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ESTIMATE ATTRACTION RATE FOR SHOPPING CENTERS

Abstract. In developing countries like Baghdad, it has seen high growth of urbanization accompanied by the high trip rate, which conduces increased vehicle traffic and human traffic. One of the major problems is the increase in traffic congestion of unplanned development of various structures at various locations. Four-step demand models are important in planning and forecasting future demand. Trip generation is an important step when planning urban infrastructure. In this study, three shopping centers (AL Mansour mall, Babylon mall, and al Waha mall) were selected, trip attraction rates were calculated using two approaches (trip rate analysis method, and Regression analysis method). The number of persons entering and exiting the site for every 15-minute interval during peak hours is estimated. This research considers various physical characteristics of shopping centers, gross floor area (GFA), number of employees and the number of stores in the shopping center. From the data analysis, good relations exist between the dependent variable (trip rate) and various independent variables, and the developed trip rate per GFA per 1000 m2 is 133 person trips and various trip rates are presented through this study.
Keywords: Trip Rate; Regression Analysis; Trip attraction; Trip Generation.

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Introduction

Travel demand forecasting is central to the design of transportation infrastructure and the creation of policies and regulations for urban planning. The four-step modelling is the most common method used in demand modelling. The first stage of modelling in four-step modelling is to forecast the trip generation (Ortu zar and Willumsen 2011) [1]. Trip generation estimates the number of trips start (production) or end (attraction) in a zone. Trip production represents the trip produced by households in the traffic analysis zone (TAZ), while trip attraction represents trips attracted by land-use activities in TAZ (Escamilla et al., 2016; Sasidhar et al., 2016; Stover and Koepke, 1988) [2–4]. Trip generation is one of the steps in the traditional transport modeling process. Trip generation rates can influence the magnitude of the roadway improvements that are constructed like the amount of land that is required to be dedicated for the road's right-of-way, and calculation of long term maintenance costs of the roadway network.

Many studies have found that the land use types and their activities has a direct influence on trip attraction (Escamilla et al., 2016) [2]. The generation of trips is a necessary step in the planning of transport facilities. Improved accuracy of the generation model is necessary to achieve accurate prediction results. The trip attraction modeling in each determined zone in a city can be carried out by linking the trips derived from the field site survey and specific land use parameters. Globally, there are many studies conducted to determine the rate of attraction of trips to shopping malls, schools, or other land use. Some of these studies are: a study was conducted in Dhanmondi area in Bangladesh by Md Majbah Uddin et. al. [5], they were using the travel rate analysis method for determining the travel attraction rates for shopping centers in Dhaka, they stated that this study would be useful in the design transportation network or the channelization of traffic control around a shopping center. Another study in Uttara Area was conducted by Md. Shamim Al Razib and Faysal Ibna Rahman [6]. The trip attraction rates of the shopping centers at Uttara road were estimated, rates are estimated by using the trip rate analysis method. They concluded that the highest peak hour person Trip Attraction Rate is in Rajlaxmi Complex with 13 person trip/1000 sq.ft/hour on weekend. Because trip attraction volumes are estimated based on land use characteristics and executing of land use-based trip attraction models are severely constrained by the lack of updated land-use data in developing countries, Amila Jayasinghe et al. 2017 [7], introduced a network centrality-based method to estimate the volume of trip attraction in traffic analysis zones. They used explanatory variables as "connectivity", "local integration" and "global integration". This method is an effective tool for developing countries and it does not depend on land use data to estimate trip attraction in the proposed model. In Delaware, a study was conducted by Shinya Kikuchi et al. 2004[8], they computed the attraction of shopping centers in Delaware, a total of 18 sites were being analyzed, and they assessed the patterns of movement of persons and vehicles using two approaches (microscopic and macroscopic). The microscopic approach deals with the trip rate of a mall as an individual center while the macroscopic approach deals with the relation between trip rate and physical features of centers. Joni Arliansyaha,*, Yusuf Hartonob 2015 [9] developed trip attraction model with seven independent variables, i.e., population size, number of schools, number of students, number of teachers, areas of school buildings, number of

offices, and number of houses by applying Radial Basis Function Neural Networks (RBFNN). The neural network model trained to predict trip attraction using seven predictors performs better than the ordinary regression model using the least square approach. Alexandre A. Amavi et al. 2014[10] introduced advanced generation/attraction models considering spatial correlation, and their improvements concerning previous models not considering spatial correlation are analyzed. K. M. RAHMAN1 et al. 2017[11], studied Kaptai road which is an important and busy road in Chittagong to determine the trip generation of adjacent commercial land uses. Trip generation situation was estimated with multiple linear regression models and trip rates of commercial land use. They concluded the weighted average rates of the shopping centers are 9.32 trips/ 1,000 sq. ft./hr. Reigna Jewel Ritz M. MACABABBAD et al. 2009[12] studied trip generation characteristics of the eight government office complexes in Quezon City through site characteristic surveys. Estimates of trip generation rates for this type of land use were obtained for the A.M. and P.M. Peak hours rates were estimated using the gross floor area and the number of employees as independent variables. The number of employees was found to be a better estimator of trip generation than GFA. Khaled Al-Sahili et al. 2018[13] established trip generation rates for the different land-use considering the most appropriate independent variables. It was found that the local trip generation rates were generally different (higher, comparable or lower). This can be attributed to the facts that travel behavior as well as socioeconomic and land use characteristics are different. F. Akter et al. 2016 [14] focused on estimating the trip attraction rate of a mega shopping mall and a school of Dhaka City using a trip rate analysis method. The major Trip rate analysis results found are average peak hour person trip attraction rate 3.91trips/1000ft2/hour and average peak hour car trip attraction rate is 1.76 trips/10000 ft2/hour for Bashundhara City. They indicate the importance of trip rate analysis before constructing any mega structures at Dhaka as new structures will affect the normal trip generation of the surrounding area by attracting a large amount of traffic. A study conducted by Parikh M.S, and Dr. H.R.Varia[15], they were designed to study the generation of trips in the residential urban area. Very few scholars have attempted to build a model of the trip-generating shopping event for the urban area of India. Uddin et al[5] calculated the attractiveness of shopping malls trip rate in the Dhanmondi area of Dhaka City by using trip rate analysis. They linked the attractiveness of the shopping center as a feature of the physical characteristics of the shopping malls.

In demand modeling, major activity centers of different land-use produce different trip rates, these rates are very important values used in predicting the future attraction of other developments, which in turn is used to predict the need for infrastructures and city transportation facilities. The new development will increase the demand for travel by also increasing the number of vehicles so that it is necessary to know the attractions of this development. The trip attraction is related very strongly to land use characteristics. To accurately plan the need for city transportation facilities and infrastructures, there is a need for an accurate estimate of trip attraction rates. Further trip rates vary from site to site and city to city. Improving the accuracy of the trip model is essential to get a better result of the trip predictions. In such a way, the demand for trips in a given future scenario can be precisely estimated by knowing the explanatory variables in that scenario. Due to limited research about the trip attraction of shopping centers in Baghdad city, and transportation impact studies for new developments are not yet adopted so there is a need to measure trip attraction. The principle goal of this study is to determine the trip generation of shopping center land uses of Baghdad city through fulfilling two objectives;

1- Identify and quantify the number of trips generated by land use shopping centers

2- To relate the generation of trips concerning land use and the characteristics of the selected sites.

1. Study Area

The city of Baghdad is experiencing rapid urbanization and motorization, which in turn gives a dramatic increase in transportation demand, and the supply remains unparalleled with demand. The trip attraction is critical for traffic engineers and planners to consider the impact of new developments such as office complex, shopping center and residential development on current and future infrastructure. Baghdad city which is the capital of the Republic of Iraq; has the largest urban population in Iraq. It is the hub of banking, commerce, and manufacturing in Iraq. The Tigris River is the most important natural characteristic of the city's identity, this divides Baghdad into Karkh and Rusafa. It has an area of 204.2 square kilometers with a population of 8.405 inhabitants (census 2015) [16]. This area type is typified by horizontal expansion, a wide range of land uses, an extensive travel pattern, and shared and priced parking both on/off-street and in structured garages or surface lots. The area is typically an employment destination. It has several sub-malls about 13 shopping malls are currently under construction and has 6 main shopping malls. The big shopping malls already exist are as follows:

- Al Mansour Mall,
- Babylon Mall,
- Baghdad Mall in Al Mansour area,
- Zayouna Mall in Zayouna area,
- Al Nakheel Mall in Palestine Street area,
- Al Waha Mall in Jadriya.

