics quality and competence (0.72), with Tracking and tracing (0.70), with Timeliness (0.60) and with international

shipments (0.51), each in different intensity. 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.

The results confirm the theory of Flint et al. [11,12], who claim that innovation is an important factor for providing logistics services and increasing competitive advantage. As Panayides and Lun [14] present, innovation increases the performance of supply chains.

Table 1 Data and the relationship of innovation and the performance of logistics in the EU

Country	Logistics Performance Index*							Global innovation 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	58.00
Sweden	4.05	4.05	4.24	3.92	3.98	3.88	4.28	63.10
Belgium	4.04	3.66	3.98	3.99	4.13	4.05	4.41	50.05
Austria	4.03	3.71	4.18	3.88	4.08	4.09	4.25	51.30
Netherlands	4.02	3.92	4.21	3.68	4.09	4.02	4.25	63.30
Denmark	3.99	3.92	3.96	3.53	4.01	4.18	4.41	58.40
Finland	3.97	3.82	4.00	3.56	3.89	4.32	4.28	59.60
France	3.84	3.59	4.00	3.55	3.84	4.00	4.15	54.40
Spain	3.83	3.62	3.84	3.83	3.80	3.83	4.06	48.70
Italy	3.74	3.47	3.85	3.51	3.66	3.85	4.13	46.30
Czech Republic	3.68	3.29	3.46	3.75	3.72	3.70	4.13	48.70
Portugal	3.64	3.17	3.25	3.83	3.71	3.72	4.13	45.70
Luxembourg	3.63	3.53	3.63	3.37	3.76	3.61	3.90	54.50
Poland	3.54	3.25	3.21	3.68	3.58	3.51	3.95	41.70
Ireland	3.51	3.36	3.29	3.42	3.60	3.62	3.76	57.20
Hungary	3.42	3.35	3.27	3.22	3.21	3.67	3.79	44.90
Slovenia	3.31	3.42	3.26	3.19	3.05	3.27	3.70	46.90
Estonia	3.31	3.32	3.10	3.26	3.15	3.21	3.80	50.50
Greece	3.20	2.84	3.17	3.30	3.06	3.18	3.66	38.90
Romania	3.12	2.58	2.91	3.18	3.07	3.26	3.68	37.60
Croatia	3.10	2.98	3.01	2.93	3.10	3.01	3.59	40.70
Bulgaria	3.03	2.94	2.76	3.23	2.88	3.02	3.31	37.60
Slovak Republic	3.03	2.79	3.00	3.10	3.14	2.99	3.14	42.90
Lithuania	3.02	2.85	2.73	2.79	2.96	3.12	3.65	41.20
Malta	2.81	2.70	2.90	2.70	2.80	2.80	3.01	50.30
Latvia	2.81	2.80	2.98	2.74	2.69	2.79	2.88	43.20
Cyprus	3.15	3.05	2.89	3.15	3.00	3.15	3.62	47.80
Correlation index	0.73	0.83	0.78	0.51	0.72	0.70	0.60	1

*Data are for the last recorded year of logistics performance - 2018

Subsequently, we processed a cluster analysis for the division of EU countries into groups with the greatest similarity from the point of view of the performance of

