

Stanisław Sośniak
Jerzy Szkutnik

Faculty of Management, Czestochowa University of Technology,
Czestochowa, Poland, e-mail: stas.sosniak@gmail.com

DEVELOPMENT AND INNOVATION OF POLISH LAND TRANSPORT

Summary: In Poland, transport, apart from industry and agriculture, is one of the main sectors of the country's economy. It plays a significant role in the field of industry as well as in the functioning of the economy. The aim of this article is to familiarize readers with road and rail transport. 120 people were tested using an original questionnaire. The analysis consisted of descriptive statistics and performed analysis ANOVA. The verification of the current situation of each of the presented forms of land transport will allow us to look at the direction in which transport should develop. To achieve it, selected literature sources were taken into account, analysis of cargo transport by road and railway was presented.

Keywords: logistic management, railway, transport by road, innovation, land transport.

Introduction

Transport is considered to be one of the key factors determining the development of the country's economy and society. It is a broadly understood concept, among other things, it enables the exchange of goods and services, determines the movement of goods at the national and international level, as well as meets the communication needs of people by increasing access to spheres of economic life (e.g. education, culture). The following transport functions are distinguished:

- consumption and consumption function, i.e. transport of goods, transport companies,
- production function - creating conditions for economic activity to meet production needs, influences and stimulates the functioning of the market and exchange,
- an integrative function that integrates the state and society through transport services [1].

The transport system distinguishes many subsystems, classified according to the environment (land, air and water transport), the subject of transport (cargo, passenger) and the means of transport and organization. A well-developed transport infrastructure leads to the strengthening of the economic, social and spatial cohesion of the country and strengthens the competitiveness of the Polish economy as the dominant link in logistic processes. The efficient functioning of the transport logistics system requires appropriate infrastructure. On and infrastructure land transport consists of rail lines and road wheel [2]. Infrastructure plays a significant role in social and economic life because it determines the progress of civilization and technology. Well-developed, it brings many benefits, including: cost savings; elimination of communication difficulties reduces the

elimination of congestion, shortening the travel time. Other benefits are undoubtedly increasing the level of mobility in society, which gives better access to education, health care and work. The extensive infrastructure improves the comfort of driving and travelling, improves the quality and standard of living. Moreover, it leads to an increase in the productivity of enterprises and increases their investment opportunities [3]. Transport directly affects human health through the emission of chemicals into the atmosphere. Modern transport infrastructure leads to lower costs in the economy, which is territorially reflected in the development of the country and limiting the negative impact on the natural environment. Taking initiatives in the field of development and improvement of transport will contribute to reducing air pollution and improving the quality of social life [4].

Contemporary and constantly evolving trends, internationalization and globalization set ever more stringent requirements. Therefore, the development of transport is an important factor of the country's economic growth. The need to create and introduce new concepts of management and innovation in transport results from the constantly low level of efficiency of many technical and organizational elements [5]. Innovativeness is a measure of the level in determining the modernity of management. The motive for searching for innovative solutions in transport is the need to improve the efficiency of management, increase the time and space availability, improve the quality of services and reduce environmental nuisance. Among the types of innovation, four basic groups should be distinguished: product, process, organizational and marketing. Innovation consists on implementing a new and significantly improved product or process, a new organizational method or a new marketing method [6].

The implementation of new investment projects as well as the introduction of systemic changes in transport will allow for the elimination of weak elements of Polish transport and will accelerate the economic development and exchange with foreign countries. The development of transport should lead to the comprehensive strengthening of the country through the implementation of new technologies, the creation of a functional and integrated infrastructure and the introduction of a higher quality service than on the competitive transport market while limiting all harmful effects on public health and the natural environment. Failure to develop transport would stop the growth of production and the social division of labour. Innovative solutions are created as a result of many research and development works carried out in individual companies or other centres.

Modern solutions used in transport will not only result in faster expansion but will provide new opportunities for cooperation with other service and industrial enterprises. The introduction of sufficiently high and fast quality of the service and the timeliness of logistics information often provides a competitive advantage [7].