Traffic congestion around shopping malls tends to make people move away from shopping malls to other places to avoid delays, the length of the queue is increasing and patterns of the road network change according to people's accessibility needs and desire to reach their destinations.

2. Sample size

The sample size was based on the ITE guide (2019)[17] which states that a minimum of four sites should be provided to get useful information and conduct analysis. The better reliability of equations when the higher sample size could be reached, ITE claimed that a sample size of at least four should be used for the creation of the regression model. The sample size for developing trip attraction rates or equations is four, according to the ITE manual. The data required about dependent and independent variables must be collected. The selection of independent variables depends on the specific activity of each land use. If the land use is residential land might use dwelling units, while if it's retail land use then the number of employees is used as a variable. In this study, the independent variables include (gross floor area, number of shops and employees). The dependent variable is the total of person trips for each shopping center during peak hours. Estimation of variables for each site was undertaken in terms of how many (surveyors) are needed to calculate the number of people entering and leaving each gate in each shopping center and access of the site and land use. As stated by ITE, the time of counting is selected according to the peak of selected land use, and to the purpose of the study. For the selected sites, the peak periods for the shopping center were selected for the weekend/ weekday in the Pm time. The ITE used a larger interval (1 hour) to capture the variation during the whole day (ITE, 2019). This study covers the weekday and weekends and for the evening period from 5 to 8 Pm.

3. Data collection

People attracted to shopping centers for various purposes like shopping, restaurant, games, and other services. Several people enter and leave the shopping centers were calculated every 15 minutes by surveyors who standing near the entrance and exits of shopping centers to determine the trip attraction rate. The 15-minute interval is chosen because the Highway Capacity Manual uses this interval as the base unit for Capacity computation (Kikuchi et al., 2004)[8]. Shopping trips were estimated by visual observation and collecting information about different physical features (i.e. Number of shops, gross floor area, number of an employee). These collected data were processed for the construction of a regression model in SPSS software to determine the rate of travel attraction concerning different physical characteristics.

Three shopping malls in Baghdad city were selected in this study: Al Mansour Mall, Babylon, and Al Waha.

- Al Mansour Mall is a shopping mall located in the Iraqi capital city, Baghdad, in the Mansour district. It is one of the largest shopping complexes in the city of Baghdad, and consists of four floors of an area of 32,000 square meters and contains more than 170 shops, and several brands; clothing stores, electronics stores, and restaurants.
- Babylon Mall is a shopping mall located in Baghdad city, Iraq, in the Mansour district, the complex is built on an area of 4000 m2 with a height of six floors with a building area of up to 3500 m2 for each floor. This commercial complex features a heritage market in Baghdad, in addition to a floor for selling children's equipment. It has entertainment and toys for children.
- Al Waha Mall is one of the commercial centers in Baghdad in the Jadriya area contains many shops, restaurants, games hall, an area of 2500 square meters and the number of shops about 43 stores The details of selected shopping centers are given in Table 1:

Table 1. Characteristics of Shopping Centers

Shopping center	Number of Gates	Number of Shops	Number of Employees	Total floor Space
Al-Mansour Mall	2	170	950	32000 m^2
Babylon Mall	1	154	650	4000 m^2
Al-waha Mall	3	43	250	2500 m^2

The location of three shopping centers is marked on the map in Figure 1.

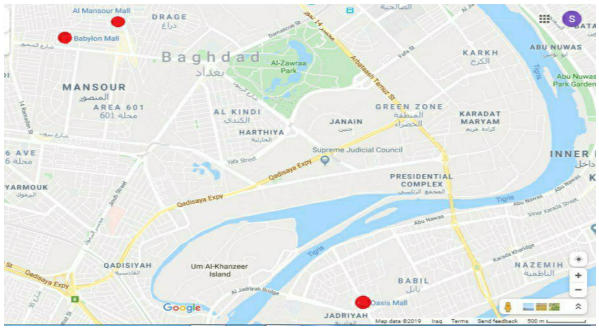

Fig. 1 Selected Shopping Centers

The following survey results are shown in Figure 2, from observing the Figure below; the peak hour for shopping centers is from 7 to 8 pm.

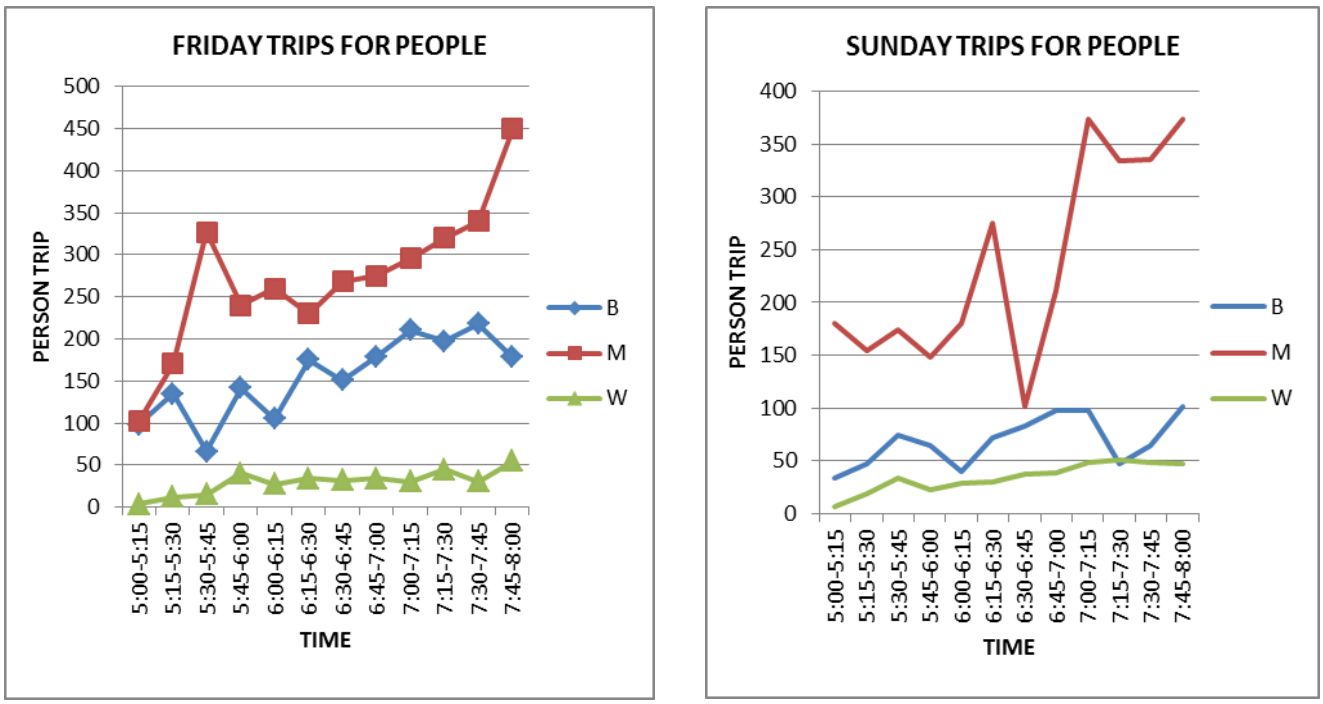

Fig. 2. Variation of Person Trips for Weekday and Weekend

4. Methodology

Two methods (Regression analysis and Trip rate) were used to estimate trip attraction rate. The dependent variables used for analysis depend on the selected land use, in our case, for shopping centers, the number of trips was chosen as the dependent variable. The definition of some of the terms used is defined below:

-Daily Customer—a person who visits a building to conduct personal business at any time during a single day.

- Employee—a full-time, part-time, or per diem/contract worker. They represent all the persons employed at the site, not just persons who appear at the time of data collected.

- Gross Floor Area (GFA)- refers to the total area (expressed in square meters), Occupied area refers to GFA within the facility which is currently being utilized. If the ground-floor area or part thereof is not enclosed within the main exterior walls, this floor area is considered to be part of the overall GFA of the building. GFA used as an independent variable for trip generation calculation, For calculation, the floor area of all parking garages within the building should not be included in the GFA of the entire building.

