



ANALYSIS OF THE OPERATIONAL EFFICIENCY OF SELECTED RAILWAY CARRIERS

Paweł Sobczak

Department of Engineering Management and Logistics Processes, Faculty of Applied
Sciences, WSB University, Ciepłaka 1C, Dąbrowa Górnicza 41-300, Poland,
Email: psobczak@wsb.edu.pl

Abstract The provision of transport services is related to the fulfillment of a number of factors and travelers' expectations. Transport companies, realizing their activities, try to best meet the expectations of their clients. Meeting these expectations later translates into the level of use, by travelers, of a given carrier to carry out a trip. The article was made using the method of documentation analysis, evaluation and comparison of the effectiveness of selected railway carriers providing transport services with similar characteristics.

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1. INTRODUCTION

Transportation companies perform an important and vital role in terms of both global and local. Globally, transport companies are an important element of supply chains and are necessary for moving goods and people between different locations. It also contributes to shaping the economy and other aspects of the functioning of countries, regions and their sub-areas. Locally, transport companies in addition to their basic role also play important functions not only driving the economy, but also constitute a socio-creative element. Appropriate transport accessibility generates on the one hand, and on the other, it ensures the creation of social areas such as regions and their centralizing points, ie cities or agglomerations.

One of the basic needs in the agglomeration area is to ensure an adequate level of transport services. These services can be provided in various modes of transport and by various entities. Currently, car transport, both individual and public transport is one of the most popular ways of transport services in urban and agglomeration areas. However, it is characterized by a wide range of negative environmental impacts (including noise, environmental pollution) as well as social (e.g. effects of accidents). The problem of car transport carried out in cities and agglomerations is also congestion. In connection with the above, for several years in Poland activities have been carried out, the aim of which is to diversify the transport branches that provide public passenger transport services within the city or agglomeration (public transport). Diversification is carried out through the development of urban and agglomeration rail transport, the aim of which is to improve transport in a given area and to improve the important environmental factors. The aim of the article is to conduct an assessment and comparison of the effectiveness of the operation of selected railway carriers. At the beginning, a short description of rail carriers in Poland was made, with particular emphasis on carriers operating mainly in the area of the voivodship. Next, the efficiency indicators selected for the assessment of railway carriers were elaborated and described. In the next stage, they were analyzed and compared using the proposed indicators and final conclusions from the analyzes were presented.

2. RAILWAY CARRIERS IN POLAND

Currently in Poland, based on UTK (Office of Rail Transport) information from the end of 2017 (Sprawozdanie, 2017) the activity related to the provision of passenger transport services in rail transport is carried out by 35 railway carriers, and 15 of them provide regular passenger transport services.

Rail carriers that provide their services in Poland can be divided into two types:

- carriers providing services throughout the country,

- carriers providing services mainly in the area of a voivodeship or agglomeration.

In ensuring efficient and effective public transport in cities and agglomerations, the second group of carriers performs the most important role. The quality of their services depends on whether travelers change their habits and travel habits associated with the use of mainly car transport. Of course, this is not an easy task and a number of factors should be taken into account here such as:

- number of connections,
- travel time,
- travel comfort,
- the cost of travel,
- referring them to both public and individual car transport.

These factors try to include (among others when preparing the transport offer) railway carriers providing their services. This is especially evident not only for nationwide but also local carriers. Their fleet is being modernized and expanded on an ongoing basis, the advantage of these carriers is also the fact that most of them have been operating on the market for about 15 years or less, so their structure and organizational model from the beginning was prepared for functioning in a free market economy and competition and "fighting" for the client and, what is very important, they try to effectively manage their capital, which is one of the main goals of each company (Malinowska, Piontek & Cyplik, 2017).

Carriers providing services in the area of a given province and agglomeration, which is often its capital, are particularly interesting in terms of effectiveness of operations. These carriers are: (1) Koleje Śląskie, (2) Koleje Dolnośląskie, (3) Koleje Małopolskie, (4) Koleje Wielkopolskie, (5) Koleje Mazowieckie.

The activities and results of the operation of the above-mentioned carriers were subjected to a comparative analysis.

2.1. Koleje Śląskie

Koleje Śląskie Sp. z o.o. its transport activities began in 2011. At the end of 2012, Przewozy Regionalne took over from almost all regional rail connections in the Śląskie voivodship (Koleje Śląskie). Since then, the majority of passenger transport using rail transport is carried out by this carrier. Significantly, it provides its services throughout the entire region. In 2017, Koleje Śląskie transported almost 16 million passengers, which placed them in the 6th position in terms of the number of passengers transported.