In Poland, the existing transport system in passenger and cargo transport is largely dominated by road and rail transport. Unfortunately, due to the insufficient system of highways, expressways and high-speed railways in Poland, there is a barrier in the processes of economic development of the country, it limits the possibilities of using the geographical location of Poland, the size of the market and the development of the economy, as well as inhibits international exchange, reduces the mobility of the workforce and the possibility of attracting foreign capital [5].

1.1. Car transport

The most important and popular type of transport is road transport. Cargo and passengers move on land roads using wheeled means of transport. The road infrastructure consists of linear (roads) and point infrastructure (e.g. bus stops, logistic centres, road junctions, parking lots, stations). Recently, the most developed economies of the EU and the European Union have seen a marked increase in the number of journeys by public transport, which is a consequence of the constantly deteriorating road conditions, despite the investment of huge money in road infrastructure. Low traffic capacity of roads, streets and intersections during rush hours affects the quality of travel, causing congestion and delays in transport. Road transport began to develop at the beginning of the 20th century, along with the popularization of motorization. However, the roads began to exist much earlier, because they were driven used by horses, in carriages or on foot. The roads connected the settlement units. Today's paved roads were mostly built in the old places, because their purpose was the same - they must connect towns [8].

The data from recent years show that modern technologies and innovative solutions are constantly being introduced in road transport, which significantly affect the competitiveness of enterprises. These changes affect the technologies of building vehicles used in road transport. The development of road infrastructure leads to an increase in driving speed by up to 20-40%, a reduction in noise emissions from cars, an increase in the load capacity of transport means and a reduction in harmful exhaust emissions. Due to the flow efficiency, the product is delivered at the right time to the right place in accordance with the requirements of the supplier or recipient. On the other hand, the costs of transport affect the efficiency of the system operation and depend on

the type of transport used, time and route [9]. In Poland, thanks to the implemented investment projects, the travel time on many transport routes has decreased. It was examined that in poviats where road investments were implemented, the level of wealth of the population increased [10].

Four European transport corridors run through Poland, which constitute an important element in the economic, spatial and social dimensions and increase global competitiveness. The network of trans-European corridors in Poland covers most urban agglomerations. The development of transport is aimed at improving domestic and international traffic. Having a spatially rich and well-developed infrastructure by the state encourages society to undertake economic activity, then entrepreneurship develops, the labour market functions properly, and living conditions improve. In Poland, the length of expressways and highways is constantly being expanded. By 2025, there will be over 6,000 km of roads of this type [11].

1.2. Railway transport

Another important branch of transport is rail transport including: passenger and freight rail transport. In this case, the movement of passengers and goods is possible with the use of railway vehicles running on the railway network. The infrastructure of the described transport includes, among others, railway lines, stations, stops, technical facilities. More and more people are switching from private car travel to public transport services, including rail. Factors that make rail transport a convenient means of transport for people include: speed, driving comfort, the ability to travel at different times of days regardless of the weather, and a higher level of safety compared to other means

of transport. Another important feature is greater accessibility for people with a lower financial status or with problems with the locomotors system [12].

Rail transport in Poland began with the Warsaw-Vienna and Upper Silesian railways in the 1840s. The first railway line, 30 km long, was built in 1842 and connected Wrocław with Oława. The development of railroads intensified tourism in those days and the current state and organization is the result of almost 200 years. After World War II, rail transport was an unrivalled form of moving people and cargo. In the period of system transformation, i.e. from the beginning of the 90s, a significant regression in the number of passenger rail transport was noticeable, resulting from the policy of the state, which recognized the development of road transport as a priority. Not enough resources were allocated to carrying out the necessary repairs to the railway infrastructure, which led to economic degeneration and decapitalisation. The 21st century brought major structural changes to the railroads, but this did not prevent further numerous liquidations of railroads. In the first decade of the century, the Polish railway network was shortened from 23,000 km to 19,000 km. Only since 2014 there have been positive changes resulting from the modernization of railways, and renovation of stations and stops. The condition of the railway infrastructure is improving, which has allowed for increasing train travel. The vast majority of investments were implemented with the support of EU funds, state budget, railway funds and PKP's own funds. The current organization of the rail transport system is the result of reforms that have been ongoing since 1989. Most of the lines are currently managed by Polskie Linie Kolejowe SA. Railway infrastructure managers are required

to make lines available to all interested service providers, resulting in an increase in the number of rail transport providers [13].

