

LOGISTICS PERFORMANCE AND TRANSPORT INFRASTRUCTURE

Svetlana Nikoličić^a, Marinko Maslarić^a, Jan Strohmändl^b, Dejan
Mirčetić^a

^a University of Novi Sad, Faculty of Technical Sciences, Serbia

^b Tomas Bata University in Zlin, Faculty of Logistics and Crisis Management, Czech Republic

Abstract: *Logistics plays a vital role in the economy of a country, not only by enabling the operations in diverse industrial sectors, but also through the profit actualized. For the implementation of logistics processes, logistics systems utilize a variety of strategies, resources and a wide range of services within and beyond the individual companies, while their performance is measured by different logistics indicators. For the evaluation of logistics at the national level, the World Bank has established a logistics performance index (LPI), targeting six key areas. One of the key areas for the evaluation of logistics at the national level is the transport infrastructure. The objective of this paper is the analysis of quantitative and qualitative indicators of transport infrastructure in order to identify differences between the Republic of Serbia and some better positioned country in the LPI list.*

Keywords: *logistics, transport infrastructure, logistics performance index.*

1. INTRODUCTION

The importance of logistics for the economic system of a country can be observed from several aspects. At the level of individual companies, logistics supports the movement of material goods (and information) intended for production or consumption, thus sustaining the process of their production and sales activities. When the economy of a country develops, the production and consumption grow as well, resulting in the increased volume of goods flow and an increase in the demand for a variety of logistics activities. The globalization of production and trade created the global supply chains that represent the backbone of the international trade and require a fast, reliable and inexpensive flow of goods. In such conditions, the logistics sector has been recognized as one of the key pillars of a country's development, not only through the support of national production and consumption, but also through the income that logistics realizes as an independent sector.

The functioning of a logistics system, which results in the transfer of material goods, is based on the application of diverse logistics strategies and in the use of a wide range of resources and services within and beyond the individual companies. Logistics performance, apart from the potentials of individual companies, largely depends on the macro-logistics potentials of the region where these logistics processes are implemented. Macro-logistics system is composed of (i) shippers, traders, and consignees; (ii) public and private sector logistics service providers;

(iii) provincial and national institutions, policies, and rules; and (iv) transport and communications infrastructure (Banomyong, 2009).

This paper focuses on the analysis of transport infrastructure in the Republic of Serbia, as a component of the macro-logistics system of the country. The analysis includes the basic characteristics of the existing transport network, the infrastructure indicator as the important part of the logistics performance index (LPI), and the comparison with the corresponding values in Austria and the Czech Republic, as countries selected for comparison. The goal is to utilize the comparative analysis to perceive differences and objectives which are to be achieved so that Serbia can approach European standards in this matter.

2. TRANSPORT INFRASTRUCTURE

In the context of economic globalization, the transport infrastructure has become one of the main instruments of economic development of a country and its regions. One of the results of the transport infrastructure development will be an effective transportation and logistics service which allows providing the most efficient and high-quality transport service the region needs (Vakhitova and Gadelshina, 2014). The establishment of a competitive transport system is much more than the construction of transport infrastructure. However, quantitative and qualitative characteristics of transport infrastructure, its compliance with the neighbouring countries, as well as the integration into the regional and European network, present the basis for the establishment of a competitive transport system. The analysis of the development of transport infrastructure in Serbia was carried out by the comparison with two EU countries, Austria and the Czech Republic. These countries were selected for several reasons: they do not have the access to the sea; the extent of their territory and population has similar characteristics to Serbia; according to the level of the economic development, they are significantly ahead of Serbia; and, they can be role models for the development of infrastructure in the country (according to the value of GDP for 2015, Austria is in 29th place, the Czech Republic is in 49th place, and the Republic of Serbia is ranked 91st (World Bank, 2017a)) (Table 1). The analysis includes the transport infrastructure of road, railway and river (and canal) transportation.