2.2. Koleje Dolnośląskie

Koleje Dolnośląskie was appointed to operate by the Sejmik of the Lower Silesian Voivodship on December 28, 2007. The company is owned by the Local Gov-

ernment of Lower Silesia (Koleje Dolnośląskie, 2017), while the main task set for the company is to provide rail passenger transport services, while the aim is to ensure an efficient regional rail system in the Lower Silesian region. In 2017, the company transported over 9 million passengers and took 7th place in the classification according to the number of passengers.

2.3. Koleje Małopolskie

Koleje Małopolskie was established by the Sejmik of Małopolskie Voivodeship in December 2013. The company's goal is to provide public services in the field of public transport. The goal is to be achieved by ensuring effective organization and operation of passenger rail traffic in the Małopolskie voivodship (Koleje Małopolskie, web page 28.03.2018). In order to carry out its activities in June 2014, the company obtained a license to perform rail transport of people No. WPO/236/2014 (Koleje Małopolskie), while in August 2014 obtained a European security certificate and in October 2014 a national safety certificate (Koleje Małopolskie). In 2017, the company transported almost 6 million passengers and ranked 10th in terms of the number of passengers.

2.4. Koleje Wielkopolskie

Koleje Wielkopolskie is a company established to carry out railway transport in Wielkopolska on September 28, 2009 by the self-government of the Wielkopolska Voivodeship. The transport activity began on June 1, 2011. The sole shareholder of the company is the self-government of the Wielkopolskie Voivodeship (Koleje Wielkopolskie). In 2017, the company transported over 9 million passengers and placed 8th.

2.5. Koleje Mazowieckie

Koleje Mazowieckie is a company that was established by the Mazowieckie Voivodeship Self-government (51% of shares) and PKP Przewozy Regionalne Sp. z o.o. (49% of shares) on July 29, 2004. The company began its transport activity on January 1, 2005. From January 8, 2008, the sole shareholder of Koleje Mazowieckie is the Self-government of the Mazowieckie Voivodeship (Koleje Mazowieckie). In 2017, the company transported over 62 million passengers, making it the second company providing transport within the province and agglomeration in terms of the number of passengers carried (better result and leadership position Przewozy Regionalne with the result of nearly 80 million passengers, but Przewozy Regionalne provide their services at all over the country, which is why they were not analyzed in the article).

2. RESEARCH METHODOLOGY

The article analyzes and compares the effectiveness of the operation of selected companies providing passenger transport services in rail transport. All analyzed companies provide their services mainly within one province (they have only few relationships to neighboring voivodships or neighboring countries to ensure transport accessibility). Research and analyzes were carried out using the document analysis method. On the basis of information obtained from the UTK (Office of Rail Transport) and annual reports and reports of carriers, information was collected that made it possible to calculate and compare selected performance indicators.

According to (Rutkowska, 2013), efficiency is difficult to define unequivocally, but it can be determined, among others, as "implementing actions much better when doing what others in the same industry do, realizing the same concept of business operation". Methods of testing logistic processes are very diverse (Gałowska, 2017). Similarly indicates (Nerc-Pełka, 2010) writing that practical and theoretical methods of effectiveness assessment propose a variety of measures that are appropriate for different types of enterprises. In connection with the above, measures have been proposed and used that, based on the definitions above, can be called performance indicators:

- Number of transported passengers

$$n \text{ [pass.]} \quad (1)$$

where:

n – number of transported passengers [pass.]

- Transport work

$$W \text{ [pass.km]} \quad (2)$$

where:

W – Transport work [pass.km]

- Punctuality

$$P = [\%] \quad (3)$$

where:

P – punctuality [%]

- The efficiency of rolling stock

$$w_{tab} = n/tab \text{ [pass./item]} \quad (4)$$

where:

w_{tab} – The efficiency of rolling stock [pass./item]

n – numer of passengers [pass.]
 tab – numer of rolling stock [item]

- Employee efficiency

$$w_{prac} = n/n_{prac} \text{ [pass./empl.] = [-]} \quad (5)$$

where:

w_{prac} – Employee efficiency [pass./empl.] = [-]
 n – numer of passengers [pass.]
 n_{prac} – numer of employee [empl.]

- Demographic efficiency

$$w_d = n/n_m \text{ [pass./inhab.] = [-]} \quad (6)$$

where:

w_d – Demographic efficiency [pas./miesz] = [-]
 n – numer of passengers [pass.]
 n_m – numer of inhabitants [inhab.]