Average Rate (Average Trip Rate)—the weighted average number of vehicle or person trips entering or exiting a development site per one unit of the Independent Variable. It is estimated by dividing the sum of all trips for all data point sites contributing by the sum of all independent variable units for all data point sites contributing.

The trip attracted to shopping centers was obtained by counting the number of people entering and leaving the shopping center every 15 minutes from 5 to 8 pm. Two surveyors needed near the entrance and exit of shopping centers for collecting trip data. Visual observation was used to count the trip. Data were obtained basis on a weekday and weekend. There was a variation in trip data which, the basis on the day of the week, time of the day. The independent variable data of characteristics shopping centers were collected and statistical analysis was carried out to estimate the rate of attraction of the trip. The trip attraction rate was estimated by the following equations:

1. Trip attraction rate (Trips/1000 sq.m2) = Total person trip /(GFA/1000)
2. Trip attraction rate (Trips/shop) = Total person trip/total number of shops
3. Trip attraction rate (Trips/employees) = Total person trip/ number of employees

Maximum hourly travel data for each shopping center was considered the highest hourly data used in the analysis. The sum of every four consecutive intervals of peak hour was then used for the calculation of the peak hour trip data. The following Figure 3 shows the methodology of the study. This was done for both weekday data and weekend data. Linear Regression Model is used for analyzing the collected data.

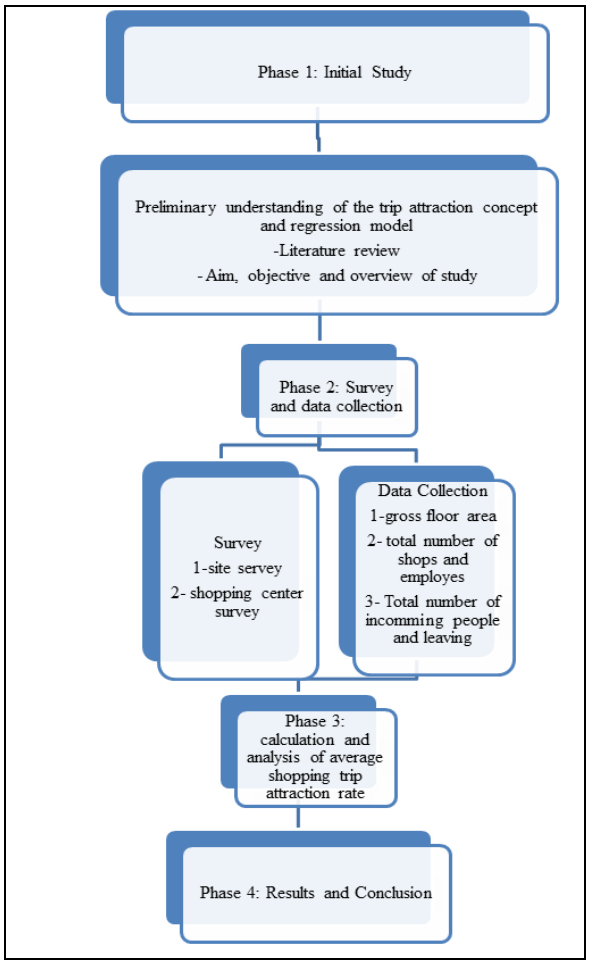

Fig. 3. Methodology of the study

From the analysis of count data the following summary data of average trip for three days for both weekend and weekday are shown in Table 2.

Table 2. Average Trips of all Shopping Centers

Shopping Centers	Code	Average Trip	
		Peak (weekend)	Peak (weekday)
Babylon Mall	B	1760	1096.75
Al-Mansour Mall	M	2945	2968
Al-Waha Mall	W	407	350.25

From this analysis, it was observed that most shopping centers had peak hours from 7,00 to 8,00 pm. In this study, data were collected between 5,00 pm to 8,00 pm. The highest hourly data is taken as the average hourly travel rates for each shopping center. This methodology is being pursued for both weekday and weekend research, it is clearly shown that shopping centers are attracting more weekday trips.

Building a statistical relationship (statistical equation) between two quantitative variables, dependent and independent variables using regression analysis. A simple linear regression model generated between variables and the dependent variable. This relationship can be used to estimate the value of the dependent variable when knowing the value of the independent variable. The value of y represents the dependent variable and the value of x represents the independent variable. The Table 3 shows a descriptive statistical analysis of the trip rate for all shopping centers per (total area, number of workers and shops) and the following regression models were developed and shown in Table 4.

Table 3. Descriptive statistical of Average Trip

Average Trip per GFA		Average Trip Rate per Number of Employees		Average Trip rate per Number of shops	
Mean	133	Mean	2.76	Mean	14
Standard Error	35.38438	Standard Error	0.440103	Standard Error	3.929207
Median	127.4156	Median	2.707692	Median	13.39432
Standard Deviation	50.04106	Standard Deviation	0.76228	Standard Deviation	5.556737
Sample Variance	2504.108	Sample Variance	0.581071	Sample Variance	30.87733
Range	70.76875	Range	1.472	Range	7.858413
Minimum	92.03125	Minimum	1.628	Minimum	9.465116
Maximum	162.8	Maximum	3.1	Maximum	17.32353
Sum	254.8313	Sum	7.435692	Sum	26.78865

Statistical models are generated to correlate 1 hour average trip with physical characteristics (GFA, number of stores and employees) of shopping centers. For the shopping centers, in the regression model, 1-hour trip attractions are taken as the dependent variable and physical features are taken as independent variables. This methodology is being pursued for both weekday and weekend research

Table 4. Developed statistical Models

With the independent variable of gross floor area (GFA)					
For weekday					
	Coefficients	Standard Error	t Stat	P-value	R^2
Intercept	458.8027	353.336	1.298488	0.417787	0.945654
GFA	78.92446	18.92042	4.171391	0.149789	
For Weekend					
	Coefficients	Standard Error	t Stat	P-value	R^2
Intercept	851.1779354	705.0366397	1.207282	0.440391	0.755998632
GFA	66.45366737	37.75327044	1.76021	0.32890579	
With the independent variable of the number of employees					
For Weekday					
	Coefficients	*Standard Error*	*t Stat*	*P-value*	R^2
Intercept	-772	834.9715298	-0.92458	0.5249341	0.89776945
no.of employees	3.638378378	1.227766556	2.963412	0.2071879	
For Weekend					
	Coefficients	*Standard Error*	*t Stat*	*P-value*	R^2
Intercept	-523.75	108.4006504	-4.83161	0.1299268	0.998056988
no.of employees	3.612567568	0.159395486	22.66418	0.028071	
With the independent variable of the number of shops					
For Weekday					
	Coefficients	*Standard Error*	*t Stat*	*P-value*	R^2
Intercept	-425.832814	1591.551028	-0.26756	0.8335655	0.632941791
no.of shops	15.51089493	11.81197287	1.31315	0.4143363	
For Weekend					
	Coefficients	*Standard Error*	*t Stat*	*P-value*	R^2
Intercept	-390.441615	893.3721105	-0.4370425	0.7376958	0.8695834
No.of shops	17.1207761	6.630316557	2.58219589	0.2352195	

5. Trips estimated using Trip Rate Method

Accordingly, the most common and accepted methodology used to calculate forecasted trips was based on the rate 1990[18]. Another method of trip rate was used. Average Rate (Average Trip Rate) equals the weighted average number of vehicle or person trips entering or exiting a development site per one unit of the Independent Variable. It is estimated by dividing the sum of all trips for all data point sites contributing by the sum of all independent variable units for all data point sites contributing, it is clearly shown that shopping centers are attracting more weekday trips. The following Figures from 4-6 shown the average trip rate for different site characteristics.