Table 1. General data (European Commission, 2016)

Country	Area (1000 km ²)	Population (million)	GDP (billion EUR)
Austria	83.9	8.585	329.3
Czech Republic	78.9	10.538	154.7
Republic of Serbia	88.4	7.112	33.3

The length of roads in Austria, the Czech Republic and the Republic of Serbia is provided in Table 2 according to the importance, while Table 3 presents the characteristics of roads in Serbia according to the type of surfacing. The indicators of the density of road transport network specify the following:

- According to the territory, Serbia has 2.9 times less roads than Austria and 3.2 times less than the Czech Republic;
- According to the population number, the length of road network in Serbia is 2.3 times longer than in Austria and 1.9 times longer than in the Czech Republic.

Table 2. Length of the road network (at the end of 2013) (European Commission, 2016)

	Motorways (km)	Main or national roads (km)	Secondary or regional roads (km)	Other roads (km)	Total (km)	Density	
						Km/1000km ²	Km/ mill popul.
Austria	1,719	9,997	23,640	88,759	124,115	1,479	14,457
Czech Republic	776	6,250	48,736	74,919	130,681	1,656	12,401
Republic of Serbia	603	4,794	10,341	29,271	45,009	509	6,329

Table 3. Roads by the type of surfacing in the Republic of Serbia, 2015. (Statistical Office of the Republic of Serbia, 2017)

Length in km	Total	Modern surfacing					Macadam	Earthen
		All	Out of all, motorways	Asphalt	Concrete	Cubes		
Total	45688	30438	693	30306	75	57	7685	7565

The total length of railway lines and the indicators of the density of railway transport network (Table 4) indicate the following:

- According to the territory, Serbia has 1.4 times less railways than Austria and 2.8 times less than the Czech Republic;
- According to the population number, the length of railway in Serbia is 1.1 times longer than in Austria and 1.7 times longer than in the Czech Republic.

Table 4. Railways and inland waterways (European Commission, 2016)

	Length of railways			Length of inland waterways (km)		
	Railways (km)	Density		Inland waterways (km)	Density	
		Km/1000km ²	Km/ mill. popul.		Km/1000km ²	Km/ mill. popul.
Austria	5058	60	589	351	4	41
Czech Republic	9456	120	897	687	9	65
Republic of Serbia	3809	43	536	1364	15	192

Table 5. Effective length of railways in the Republic of Serbia, 2015. (Statistical Office of the Republic of Serbia, 2017)

	Construction railway length	Real exploitation railway length (km)					
		Total	Single-track	Double-track	Electrified		
					All	Single-track	Double-track
Total	3739	37669	3471	295	1279	984	295

More detailed characteristics of the railways in Serbia are presented in Tables 5 and 6. In Serbia, 34.0% of the lines is electrified; this is approximately the same as in the Czech Republic, in comparison to 69.7% of railways being electrified in Austria. The total of 71% of railways in Serbia have the permissible speed below 60km/h, while only 2.3% have the permissible speed greater than 100 km/h.

Table 6. Length of railway in the Republic of Serbia according to the permissible speed (Statistical Office of the Republic of Serbia, 2017)

	Total (km)	Permissible speed (km/h)												
		Not known	up to 20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	111-120	over 120
Construction railway length	3739	535	206	361	567	702	268	147	406	37	423	-	87	-

The length of inland waterways (Table 4) is determined primarily by the natural conditions, so that:

- According to the territory, Serbia has 3.7 times more inland waterways than Austria and 1.7 times more than the Czech Republic;
- According to population number, the length of inland waterways is 4.7 times longer in Serbia than in Austria and 2.9 times longer than in the Czech Republic.

Through the territory of the Republic of Serbia, there is a European Corridor, The Rhine-Danube Corridor, which connecting the central regions around Strasbourg and Frankfurt via Southern Germany to Vienna, Bratislava, Budapest and finally the Black Sea. Part of the Danube flowing

through Serbia plays an important role in the functioning of this corridor. More detailed characteristics of inland waterways in Serbia are provided in Table 7.

Table 7. The length of inland waterways in the Republic of Serbia, 2015* (Statistical Office of the Republic of Serbia, 2017)

	Length of waterways (km) per ship capacity				
	150t	400t	650t	1500t	3000t and more
Danube	588	588	588	588	588
Sava	211	211	211	211	-
Tisa	164	164	164	164	-
Tamiš	41	3	3	3	-
Bega	67	67	35	9	-
Danube-Tisa-Danube Canal	522	505	449	13	-

*Data on the length of inland waterways in the Republic of Serbia presented in Tables 4 and 7 are different, even though they are taken from the official statistical reports.