In rail transport, the basic factor stimulating the search for the implementation of new solutions is the need for technical interoperability of rail infrastructure. Despite much progress, there are still noticeable differences between national systems of transport, eg. Different joining techniques wagons or non-unified system signalling. Another equally important factor is the need to strengthen the position of inter-state competition, in particular with regard to collective road transport. Rail is a convenient means of transport for tourists, however, the low level of innovation of railway transport enterprises in Poland limits their development and prevents them from competing with other means of transport. Railway undertakings should take more effective measures to offer a comprehensive offer to passengers [14].

In Poland, the railway network is well developed in quantitative terms. It has a high degree of electrification and the percentage of double and more tracks. However, comparing the Polish railway network to other European Union countries, much worse operational characteristics are noticeable. Due to the poor technical condition of the railway infrastructure, Poland is not able to meet the EU obligations and poses a safety risk. The technical condition of railways is one of the main reasons for limiting the speed of commercial transactions, which deteriorates the quality of services and the competitiveness of enterprises [15].

In Poland, there are significant deviations from European standards in the development of the infrastructure of these modes of transport. The existing disproportions resulted in poor conditions of their functioning and limited competitiveness. As a consequence of the existing mistakes made in the development process, the reactive accessibility to many

centres and regions was deteriorated. The aim of the article is to analyze and evaluate the development and innovation in road and rail transport in Poland.

2. RESULT / EXPERIMENTAL

The study was conducted on randomly selected 120 people living in the Silesian Voivodeship at the turn of 2019-2020. The respondents assessed what, according to them, the development of road and rail transport in Poland looks like and what the level of innovation is. People were tested using an original questionnaire. The respondents answered the questions on a scale from 1-4, where 1 meant bad and 4 - very good. All 120 received questionnaires were used for data analysis. Order questionnaire was not rejected.

The analysis consisted of descriptive statistics and performed analysis ANOVA. Level of significance adopted: $p < 0.05$ The responses were grouped and analyzed, and the survey results are presented below.

Table 1. Descriptive statistics of age and sex in the subjects.

	N	% N	X year	SD
women	44	37%	32	1,06
men	76	63%	34	1,48

Among the respondents, 76 people (63%) were men between 29 and 37 years old ($x = 34$), and 44 people (37%) were women between 29-35 years old ($x = 33$).

2.1. Development and innovation of road transport in Poland.

In the first part of the survey, respondents were asked to evaluate the development and innovation of road transport in Poland.