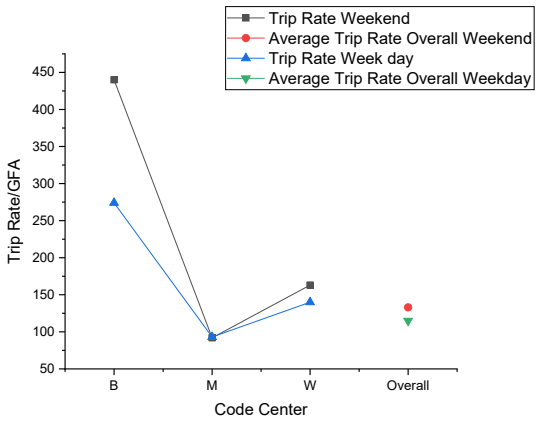

Fig. 4. Trip Rate (Person/GFA)

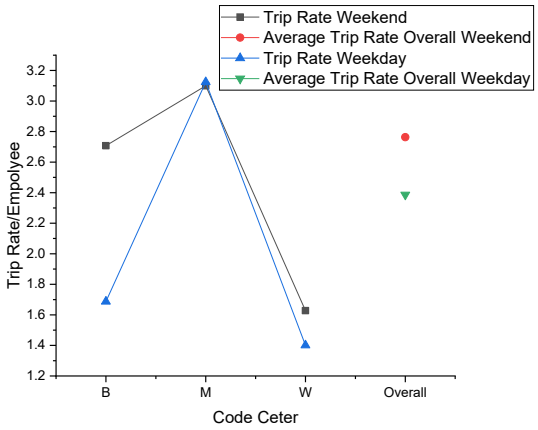

Fig. 5. Trip Rate (Person/ employees/hr)

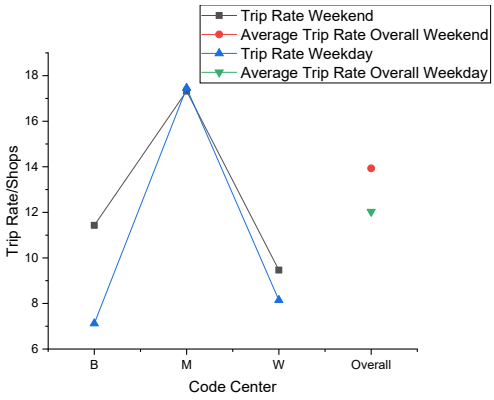

Fig. 6. Trip Rate (Person/shop/hr)

From Figure 4, the highest peak hour trip attraction rate is in Babylon mall in weekend 440 person/ 1000 m2/hr, Babylon mall attracted highest person trips per 1000m2 area during peak hour because it is a popular shopping mall of branded clothing. Al_Mansour mall has the lowest peak hour trip attraction rates 92.03124 person trip/1000m2/hour on weekend. Figure 5 represents the variation in peak hour person trip attraction rate (person/employee/hour) of three shopping centers. AL Mansour mall has the highest trip attraction rate 312.4211 person/employee/hr in weekday and lowest trip attraction rate in Al_waha mall 140.1 person /employee/hr in weekday. From Figure 6, Al_ Mansour mall has made the highest trip attraction rate 17.45882 person/shop/hr in weekday and lowest trip attraction rate in Babylon 7.121753 person/shop/hr in weekday. Table 5 shows trip rate values for the three shopping centers.

Table 5. Trip Rate per hour

Code Center	Peak Person Trip Rate (Trip/Shop/hr)		Peak Person Trip Rate (Trip/Employee/hr)		Peak Person Trip Rate (Trip/1000m^2/hr)	
	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
B	11.42857	7.121753	2.707692	1.68738	440	274.1875
M	17.32353	17.45882	3.1	3.124211	92.03125	92.75
W	9.465116	8.145349	1.628	1.401	162.8	140.1
Average Trip	14	12	2.76	2.38	133	115

6. Model Validation

Verification of existing models and rates is tested based on random samples: the sample was chosen for the study of land use to estimate the demand for shopping centers and to make inferences on the variations between the observations and the model estimation. If the predicted values of the models match or are similar to the observed values, the models may be considered confirmed. For this study and according to the scale of the sample examined. An average of 25% of the difference is acceptable. Al- Nakheel Mall was selected to verify the models and rates. For the regression analysis, the average difference is more than 25%, while for the rate method the average difference is 10% which is within acceptable limits. It can be concluded that the average trip rate method is more accurate and recommended for future forecasting.

Conclusion

Trip attraction rate is a key step in the planning of transport facilities and is important for all road networks and for channeling of traffic control around the shopping center. Trip Rate is useful to know the number of people entering an area at a specific time that is very useful for planning and monitoring traffic in that area. In this study, the trip attraction rate of the shopping center was

calculated, these trips showing a great impact on the transport network. Trip attraction rate determined by considering different physical characteristics of shopping centers. Each model and data should be useful in determining the effect of traffic around a new shopping center and the impact of traffic volumes. In this study regression models were used to determine attractions of shopping centers. Six models developed one is a function of gross floor area /1000m2/hr, second for several shops in the shopping center and the number of employees, all these for each weekday and weekend period. It is shown from the results that the GFA and number of employees are a good indicator to estimate trip rate. Also, trip rate method gives more accurate results than regression method. The developed trip attraction rate of this study is 133 trip person per GFA per 1000 m2, this value can be used to predict and develop trip attraction of new shopping centers in Baghdad city; it will be very useful and might help inaccurate prediction of trip rates and also planning of transportation facilities in Baghdad city.

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IMPACT OF STEEL INDUSTRY ON FREIGHT RAILWAY MAKRET IN CENTRAL EUROPE

Abstract. The interconnection of Eurasia through logistics chains using rail transport as the main mode of transport brings many opportunities for EU member states with Chinas economic potential. Accelerating the import of goods and semi-finished products into domestic industrial production from China by railway may pose a risk to the economic performance of countries that depend on industrial production and its structures.
Keywords: Steel Industry, Freight transport, Railway transport, GDP, Economy

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Introduction

The historical development of rail transport is closely linked to the transport of bulk substrates over long distances in order to ensure the highest possible efficiency of continental freight transport per unit of transport capacity. By reducing the energy consumption per unit of transport performance, we are drastically reducing the number of consumed resources.

The demand for transportation of bulk substrates in Central Europe stems from its economic nature. In most Central European countries, industrial production accounts for the largest share of total GDP.

The largest processor of bulk substrates in the conditions of the Slovak Republic and the countries of Central Europe is the metallurgical industry and energy industry, the metallurgical industry forms the core of the entire industrial production with connection to other sectors of the national economy, such as automotive industry, construction, transport, etc.

The concept of railway tracks was largely influenced by the location of ironworks and heavy industry companies to ensure their smooth supply of materials. The largest importers of these materials are eastern countries, especially Ukraine and the Russian Federation.

The cessation of production or the reduction of production volumes on ironworks in the countries of Central Europe poses a great risk. Ironworks provides an irreplaceable number of job opportunities in many regions. However, the connection of the metallurgical industry is further linked to other industries and services.

Securing the supply of material flow into the heavy industry is ensured by freight railway transport, because of its natural properties. Railway transport represents the most efficient, reliable and at the same time keyway of securing the supply of material and the transport of finished products from the ironworks.

Railway carriers attribute the risk of instability in the metallurgical sector. Replacing the production of the metallurgical industry with possible imports from third countries would mean outages in transport performance and the risk of non-utilization or insufficiently equipped rolling stock.

We have recorded a rapid increase in imports of steel products in 2013-2015, when imports of these products increased several times, mainly from China. The consequences were also recorded by the ironworks in Central Europe. The ability of the market to react quickly in a short period of time precedes the legislative procedures aimed at protecting the local market. Flooding the market with products from third world countries at dumped prices brought awareness before this type of risk for our domestic market.

The current situation after the pandemic also brought with it a slowdown in the economy. A drop in demand could lead to other economic actions such as unemployment and general recession in industrial production. This period brings with it a risk of similar nature with the possibility of importing goods from abroad and this ensuring a prolongation of the recession in the industrial regions.

1. Characteristic of metallurgical industry in Slovak republic

The importance of industrial production in the Slovak Republic means a share of up to 24,1% in GDP. The total volume of the industry, such as mining, production and distribution of electricity, waste and water cleaning, accounts for 28% of total GDP, which makes Slovak republic one of the most industrial countries in the EU.

The fastest-growing industry is automotive. The metallurgical industry takes the 2nd place with its share. In 2017 was a total share of 8,8% produced by the metallurgical industry.