Indicators (1)–(2) due to the lack of taking into account such parameters as: network size, size and stock status, number of employees, number of inhabitants living in the area served by the carrier, most probably in themselves will not be suitable for assessing the effectiveness of carriers, but they are a good and important supplement to information that will be obtained from indicators (3)–(6).

4. EFFICIENCY OF CARRIERS

On the basis of data received from the UTK and Annual Reports and Reports on the Implementation of Services developed by railway carriers, a summary of data was prepared that was used to calculate performance indicators.

Table 1 The number of transported passengers and transport work carried out by railway carriers in 2017

Carrier	Number of passengers [mln.]	Transport work [mln. pass.km]
Koleje Śląskie	15,730040	687,408443
Koleje Dolnośląskie	9,380451	508,047568
Koleje Małopolskie	5,730428	168,350904
Koleje Wielkopolskie	8,096779	357,430154
Koleje Mazowieckie	62,041365	2187,961181

Table 1 and Fig. 1 show the number of transported passengers and transport work carried out by carriers. As shown in Table 1 and Fig. 1. Koleje Mazowieckie performed the largest transport work and carried the largest number of passengers in the analyzed group of carriers, in the second place there are the Koleje Śląskie. The above fact may result from the largest population appearing in the voivodships served by these carriers and from the relatively well-developed network of connections offered by carriers (Sobczak 2017; Stawiarska & Sobczak, 2018).

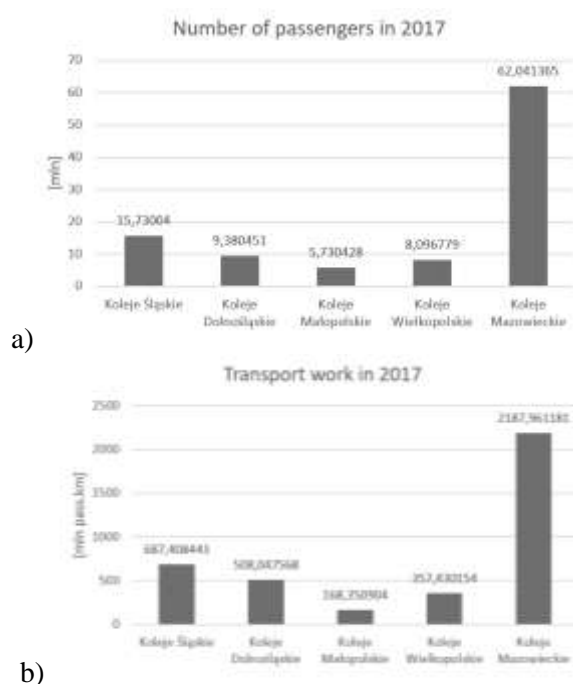


Fig. 1 The number of transported passengers and transport work carried out by railway carriers in 2017 a) number of passengers in 2017 b) transport work in 2017

One of the main factors affecting the choice of a given carrier is its punctuality. The modern traveler's certainty of getting to the place of travel in the planned time is very important, it is particularly important during the travel in the agglomeration, because this trip is very often connected with getting to work or place of education (in these cases the importance of punctuality is naturally increasing even more as a preferential factor of a given branch of transport).

In connection with the above, the punctuality of carriers in 2017 is shown in Table 2 and Fig. 2. As shown in Table 2 and Figure 2, Koleje Mazowieckie and Koleje Wielkopolskie were characterized by the highest punctuality rate above 90%, other carriers obtained slightly worse results at the level of about 85–86%. This allows us to state that punctuality is important for travelers, but it is not a de-

cisive factor (it is one of the factors). What is worrying is the drop in the punctuality of transport in the last quarter of 2017 for all carriers. This is most likely caused by modernization works on railway lines, which are not always affected by carriers (railway infrastructure manager is PKP PLK), but these works and the related timetable delay may unfortunately have an impact on travelers' preferences .

Table 2 Punctuality of carriers in 2017

Carrier	I quarter	II quarter	III quarter	IV quarter	Average
Koleje Śląskie	90,13%	91,09%	83,11%	81,00%	86,33%
Koleje Dolnośląskie	89,91%	89,97%	86,77%	79,88%	86,63%
Koleje Małopolskie	89,47%	95,16%	87,24%	68,19%	85,02%
Koleje Wielkopolskie	93,38%	92,72%	93,21%	86,12%	91,36%
Koleje Mazowieckie	92,38%	92,88%	91,53%	90,64%	91,86%