business logistics and innovations, and at the same time with the greatest possible difference among the single groups, see Figure 1.
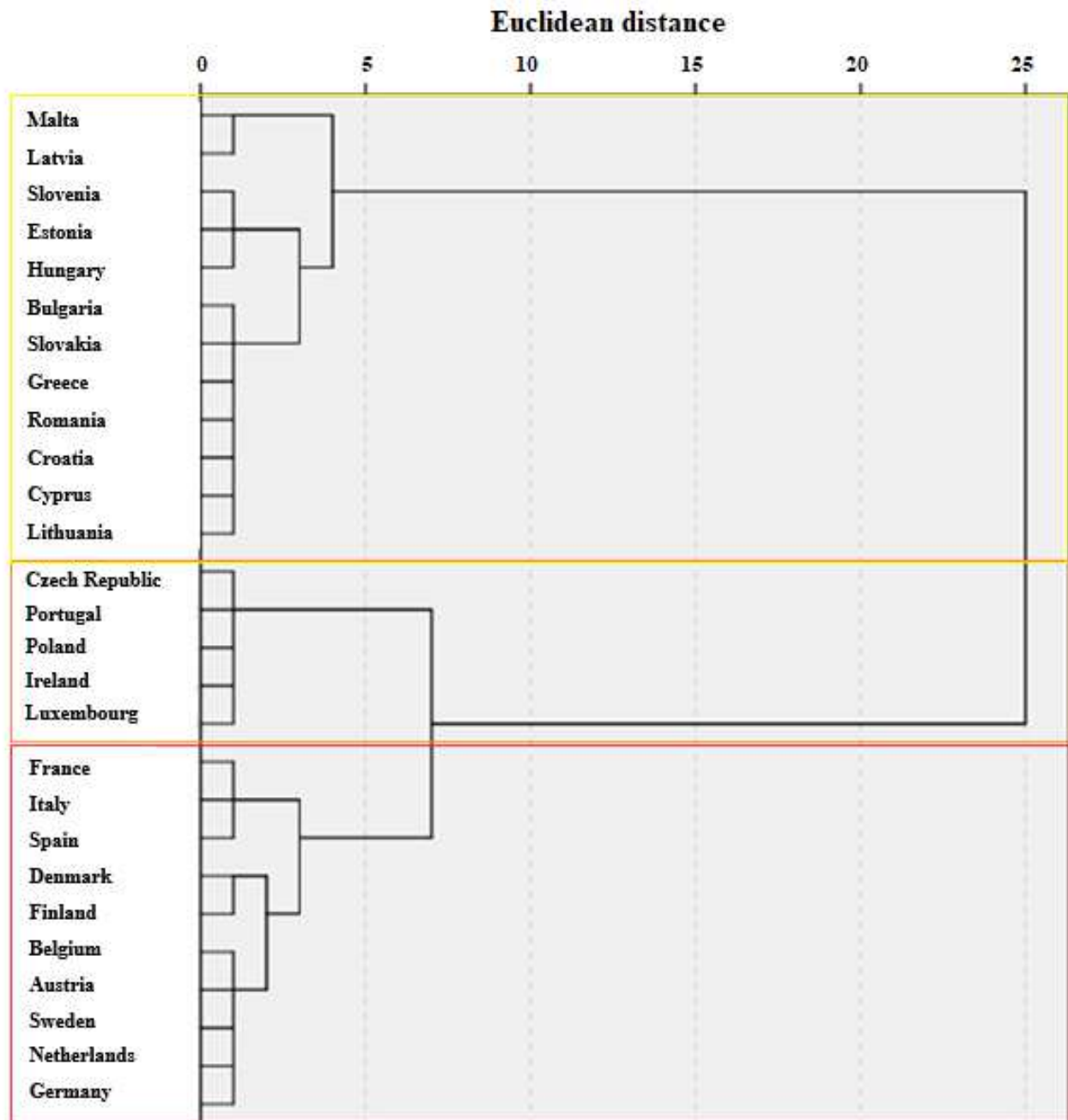
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Figure 1 Cluster analysis of the relationship of innovation and the performance of logistics in the EU

We identified the greatest distance, which represents the greatest difference between the studied groups and the greatest similarity within the groups, at the Euclidean distance of 5, from which we subsequently identified three clusters:

The first cluster - characterized by the greatest performance of logistics and innovation - Germany, Sweden, Belgium, Austria, Netherlands, Denmark, Finland, France, Spain, Italy.

The second cluster - characterized by average logistics and innovation performance - Czech Republic, Portugal, Luxembourg, Poland, Ireland.

The third cluster – characterized by low logistics and innovation performance – Hungary, Slovenia, Estonia, Greece, Romania, Croatia, Bulgaria, Slovakia, Lithuania, Malta, Latvia, Cyprus.