Currently, Slovak Republic is placed 27th in total production of steel in the world. In total the metallurgy sector is divided into two sections:

SK NACE 24 – 62 companies,
SK NACE 25 – 457 companies.

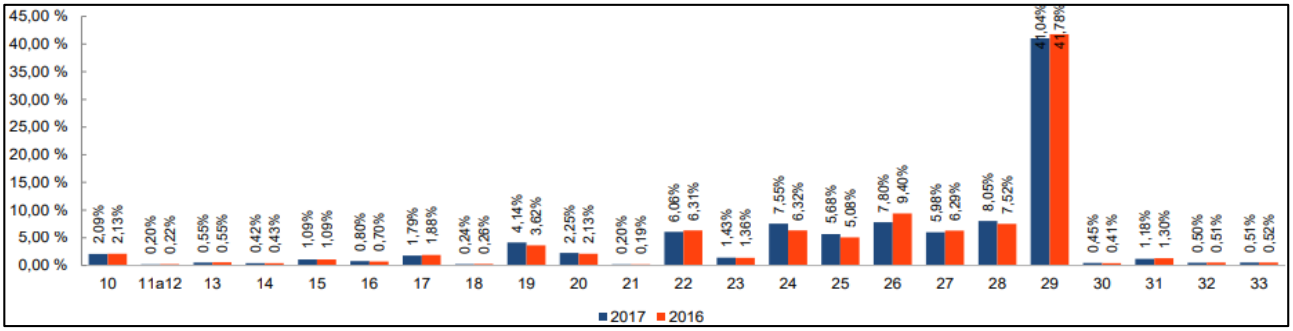

Fig. 1. The share of foreign revenues for individual sectors of the economy

Figure 1 display the share of sales from abroad in 2017 and 2016. The most important sector in the Slovak Republic is the automotive industry. The share of the metallurgical industry as the sum of SK NACE 24 and 25 is in the second place, in 2017 the share of metallurgical industry in international trade reached up to 13,23% compared to 2016, it increases of 2%, making it the fastest-growing industry.

The downturn in the ironworks in Central Europe is strongly influenced by EU environmental policy. The metallurgical industry refers to unfair conditions stemming from EU directives and regulations for the emission trading system. In terms of the validity of this Directive, ironworks are not able to compete with products from third world countries that ensure massive steel exports to the EU. The reduction of import is currently secured with anti-dumping duty.

As a result of the regulation of this sector, it leads to a reduction in production. Tightening emission standards for heavy industry companies force them to overprice their products to cover the extra costs. However, the production of the automotive industry is closely related to the use of processed steel provided by the metallurgical industry that acts as the primary supplier to the production chain of the automotive industry. However, the cheaper steel from outside of the EU drove the automotive to reduce its production costs.

The results of these risks may lead to a similar conclusion as occurred on June 20. 2019 when U. S. Steel Košice decided to shut down blast furnace no. 2 and optimize production portfolio. At the same time, ironwork announced a reduction in the number of 2,500 employees over the course of three years. Reducing production is intended to ensure the continued operation of the business. Disruption of production and the economic indicators of the company leads to a reduction of investment plans of the company, and the possibility of transition to more environmental methods of metal processing.

2. Characteristics and current state of U. S. Steel Košice

The company was established on June 7, 2000. As of January 31, 2019, U. S. Steel Košice, s. r. o. consisted of 9 subsidiaries. U. S. Steel Košice has an irreplaceable position within the metallurgical industry in the Slovak Republic. It is one of the largest steel producers in the Central European region. In terms of employment, it is the 5th largest employer in the Slovak Republic.

In 2017, it reported the largest volume of the net profit. From 2019, the production of KORAD radiators was canceled, as well as the production of spirally welded pipes. The annual capacity of U. S. Steel Košice production is represented by 4,5 mil. tons of slabs of which in 2019 was produced 3,54 mil. tons of slabs which represent almost 80% utilization of production opportunities.

Investments and research activities are focused on the modernization of production lines and the expansion of laboratories for research and development of new materials, coatings, and surface treatments, mainly in the automotive, electrical engineering, energy, packing, and other. In 2019 The company focused its research activities on reducing production costs and the content of harmful substances released into the air.

3. Impact of metallurgical industry on railway freight transport

The impact of the metallurgical industry on railway freight transport stems from the natural characteristics of the goods transported by the railways. The adaptation of rail transport to industrial production in Central Europe is clearly visible from several perspectives. In terms of the dependence of rail transport, the risk is described for the national freight carrier ZSSK Cargo a. s., in tow points namely:

- The complicated political situation between Ukraine and the Russian Federation, which cause the transfer of performances around the territory of the Slovak Republic.
- High dependence on the metallurgical industry in the Slovak Republic and surrounding countries.

Both risks directly indicate a year on year decline in output in the structure of the mix of transported commodities, especially the transport of iron ore and coal. These commodities are directly linked to the EU regulatory measures and their environmental policy. In the case of long-term production decline and the increasing demand, the opportunity in PRC intensified, with imports of products at dumped prices increasing several times year on year in 2013-2015. Follow-up measures to reduce such traffic volumes were addressed in 2017

The character of railway tracks in central Europe is based on the development of countries in recent history.

Characteristic marks of Central European railways in relation to industrial production:

- Directional and inclination conditions of railway tracks are built in the route of constant resistance,
- Composition of rolling stock of railway freight wagons
- Allocation of railway infrastructure to provide repair and maintenance of freight wagons – concentration of depots in industrial parts of the region.
- Construction of special equipment for handling bulk substrates – construction of equipment such as rotary or front trippers, etc.

The composition of the rolling stock poses a risk of not using open railway wagons, referred to E – series wagons, which represent the largest part of the rolling stock. The share of these wagons in selected countries is shown in figure 2.

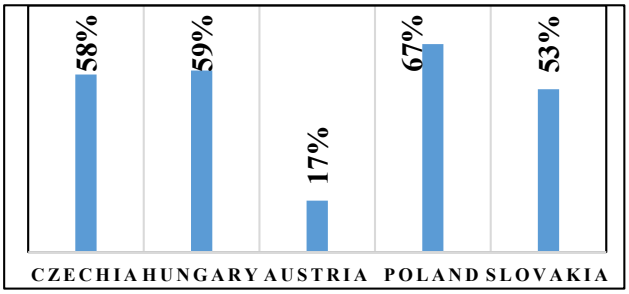

Fig. 2. Percentual amount of high sided wagons in selected countries (Source: Eurostat)

The share of high-sided wagons of a common structure makes up more than half of the total rolling stock. These wagons are directly used for the most for various types of transport, but they are mostly used for the transport of bulk substrates to the heavy industrial companies that are intended for their processing, such as iron ore and coal or wood, but they are mostly used to transportation for the metallurgical industry.

The interconnection of the metallurgical industry with other industries creates synergistic conditions for the economic growth of the country. The impact of the metallurgical industry extends to all sectors.

The import of cheaper products would mean the need to use special types of wagons for the transport of finished steel products. Currently, there is no railway freight carrier that could satisfy the need for this number of special wagons.

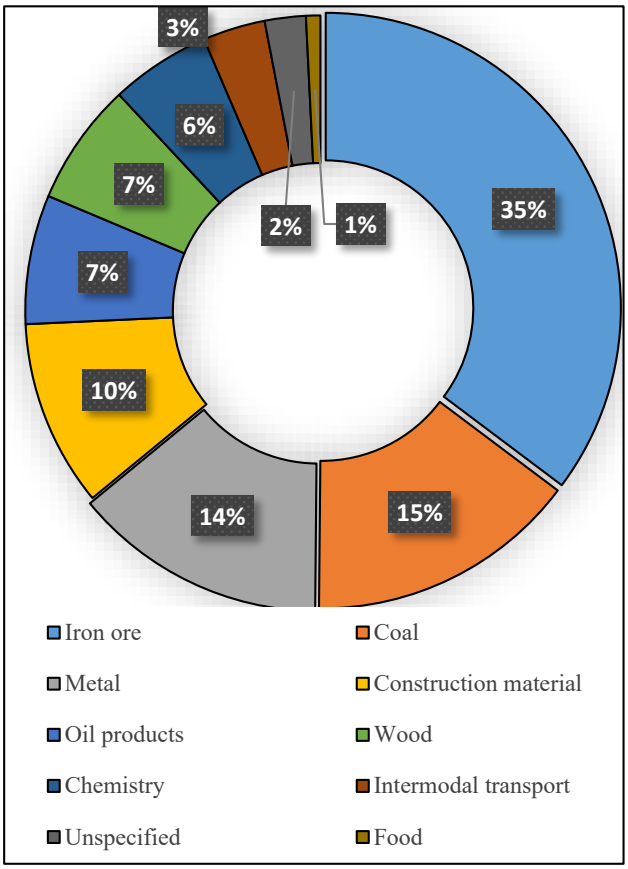

Fig. 3. Share of transported commodities in % 2018 (Source: ZSSK Cargo)