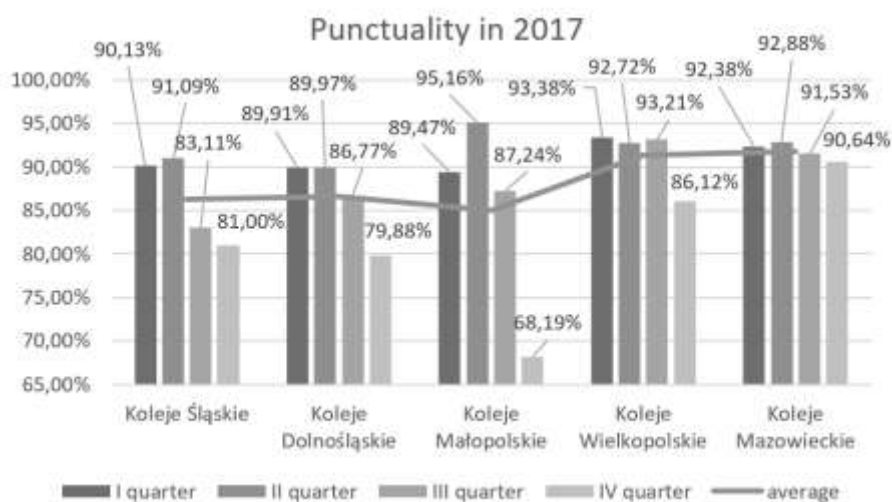


Fig. 2 Punctuality of carriers in 2017

Next, the aim of calculating the remaining proposed ratios – the rolling stock efficiency (4) and employee efficiency (5) – based on the UTK Reports and transport reports and reports, the size of the rolling stock owned by railway undertakings and the number of employees (Koleje Dolnośląskie, 2018; Koleje Wielkopolskie, 2018; Sprawozdanie, 2018; Tabor, 2018; Uchwała no. 2015/17; Uchwała no. 2017/17; Impulsy, 2017; Newag, 2016; Sześć nowych, 2016; Trzy kolejne, 2017; Koleje Śląskie, 2018). These data are presented in Table 3.

Table 3 Number of railway vehicles and number of employees

	Number of railway vehicles [item]	number of employees [persons]
Koleje Śląskie	61	1040*
Koleje Dolnośląskie	56	682
Koleje Małopolskie	22	384*
Koleje Wielkopolskie	48	473
Koleje Mazowieckie	325	2825*

* approximate data, calculated on the basis of UTK data

The purpose of calculating demographic efficiency (6) was obtained from GUS (Statistics Poland) data, information on the number of inhabitants in individual voivodships, in which the analyzed railway carriers run their operations (Powierzchnia, 2018). The number of inhabitants of analyzed voivodships is shown in Table 4.

Table 4 The number of inhabitants in 2017 in voivodships in which railway undertakings operate

Voivodships	The number of inhabitants
Śląskie	4559164
Dolnośląskie	2903710
Małopolskie	3382260
Wielkopolskie	3481625
Mazowieckie	5365898

On the basis of the data in Tables 1, 3 and 4, indicators (4)–(6) were calculated. The obtained results of calculations are presented in Table 5 and Figure 3.

Table 5 Efficiency indicators for the analyzed railway carriers

Carrier	The efficiency of rolling stock [pass./item]	Employee efficiency [-]	Demographic efficiency [-]
Koleje Śląskie	257869,5082	15125,03846	3,4502027
Koleje Dolnośląskie	167508,0536	13754,32698	3,2305055
Koleje Małopolskie	260474	14922,98958	1,6942601
Koleje Wielkopolskie	168682,8958	17117,926	2,3255747