For the functioning of the river transport, except waterways, important infrastructural complexes are inland ports as well. Inland ports on the Danube are the following: Apatin, Bogojevo, Bačka Palanka, Novi Sad, Belgrade, Pančevo, Smederevo and Prahovo; on the river Sava are Šabac and Sremska Mitrovica, and on the river Tisa there is Senta. In the developed regions, inland ports have developed and transformed from the places of integration of river and road transportation modes, where traditionally the processes of transshipment and storage of goods were performed, into centres that combine all important logistics activities in distribution and transport, i.e. into logistics centres. Unfortunately, this does not apply to the inland ports in Serbia.

Transport infrastructure is only one, yet a very important component of the macro-logistics system of a country, having one of the major roles in the overall development of a society at all levels. Without the developed infrastructure, there are no developed economies. Its construction, modernization and maintenance require large investments; however, it contributes to raising transport and logistics services to a higher level. The presented data demonstrate that in all segments the existing transport infrastructure lags behind the infrastructure in Austria and the Czech Republic.

3. LOGISTICS PERFORMANCE INDEX

The globalization of production and trade created global supply chains that represent the backbone of the international trading and require a fast, reliable and inexpensive flow of goods. In these circumstances, the logistics sector has been recognized as one of the key pillars in the development of a country and more than before, there is a demand to establish logistics standards as a means of insight into the differences between countries. A significant progress in this field has been achieved by the publication by the World Bank: Trade Logistics in the Global Economy – The Logistics Performance Index and Its Indicators. Reports on the value of Logistics Performance Index – LPI are based on data collected from the operators of logistics in the countries in which they operate and it presents a global benchmarking indicator for the comparison of key areas related to the logistics capacity of different countries (Nikoličić at al, 2016). The LPI reports integrate qualitative and quantitative values related to the key logistics areas, which can be helpful in determining the logistics capabilities of different countries.

LPI allows the comparison of countries in six key fields (World Bank, 2017b): (1) the efficiency of customs and border management clearance; (2) the quality of trade and transport infrastructure; (3) the ease of arranging competitively priced shipments; (4) the competence and quality of logistics services; (5) the ability to track and trace consignments; (6) the frequency with which shipments reach consignees within scheduled or expected delivery times.

No single area can fully enable the complete evaluation of the logistics performance. The evaluation is performed in the range from 1 (worst grade) to 5 (the maximum grade).

The position of the Republic of Serbia on the LPI list from 2007 to 2016, as well as the values of individual indicators, is presented in Table 8. In 2016, in comparison to 2014, the Republic of Serbia has dropped 13 places on the list, while the indicator of infrastructure fell from 2.73 down to 2.49. LPI for Austria and the Czech Republic are given in Table 9 and their comparison in the Figure 1.

Table 8. Ranking of the Republic of Serbia according to LPI (World Bank, 2017b)

Year	Total countries	LPI Rank	LPI Score	Customs	Infra-structure	International shipments	Logistics competence	Tracking & tracing	Timeliness
2007	150	115	2.28	2.33	2.18	2.25	2.29	2.07	2.54
2010	155	83	2.69	2.19	2.30	3.41	2.55	2.67	2.80
2012	155	75	2.80	2.39	2.62	2.76	2.80	3.07	3.14
2014	160	63	2.96	2.37	2.73	3.12	3.02	2.94	3.55
2016	160	76	2.76	2.50	2.49	2.63	2.79	2.92	3.23

It can be stated that both Austria and the Czech Republic are significantly better positioned than Serbia, if one observes the following:

- Overall LPI: In relation to the LPI of Serbia, Austrian LPI is better by 48.6% and LPI of the Czech Republic for 33 %;
- Indicator of infrastructure: In relation to Serbia, the infrastructure in Austria is better for 64% and the infrastructure of the Czech Republic by 35%.