From figure 4 we can observe a long term of decline in the transport performance of our national railway carrier. The reference period is from 2010 to 2018. The largest

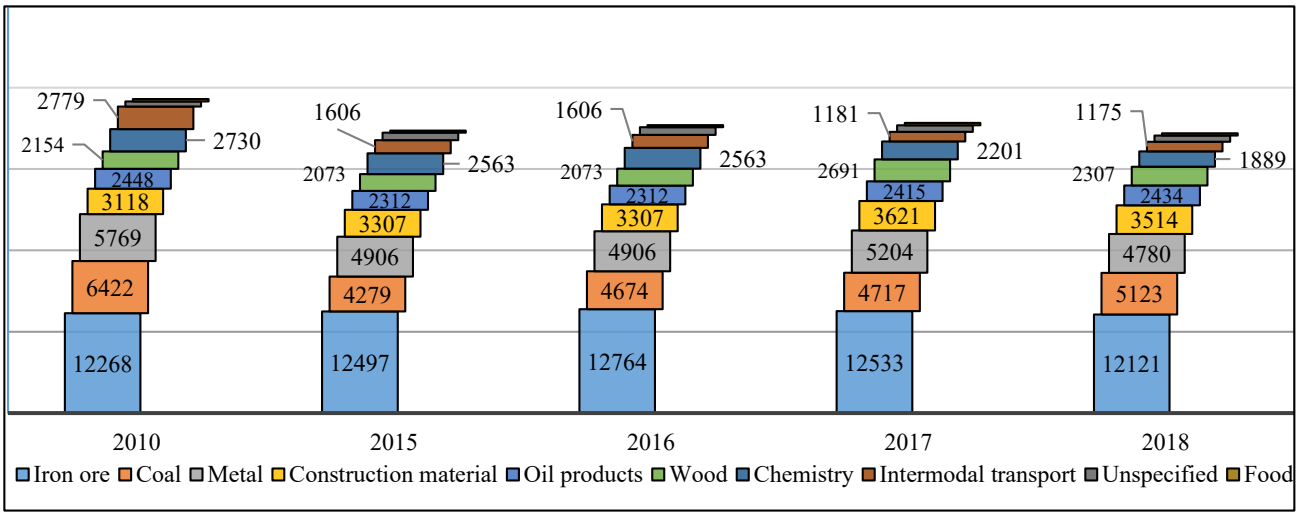

Fig. 4. Performance of freight transport (Source: ZSSK Cargo)

shortfalls are recorded in the commodity Coal, which reduction of its usage is directly linked with the environmental policy of the EU.

The decline in other commodities stems from the gradual liberalization of the market and the arrival of competitors in the freight railway market. The largest decrease in intermodal transport, where its total volume decreased almost by half during the observed period.

Iron ore coal and the transport of metals currently represent the majority of the total volume of transport by rail. In the case of a gradual reduction in the volume of transport of these commodities, the national freight carrier is exposed to the risk of the metallurgical industry and its products can be tentatively determined in Figure no. 4, which indicates the percentage of total closure.

The sum of the volume of iron ore transport, metals, and coal are representing to be the largest share of transport of the national carrier up to 64% of the total volume in 2018. The failure of the metallurgical industry in the Slovak Republic and surrounding Central Europe would step up to every part of the industry mentioned in the previous part of the article.

Conclusions

1. Railway carriers define the risk of failure in the metallurgical industry
2. The current state of metallurgical industry in Slovak republic is in defensive strategy
3. Environmental challenges for the metallurgical industry in the EU bring the potential risk of importing cheap steel from Asia.
4. The status of the economy after pandemic could restart the imports to the local EU market
5. The potential of intercontinental transport of steel products may pose a threat to the domestic market and could cause negative economic reaction e.g. unemployment...
6. The market and its mechanics are more often overtake the process of legislation.
7. Political issues on the east between Ukraine and the Russian Federation are making
8. The decline of transport volumes of our national freight railway carrier is linked with the metallurgical industry.
9. In the case of the metallurgical industry breakdown, the rolling stock of the national carrier would be

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THE ANALYSIS OF SAFETY MEASURES IN THE KOŠICE RAILWAY STATION

Abstract. The paper analyzes the impact of work technology on the safety of traffic at the Košice railway station. The paper is divided into three parts. The first part describes the characteristics of the Košice railway station, equipment in the station, and external influences that affect the technological procedures of work in the station. The second part consists of analysis according to traffic safety. The conclusion deals with possible proposals for improving the safety of traffic in Košice.
Keywords: Safety, Railway station, Railway transport, Accidents, Incidents

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Introduction

The issue of safety in transport processes is an important topic for discussion. Safety is one of the most important criteriums when choosing a mode of transport. Railway transport is characterized by a high level of safety. Even though these high safety standards that are currently strictly adhered to, the legislation is pushing its boundaries even more further. All of this effort is to ensure the protection of human life, which value is incalculable.

The objective of this article is to analyze the safety measures at the Košice Railway station.

1.0 Characteristics of Košice railway station and its interlocking station security device

The Košice railway station is located in the middle of the metropolis of eastern Slovakia in the city of Košice. The station has been used for railway transport since 14 August 1860, when the Miskolc - Košice line was opened. Gradually, the following tracks were built:

- 14. 8. 1860 Košice - Čaňa - Hidasnémeti,
- September 1, 1870, Košice - Kysak - Prešov,
- October 22, 1873, Košice - Michaľany - Čierna nad Tisou.

The Košice railway station provides a wide range of services in the field of railway operation. There are facilities for the maintenance of railway vehicles, the perimeter of the passenger station includes facilities ZSSK a. s., specifically:

- Locomotive depot,
- Deposit yard Stromová,
- AutoRamp,
- Stable wagon washer.

Košice (passenger group of tracks) has a safety equipment of the 2nd category – transitional station interlocking equipment, where the main signals depend on the position of all passed switches and all currently prohibited train paths are excluded.

- St.3, St.4, St.5, and St.6 are equipped with a transitional ZZ.
- St.2 is equipped with a relay ZZ with individual exchange service.

The interlocking device in the perimeter of the personal group of tracks is a representative of a temporary, currently named hybrid station interlocking device according to the Operational plan of Košice railway

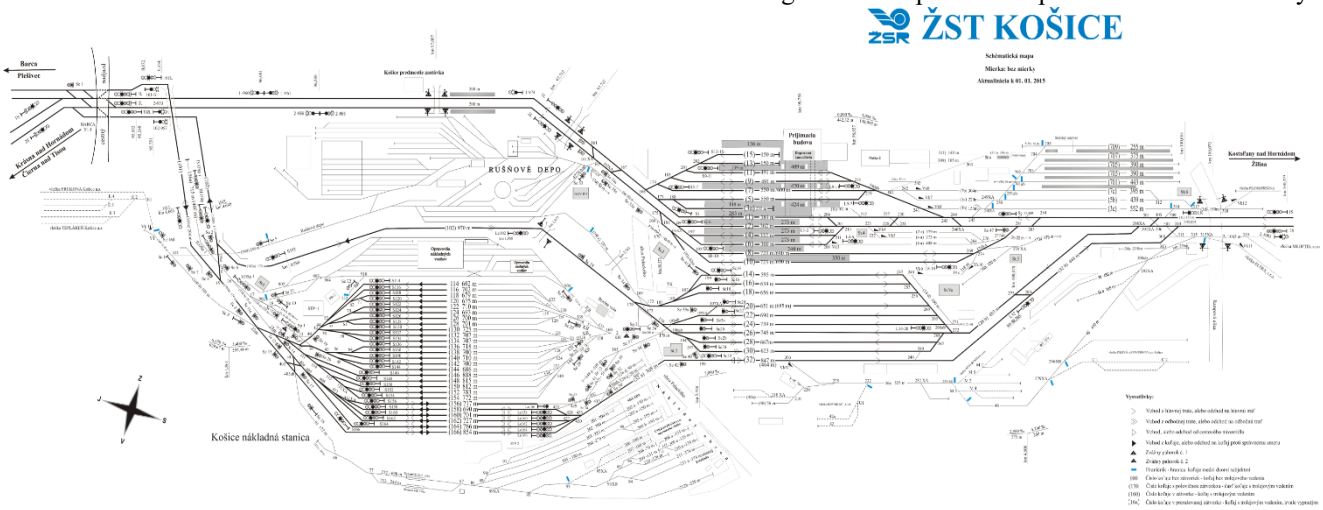

Fig. 1. Schematic of Košice railway station (Source: ŽSR PP ŽST Košice)

station. It has been in operation since 1973. The task of this security device was to increase the safety of operation, and it was to serve as long as the demands on the operation did not grow more than the existing station security device was able to meet, respectively. as a temporary solution to the situation until a definitive station interlocking is built.