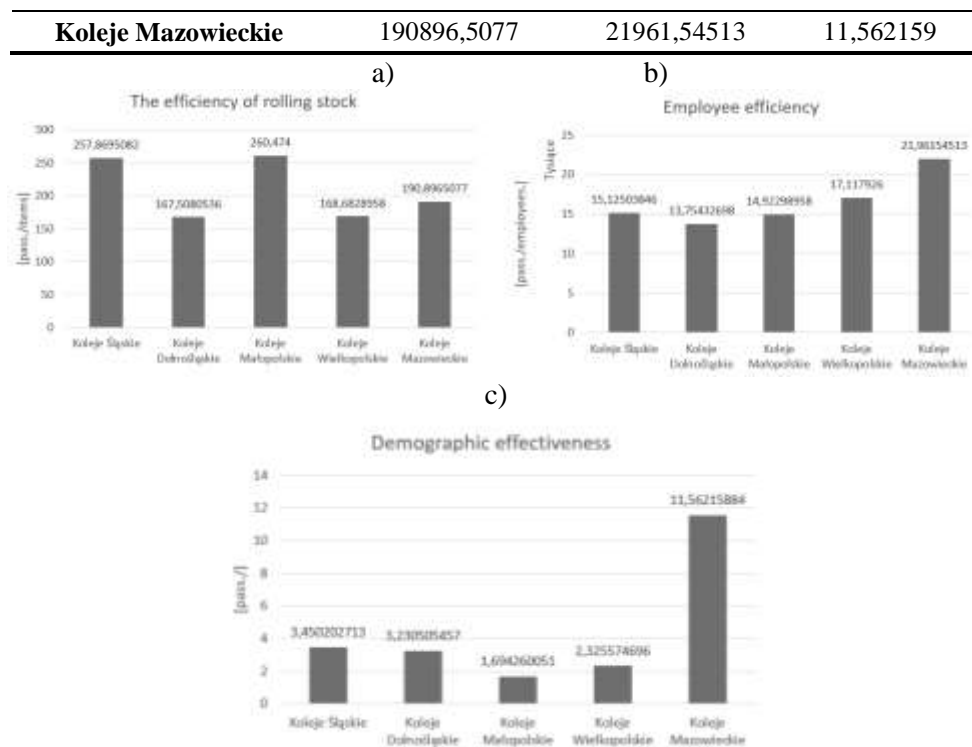


Fig. 3 Efficiency indicators for 2017 for the analyzed railway carriers a) the efficiency of rolling stock, b) employee efficiency, c) demographic effectiveness

5. CONCLUSION

Rail transport plays a particularly important role in the implementation of public transport in urban and agglomeration areas. In order to be able to compete with the currently popular car transport, it must carry out its activities in an effective manner. The article describes and proposes examples of efficiency indicators of transport companies.

Indicators 1 and 2 as mentioned give a good picture of the degree of use of a given carrier by travelers (especially in statistical terms when comparing data in specific years), but they do not take into account changes that may occur in the structure of a given carrier (changes in inventory and number of employees).

As presented in Table 5 and Figure 3, the proposed index of rolling stock efficiency makes it possible to compare the efficiency of using the rolling stock owned by the carrier. The obtained data clearly shows that Koleje Śląskie and Koleje Małopolskie use the most intensively owned rolling stock, which is a good sign of

the carriers. Of course, it should be remembered here that this index has its own limit value, which should not be exceeded. As a result of too many travelers traveling at the same time there may be a decrease in quality (too big filling of the wagons reduces the comfort of travel and may contribute to a decrease in the number of customers). The value of the rolling stock efficiency index should be raised indirectly – by increasing the number of courses performed by each of the wagons during the year.

The employee efficiency ratio, in turn, allows a very good and objective way to assess the efficiency of the carrier's staff in relation to the services provided. As shown in Table 3 and Figure 5, in 2017 Koleje Mazowieckie received the highest value of the indicator, i.e. the carrier, from all analyzed companies, most effectively uses (translates) the work of its human resources on the effect of the enterprise, which is the carriage of people. It should be noted that other carriers got a result about 25% worse.

However, the demographic effectiveness index allows to observe what is the effectiveness of services provided in relation to people living in a given area. The analyzes clearly show that in this case, Koleje Mazowieckie also performs best. This may of course be related to other factors such as the specificity of the area of operation of the Koleje Mazowieckie, which include is the area of the Warsaw agglomeration. The obtained result can generate significant flows of people entering and leaving the agglomeration on a daily basis due to their professional and educational needs combined with a large transport congestion in the city. In the other analyzed regions, this effect is not as intense and is not focused on such a relatively small area as it is in the Warsaw agglomeration (road congestion may have a positive impact on the choice of another mode of transport). Very similar values of the indicator for the Koleje Śląskie and Koleje Dolnośląskie were observed. Importantly, the demographic efficiency rate should be analyzed in relation to the other proposed indicators.

Summing up, the proposed ratios can be a good tool for analyzing the effectiveness of the company's operation, especially at the time of performing statistical analyzes for a period of several years. It can be a very good tool that allows "self-control" of the company's efficiency.

An important advantage of the proposed indicators is also the availability of the data used in them. This enables not only an analysis of your own company, but also a comparison of the effects of your own activities with the activities of enterprises with a similar business profile. Comparative analyzes using the described indicators should also be performed systematically by enterprises in order to observe both good and bad practices of other organizations more quickly

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BIOGRAPHICAL NOTES

Paweł Sobczak is an Assistant Professor at WSB University, Faculty of Applied Sciences, Department of Engineering Management and Logistics Processes. In his scientific activity he deals with the issues of analysis and improvement of public transport, as well as specializes in the use of modern information technologies in logistics, with particular emphasis on warehouse processes.