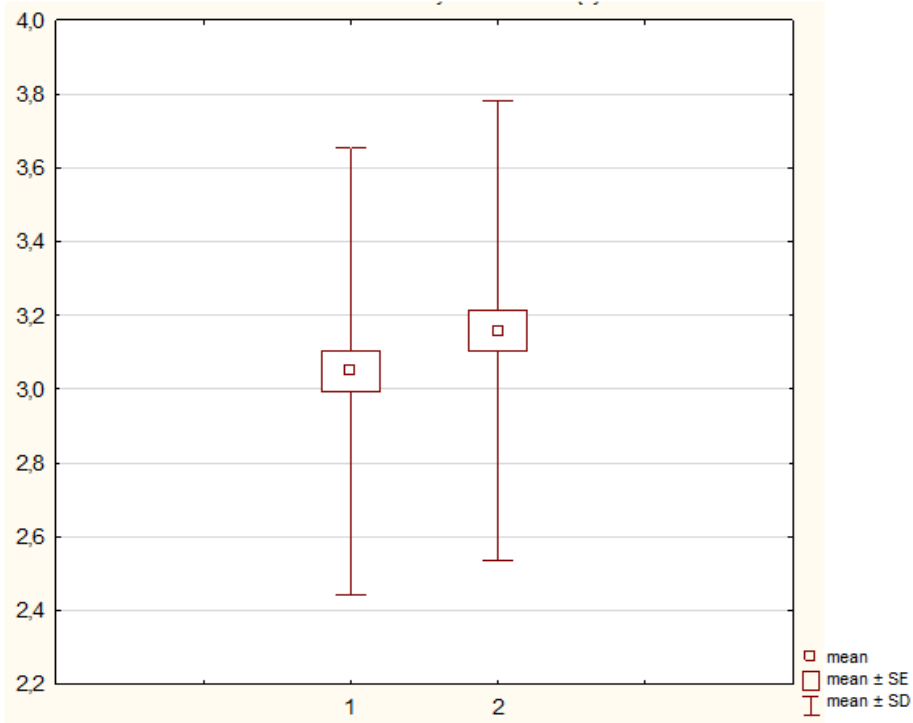


Figure 1. The level of development (1) and innovation (2) in road transport in the opinion of the respondents. [own study]

Most of the respondents assessed the development of car transport in Poland as good (66% / 79 persons) and very good (20% / 24 persons), and only 14% (17 persons) assessed the development as average or bad. Similar results were obtained in the assessment of the innovativeness of this transport. Over 59% (71 people) stated that the level of innovation in Poland is good, 28% (34 persons) - average, 13% (15 people) - weak.

Table 2. Analysis of the average values of the level of development and innovation in road transport. [own study]

	X	M	Min.	Maks.	SD	V(%)	p
evelopment	3,05	3	1	4	0,61	19,87	0,00
innovation	3,16	3	2	4	0,62	19,68	

The analysis of average values gave the basis for the assumption that there is a relationship between the assessment of the development of road transport in Poland and the level of its innovation. These conclusions were confirmed using the Kruskal-Wallis test, in which the probability of the tested p close to zero was obtained ($p = 0,00$) Statistical analysis showed that road transport develops in direct proportion to innovation in road transport, therefore it can be concluded that the development of road transport affects its level of innovation in Poland.

2.2. Development and innovation of rail transport in Poland

The next questions in the survey concerned rail transport in Poland. The respondents also assessed the development and innovation of this transport.

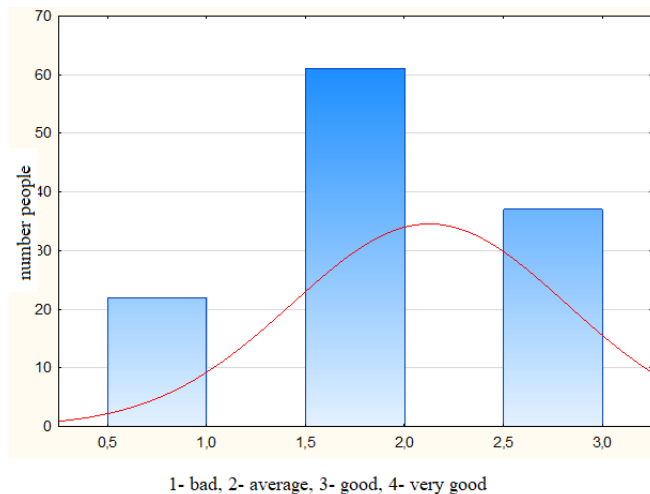


Figure 2. The level of development of rail transport in Poland as assessed by the respondents. [own study]

The development of rail transport was assessed at an average level of 51% (61 people), 31% (37) considered it well developed, and 18% (22) - bad.