Current interlocking security equipment secures only train paths by means of electromagnetic locks, which are located on auxiliary building blocks. Shunting paths within the personal station, they are implemented by the chief signalman, who is in charge of checking the position of the exchange controllers. The signalman uses these exchange controllers to select the desired path on his control panel. This procedure is used for St. 3, St. 4, St. 5, and St. 6. The shunting signal is given by the lead signalman to the employee who controls the shunting (shunting leader) with the rules using a radio station or hand signals. (PP ŽST Košice from 2015)

In the case of shunting of unaccompanied HKV, the head of the shunting is the signalman in his area of responsibility. (PP ŽST Košice from 2015)

Košice freight station has interlocking security equipment of the 3rd category - the main and set-up signals depend on the position of all passed and reversed switches and tracks as well and it excludes all currently prohibited travel routes. (PP ŽST Košice from 2015)

1.1 Rail-Road crossing in the perimeter of Košice railway station

Within the perimeter of Košice railway stations passenger station, there are 2 Road-Rail crossings.

- JIČ SP1316, which is located in front of the entrance lights 1L and 2L at km 97,725,
- JIČ SP0122, which his located at St. 6 on Rampova Street at km 100,073.

Crossing SP0122 is controlled from St. 6 using an electromagnetic lock, depends on the position of the train path. The disadvantage of this crossing is the location of the light sign Sc at km 99,480, which is an obstacle to the occupation of the isolated section. If the train stops at a light sign Sc at km 99,480, the train is no longer physically at a level crossing but the level crossing remains closed. The cause is an insulated rail, which isn't designed for long passenger trains that are operating from 2015.

Both of the Rail-Road crossings are secured with lights and barriers, which means that they are well secured.

2.0 Analysis of safety measures in transport processes

Accidents caused by ŽSR employees are discussed in more detail. Due to the high traffic frequency at Košice railway station, there are high demands placed on the employees. All actions and processes must be in accordance with legal norms and regulations, which are binding for their activities. In case of an accident or operational failure, the situation is being resolved according to the regulation Z17 called Accidents and incidents. After the investigation of the accident, there are usually taken measures to eliminate this kind of risk.

The accidents that occurred during the referenced period in Košice railway station includes accidents caused by:

- transport staff, who manage the transport activities in the railway station
  (dispatcher, signalmen, switch supervisor)
- the accidents that are caused by the unsatisfactory condition of railway infrastructure
  (rail break, station security device)
- the accidents caused by the carriers or by the movement of railway vehicles.
  (locomotive driver faults, rolling stock failure)
- injuries, or death of persons moving unauthorizedly over the tracks

The main concern from the safety point of view should be to prevent and minimalize the probability of happening these types of accidents.

By modernization and using new equipment to secure transport we are able to reduce the chances of accidents or incidents. The most common form of their prevention is to eliminate the human factor. On the other hand, accidents that are not related to railway operations, such as intentional or unintentional termination of life under a rolling stock can hardly be influenced by the forces of the infrastructure manager and its employees or prevent their occurrence.

The aim of the analysis is therefore to breakdown accidents and to point out possible reserves that can really catch up. Accidents caused by the poor technical condition of equipment and errors by transport staff are major components of accidents that can be affected. The output of the analysis is dealt with in the next part of the article, where are possible improvements to increase safety on Košice railway station.

2.1 Summary of accidents according to regulation Z17

During the monitored period, there were 45 recorded accidents in the Košice railway station which were documented. Most accidents occurred in 2014. Accidents for the monitored period are shown in figure 1, which are classified according to regulation ŽSR Z17.

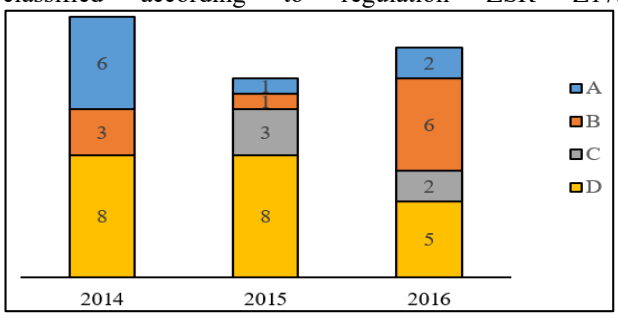

Fig. 2 Accidents according to the category of regulation ŽSR Z17 (Source: Author from internal pieces of information ŽSR)

Accident categorization according to regulation Z17: Serious accidents are coded "A" and serious accidents include events that have at least one of the following consequences:

- fatal injury (including suicide),
- serious injury (including a suicide attempt) to at least 5 people,
- extensive damage to railway vehicles, railway infrastructure, the environment, third party property,
- interruption of traffic on Category 1 lines for more than 6 hours.

Minor accidents code-marked "B" includes events that have at least one of the following consequences:

- serious injury (including a suicide attempt)
- damage to railway vehicles and railway infrastructure and others.

Incidents form a category coded "C". Incidents include events such as rail break, signaling error, passing the STOP sign, etc.

Operating faults, which are displayed in figure 2 are the largest represented by code "D". These events include events such as an unsecured train running, train rupture, etc. (ŽSR Regulation Z17 Accidents and Extraordinary Events)

The result of each accident investigated under regulation Z17 is the conclusion of accidents, where it is clearly divided into how many "%" who are responsible for the accident and a list of measures taken or taken on the basis of the events performed. This means that every accident caused contributes to the fact that similar circumstances do not recur, methods such as modification of technological work procedures, modification of equipment at a given workplace, or addition or introduction of a document for recording the activity, which has the task of reminding that no activity in the process is omitted.

2.2 Summary of accidents according to the cause of their fault

Figure 2 lists the accidents, according to the cause of their fault. They are divided into five groups. The group infrastructure includes incidents that occurred due to equipment of the railway station and its condition and also the station staff.

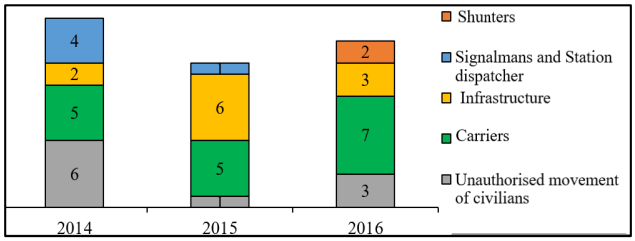

Fig. 3 Accidents according to the cause of their fault (Source: Author from internal pieces of information ŽSR)

Selected accident categories in the legend of figure 3 are selected according to those which can be influenced to a large extent by means of work technology or by means of other technological measures. Accidents caused by the infrastructure manager's staff should be the lowest number approaching zero.

Among the most common accidents caused by signalmen are accidents such as changing the switch under (before) the movement of a rail vehicle or incorrect position of the train path. These accidents most often result in the derailment of rail vehicles.

Shunting accidents, which are registered only in 2016, are inconsistent checking of the change of adjustment when operating locally built exchanges, and failure to remove the stop to secure parked vehicles against the unintentional movement. The result of both accidents was the derailment of rolling stock.