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Finally, we illustrated the stated findings in Figure 2, which represents a map of countries from the point of view of logistics performance and innovation in the EU.
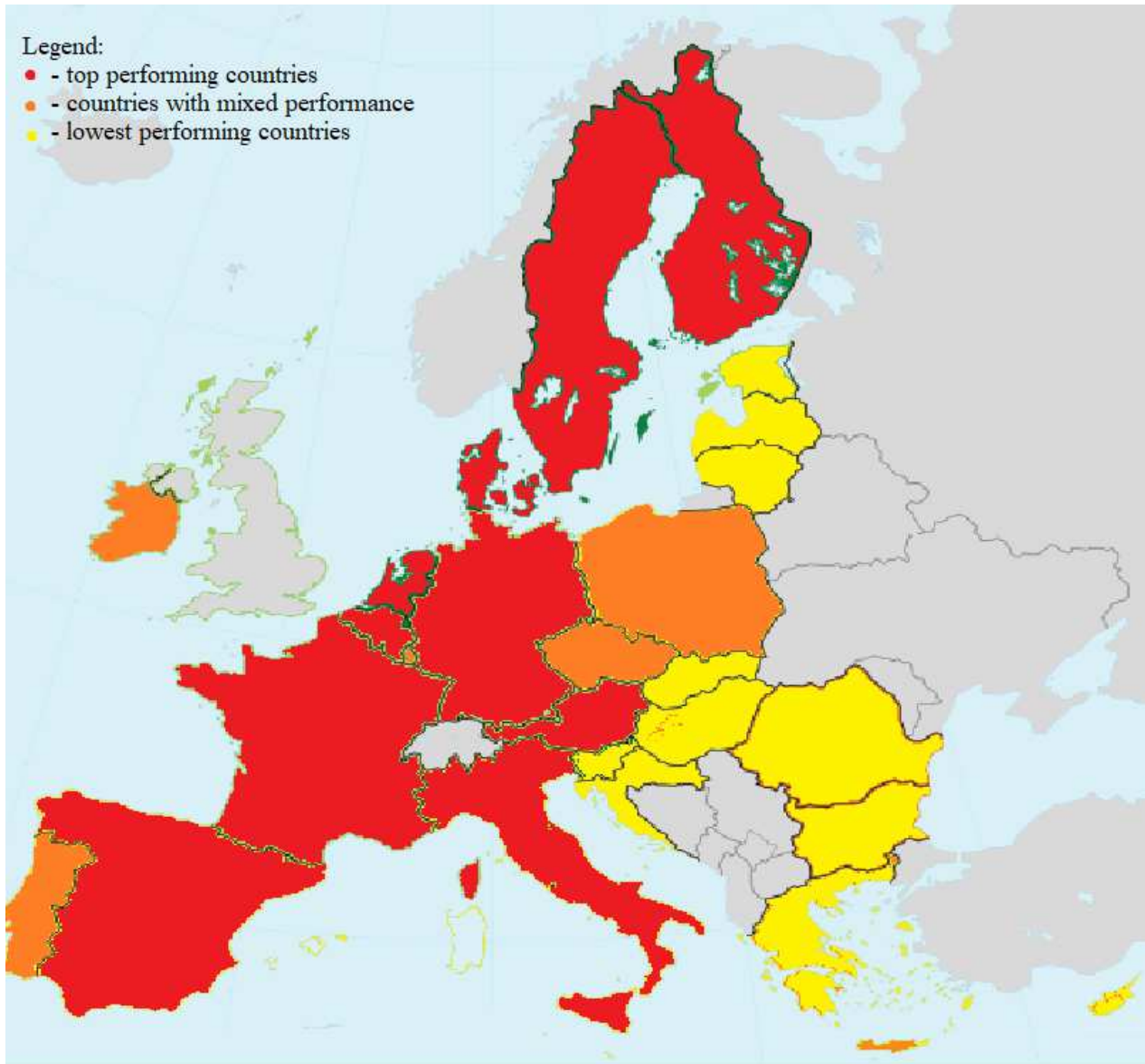

Figure 2 Map of countries from the point of view of logistics performance and innovation in the EU

Based on the performed analyses, we can conclude that the countries with the greatest performance in business logistics and innovation tend to form geographically close groups. Subsequently, as we can see from the graphic analysis, the performance of business logistics and innovation decreases with increasing geographical distance from more efficient countries in the researched area, i.e. countries with higher performance in business logistics and innovation. This fact was confirmed by several studies focusing on the relationship among innovations and other factors such as ecological innovations or sustainable development [23,24].

4 Conclusions

Innovations have become an important factor affecting the success of the company on the market, and in the case of their correct implementation, they are an important factor for the company bringing success on the market in the competitive fight. At the same time, innovations are a tool that enables managing not only growing competitive pressure, rapid technological development, and globalization of business. Innovations in technology are mainly the driving force behind significant changes, which are subsequently also manifested in the field of logistics and supply chain management. For this reason, we can talk

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about a time when the field of logistics is experiencing significant changes bringing a lot of news. However, innovation performance and logistics performance are not at the same level in individual countries, and different factors affect this performance.

In the paper we examine the relationship between innovation and logistics performance in the EU. We investigated this relationship through correlation analysis, which confirmed a moderately strong dependence between the investigated variables. From the point of view of the individual performance parameters of logistics and innovation, a great dependence was confirmed between innovation and customs. As stated in the paper, we assume that this high dependence among the investigated variables was mainly caused by the fact related to the Schengen area, which ensures the free movement of goods within most European countries. Other parameters of logistics performance show moderate dependence on innovations. As part of the cluster analysis, we examined groupings of EU countries from the point of view of the investigated relationship between innovation and logistics performance. Based on the findings of the cluster analysis, we conclude that the relationship between innovation and business logistics performance has been confirmed. Countries with the greatest logistics and innovation performance tend to form geographically close clusters. The performance of business logistics and innovation decreases with increasing geographical distance from more efficient countries.

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