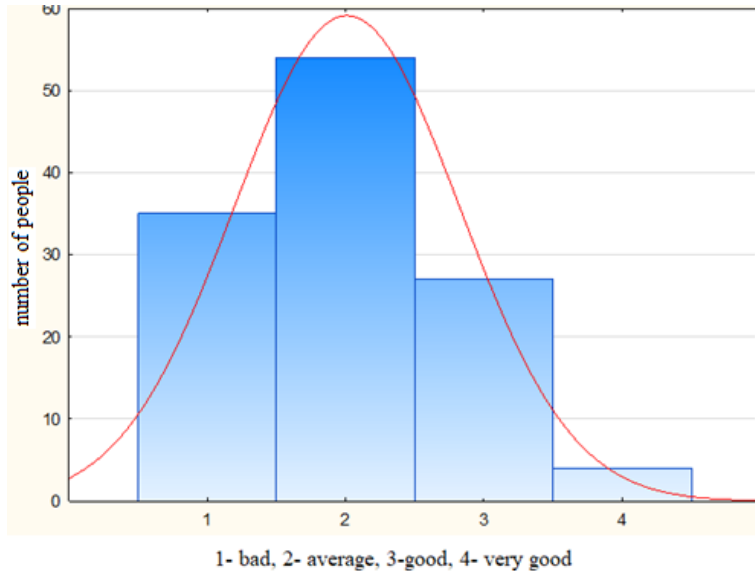


Figure 3. Assessment of the level of innovation in rail transport in Poland in the opinions of respondents. [own study]

When asked about the innovativeness of rail transport in Poland, the inhabitants of the Śląskie Voivodeship responded negatively, assessing 74% (89 people) of innovation as bad or average, and only 22% (27 people) as good. The innovativeness of transport at a very good level was assessed by only 3% (4 people) of the respondents.

Table 3. Statistical analysis of the average assessment of the level of development to the level of innovation in rail transport. [own study]

Railway transport	Medium group 1	Medium group 2	p	N Group 1	N Group 2	SD Group 1	SD Group 2	P Variances
Innovation vs. development	2.00	2.13	0.200	120	120	0.81	0.69	0.09

Most of the inhabitants of the Śląskie Voivodeship assessed the development and innovation in rail transport as average. Statistical analysis was performed and the obtained results were compared. The analysis showed that despite similar assessments of the respondents, the development and innovation of rail transport are independent of each other. No statistical significance ($p > 0.05$).

The last question analyzed in the survey concerns the application of modern technologies in transport. The respondents were asked whether the introduction of new technologies in road and rail transport could affect the competitiveness of enterprises in the country.

2.3. Comparison of road transport with rail transport.

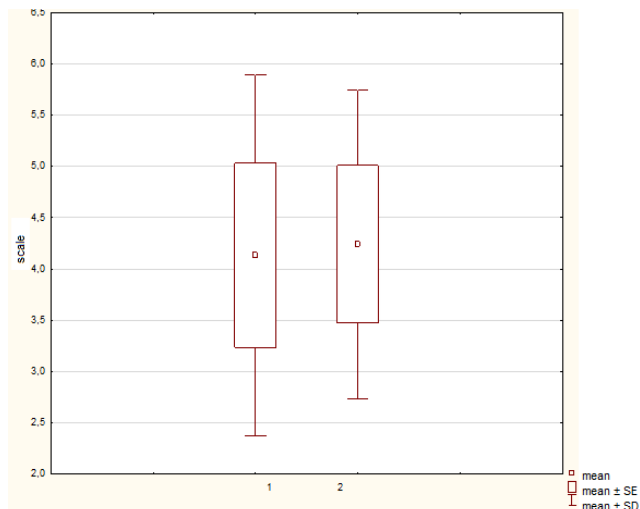


Figure 4. List of the results of the evaluation of the inhabitants of the Śląskie Voivodeship of using modern technologies in road (1) and rail (2) transport. [own study]

The respondents agreed that the introduction and application of modern technologies will have a positive impact on the competitive advantage of the country's enterprises both in road and rail transport. In both cases, the average grade was above good.