Table 9. LPI values for Austria and the Czech Republic in 2016 (World Bank, 2017b)

	Total countries	LPI Rank	LPI Score	Customs	Infra-structure	International shipments	Logistics competence	Tracking & tracing	Timeliness
Austria	160	7	4.10	3.79	4.08	3.85	4.18	4.36	4.37
Czech Republic	160	26	3.67	3.58	3.36	3.65	3.65	3.84	3.94

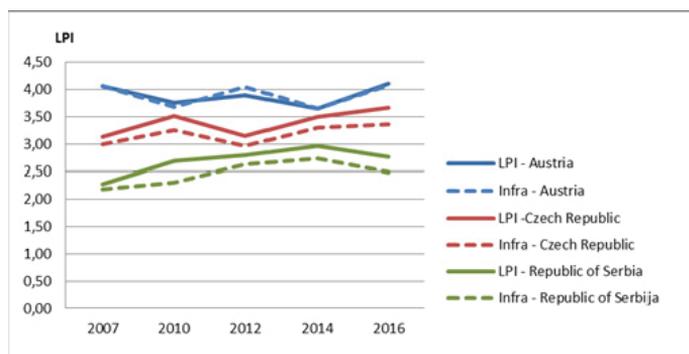


Figure 1. LPI score and component of infrastructure (based on World Bank, 2017b)

4. CONCLUSION

The improvement of the competitiveness of domestic products and services in domestic and regional markets, as well as the inclusion in the global flows of goods, are the way to the sustainable economic development of Serbia. For the modernization and the development of transport infrastructure as a component in the social development, it is necessary to observe the characteristics of the current state and prospects of the development of the entire transport subsystems in the country, the region and Europe.

Through the limited analysis in the paper, it has been demonstrated that the infrastructure of road and railway transport in Serbia lags significantly behind Austria and the Czech Republic, as the countries selected for comparison. It also demonstrates that the great potential for Serbia is the Danube (and its inland ports). Serbia, despite the geographical advantages, has been erased from the map of the European corridors built next to the Serbian borders with Romania and Bulgaria, which should be the last warning to all the governments. The infrastructure is the potential of Serbia, which can and should be utilized.

The development of national and regional transport and logistics infrastructure has to be faster and with precisely defined priorities in order for Serbia to become closer to European standards. The fact is that the current situation is far from the minimum acceptable and competitive in the open market. Infrastructure development strategies have to include clear objectives, the size of the investment, construction deadlines, funding resources and methods of payment during the exploitation in the international market competition. Several times smaller GDP in comparison to the reference countries cannot be the justification for the neglected infrastructure, or for poor technical performance of newly built or reconstructed infrastructure, since the infrastructure hypothesis, i.e. the basis for economic development is in attracting foreign investment capital and sustainable development.

In addition, it has been observed that there are differences in the data from the official statistical reports by the European Commission (European Commission, 2016) and the Statistical Office of the Republic of Serbia (Statistical Office of the Republic of Serbia, 2017), which in its turn: (1) creates confusion and provides a false idea about data that are significant for ranking in the world, and (2) Sends the wrong message about following the regulatives in the country.

ACKNOWLEDGMENT

The study was financially supported by the Serbian Ministry of Education and Science (Project No. TR36030).

REFERENCES

- [1] Banomyong R. (2009). Logistics Development in the North-South Economic Corridor of the Greater Mekong Subregion, *The Journal of GMS Development Studies*, Vol 4, pp. 43-57.
- [2] European Commission (2016). *Statistical pocketbook 2016: EU Transport in figure*. European Union, 2016.
- [3] Nikoličić, S., Pavković, A., Mirčetić, D., Dumnić, S. (2016) *Logistička sposobnost Republike Srbije*. *Suvremeni Promet*, Vol. 36, No. 1-2, pp 73-77.
- [4] Statistical Office of the Republic of Serbia (2017) *Bilten: Saobraćaj i telekomunikacije u Republici Srbiji*, 2015. Republika Srbija, Republički zavod za statistiku, 2017.
- [5] Vakhitova T.M, Gadelshina L.A. (2014). Directions of the Region Transport Infrastructure Development in the Context of Its Competitiveness. *Mediterranean Journal of Social Sciences*, Vol 5 No 24, pp. 313-316.
- [6] World Bank (cited 05. 03. 2017). Available from: <http://databank.worldbank.org/data/download/GDP.pdf> (2017a).
- [7] World Bank *Connecting to Compete: Trade Logistics in the Global Economy - The Logistics Performance Index and Its Indicators* (cited: 02. 02. 2017). Available from: <http://lpi.worldbank.org/report>. (2017b).