3. SUMMARY

Transport is of great importance not only in the entire economy, but also in the everyday life of every person. Rail transport in Poland began to develop in the mid-nineteenth century. The main advantage of this transport over road transport is the lower cost of transport in the case of large quantities of goods and longer distances. On the other hand, road transport has developed along with the spread of motorization, it is the result of the growing economy. Poland is not a leader in the innovation of modern technologies and solutions necessary for the development and use of rail and road infrastructure. The introduction and application of modern technologies will have a positive impact on the competitive advantage of domestic enterprises in rail and road transport.

References

1. Koźlak A, *Ekonomika transportu. Teoria i praktyka*, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk 2008.
2. Alina Lipińska-Słota, *Transport Lądowy w rozwoju gospodarczym Polski i jego finansowanie w perspektywie do 2020r.*, Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach, Katowice, 2016.
3. Sendek-Matysiak E. *Ocena stanu infrastruktury transportu drogowego w Polsce w latach 2000-2015 przez kierowców*. Prace

- naukowe Politechniki Warszawskiej. Transport, Warszawa 2017, z. 117, 331-341.
4. Włodarczyk A., Mesjasz-Lech A. Journal of Economic and Social Development (JESD) Vol. 6, No. 1, 93 Development of Road Transport Logistic Infrastructure and Air Pollution in the Visegrad Group Countries, 2019.
 5. Nowicka-Skowron M., Kaczyńska M., Dobrovsky L. Road Transport Management and innovations. Zeszyty Naukowe Politechniki Częstochowskiej Zarządzanie nr 35, 2019, 97-107.
 6. A. Korombel, M. Nowicka-Skowron Innowacje i działalność innowacyjna polskich przedsiębiorstw w świetle krajowych i zagranicznych badań. Zeszyty Naukowe Wyższej Szkoły Humanitas. Zarządzanie, Sosnowiec, 2017 (4), 9-19.
 7. Rześny-Cieplińska J. Kierunki Rozwoju systemów transportowych ze szczególnym uwzględnieniem przewozów drogowych. Studia Ekonomiczne, Uniwersytet Ekonomiczny w Katowicach, nr 143 Współczesne uwarunkowania rozwoju transportu w regionie, Katowice, 2013, 341-348.
 8. Maciąg P., Maciąg M. Kierunki rozwoju transportu drogowego. Eksploatacja i testy. Autobusy : technika, eksploatacja, systemy transportowe, Radom, 2017, 18, nr 12, 1074-1079.
 9. R. Sałek, K. Grondys, Uwarunkowania dla zastosowania nowoczesnych technologii ICT wspierających działalność przewozową w transporcie drogowym. Autobusy: technika, eksploatacja, systemy transportowe, Radom, 2017, 18, nr 12.
 10. Budowa dróg w Polsce. Fakty i mity, doświadczenia i perspektywy, https://www.pwc.pl/pl/publikacje/assets/budow_drog_w_polsce_raport_pwc.pdf. (dostęp; 03.10.2020)

11. Musiał- Malago M. Infrastruktura transportowa w Polsce. Zeszyty Naukowe Akademii Ekonomicznej w Krakowie, nr 746, Kraków, 2007.
12. Mężyk, A., Zamkowska, S.: Problemy transportowe miast. Stan i kierunki rozwoju. Wydawnictwo Naukowe PWN, Warszawa (2019).
13. Wilczek-Karczewska M. Rozwój kolei żelaznych na ziemiach polskich w ujęciu historycznoprawnym. Kwartalnik Antymonopolowy i Regulacyjny, Warszawa, 2015, nr 1 (4). 119–124, (dostęp: 2020-05-01).
14. Kozłowski M., Pawełczyk M., Piotrowska-Piątek, A. Innovativeness of railway transport in the context of the development of tourism in Poland. *Qual Quant*, Springer, 2020, 54, 1691–1703
15. Wasiak A. Kierunki i cele rozwoju infrastruktury kolejowej, w: Korenik S. Szólek K. Konkurencyjność i potencjał rozwoju polskich metropolii – szanse i bariery, *Biuletyn KPZK PAN*, z. 214, Warszawa 2004, 325.