Accidents caused by infrastructure deficiencies are very common, most often rail breaks, or problems with traction line anchorage. The technical errors of the safety device, specifically non-functional relays, are also included in this category in the analysis. These accidents can be partially prevented by regular inspection of the condition of technical equipment, and their maintenance.

Carriers cause a significant percentage of accidents in the district of Košice Railway Station; these accidents include in the analysis of all accidents caused by technical as well as human factors. Among the most common accidents resp. faults include torn train couplings, infrastructure damage due to the poor technical condition of rolling stock, e.g. bad function of pantographs or non-compliance with prescribed measures - tolerances on the chassis. Also disregarded driver signals are included.

The most frequent accidents with the nature of death or serious injury to health are included in the category of unauthorized movement in the track. Persons in the track violate the Railway Act no. 513/2009 Z. z.

Conclusion

Rail transport is characterized by a high standard of safety. Demands for railway safety are also enshrined in European transport policy in the basic document of the White Paper, which includes a section devoted to the permanent maintenance and increase of transport safety and its reliability.

Accidents caused by carriers at ŽST Košice cannot be resolved at the station level. In order to achieve the reduction of accidents due to the insufficient technical condition of the carriers rolling stock, it is necessary for some way to force carriers to inspect their rolling stock more extensively or modernizing their vehicles.

Unfortunately, accidents involving collisions of rolling stock with persons with unauthorized movement in the track represent a significant percentage at Košice Railway Station, but in many cases, it is impossible to prevent this event.

From the results of the analysis of accidents that have occurred in recent years at Košice railway station, the proposals to increase the safety of traffic can be divided according to the horizon of their implementation into:

- long-term solutions to the traffic situation,
- resolving the situation with immediate effect.

Long-term solutions represent a comprehensive provision and treatment of deficiencies, for which traffic accidents or operational failures occur. The elimination of accidents would also ensure a better flow of traffic on a one-off basis, in particular a reduction in the train's delay time in the event of an investigation, and would also reduce the costs of material damage.

Short-term solutions with immediate effect are aimed mainly at reducing the errors of the human factor, both in the case of ŽSR employees but also the employees of carriers (train drivers).

Among the proposals that would belong to the long-term solutions category, we could include technical solutions, which should have the task of ensuring the increase of traffic safety in ŽST Košice and at the same time streamlining the operation. These proposals have higher time requirements and would be costly to put into operation.

Proposed measures:

- Comprehensive reconstruction of the railway station,
- Partial reconstruction of the railway station.

Among the immediate effect proposals, we could include possible measures that will reduce the demands on the performance of the work of ŽSR employees; these proposals would have the character of a smaller scale, which could be implemented in a short period of time, or with immediate effect. These possible improvements would lead to relieving staff of ancillary activities that are not directly related to the provision of rolling stock rides. Putting them into practice would not be too costly.

Proposed measures:

- Elimination of deficiencies in PZZ in the station and in inter-station sections,
- Certification of the REVOC recording device in train dispatcher office department,
- Checking compliance with speech discipline.

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QUALITATIVE AND QUANTITATIVE INDICATORS OF RAILWAY STATIONS

Abstract. The liberalization of the rail freight market has been booming in recent years. On a pan-European scale, new freight carriers are increasing year after year. Support for the liberalization of the railway sector is mainly implemented through the so-called railway packages and one of the tools is the quantitative and qualitative indicators of the individual railway stations. The relevance of the article is mainly to propose measures for railway stations, where freight transport is declining despite the liberalized market. These are main railway stations located on regional lines and railway stations with a smaller scope of transport work. The aim of this paper will be to propose measures to support freight transport in the Slovak Republic by setting minimum requirements (standards) for railway stations depending on their performance, respecting their current technical level of railway operation.
Keywords: railway station, freight carrier, railway transport

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Introduction

Railway transport, whether passenger or freight one, should be a central part of a transport system of each developed country. The railway transport market has, however, been entered by the liberalisation through "railway packages". Among others it has led to a competition and entry of new carriers into the process of transportations. A carrier with all shares owned by the state and who - as part of the transformation process - has separated themselves from the infrastructure manager and railway undertaking operating passenger transport, still features the biggest performances even in spite of their decreasing trends. In 2018 there happened a slight decrease in transport performances in 515 thousand gross tonne-kilometres for this carrier (Železnice Slovenskej republiky, 2019). Even despite this drop the state carrier still has approximately 65 % share on performances of freight railway transport in gross tonne-kilometres. For the comparison sake in 2012 it had up to 88.24 % share on performances in gross tonne-kilometres (Gašparík, 2012).

In the view of the fact given above this article will deal with ZSSK CARGO carrier only. To determine quantitative indicators of railway stations we will study the number of wagonloads for 2018 and 2019, and to determine qualitative indicators we will study the usage of consignment notes in their electronic form. This news was introduced by the carrier on 1 January 2019 after several years of development. These indicators will be evaluated for Žilina operation centre. There in the article we will analyse national transportations only.

1. Quantitative and qualitative indicators of railway stations

A railway station is defined as a transport control centre with a track lead intended for controlling a sequence of trains, handling passengers and cargo (Přispěvatelé Wikipedie, 2005). Quantitative and qualitative indicators are divided by the kind of transport (passenger and freight transport). In each kind of transport there are some common and some distinct indicators studied. Table 1 presents some selected quantitative and qualitative indicators of railway stations for freight transport.

Table 1. Quantitative and qualitative indicators of railway stations in freight transport

Quantitative indicators	Qualitative indicators
number of submitted and issued complete wagon load in national and international transport	possibility to submit a paper consignment note
number of freight trains in 24 hours	authority to issue carriage documents
number of stabling sidings	availability team track

Žilina operation centre comprises 660 transport points in total where operations related to cargo

transportation can be performed (loading operations, commercial operations). They, however, also include stations which have certain limitations (a station not staffed with a carrier's worker, submission of national shipments only, a railway station without any technical equipment, etc.). Table 2 presents the structure of Žilina operation centre

Table 2. Structure of the Žilina operation centre (Železničná spoločnosť Cargo Slovakia, a. s., 2003)

Operation centre	Circuit of operation	Central commercial workplace	Possibility to submit a paper consignment note
Žilina	Ružomberok	Lisková	Bánovce nad Bebravou
	Trenčianska Teplá	Trenčianska Teplá	Dolný Hričov
	Žilina	Žilina	Ladce
			Liptovský Hrádok
			Lisková
			Medzibrodie nad Oravou
			Nové Mesto nad Váhom
			Púchov
			Ružomberok
			Trenčianska Teplá
			Trstená
			Žilina

The district of operation covers individual railway stations at which the railway undertaking provides its services. Figure 1 presents the number of railway stations falling under individual districts of operation.

Fig. 1. Number of railway stations in individual operating district (Železničná spoločnosť Cargo Slovakia, a. s., 2003)

The chart makes it clear that the division of railway stations is comparatively even. There between the district of operation with the highest number of railway stations and the district of operation with the smallest number of railway stations exists the difference of four stations only.

2. Comparison of the number of submitted national complete wagon load

The basic quantitative indicator is represented with the number of received and submitted wagonloads by the shipper at the given railway station.

The carrier's transport regulations define a wagonload as follows:

a) goods transport of which requires at least one wagon,
b) goods comprising long indivisible objects on multiple wagons,
c) a rail vehicle on multiple wheels,
d) empty AVV wagons and other wagons submitted for transportation with at least one consignment note.

The haulage of individual wagonloads is realised by means of handling trains which feature a different periodicity. It depends on the actual load.

Direct consigner's trains or destination-routed block trains are categorised as freight express trains (NEx) or passing-through freight trains (Pn). The category is assigned to a train on the basis of the assessment whether the load is collected per time (NEx trains) or per weight (Pn trains) (Gašparík & Šulko, 2016).

Table 3 contains statistical data for the latest 2 years and it compares the number of submitted national wagonloads in Žilina operation centre.

Table 3. Quantitative and qualitative indicators of railway stations in freight transport (internal data of the railway undertaking)

Railway station	Year 2018	Year 2019
Bytča	0	14
Bytčica	420	168
Diviaky	0	30
Dolný Hričov	0	140
Horná Štubňa	0	8
Konská pri Rajci	55	20
Krásno nad Kysucou	279	59
Lietavská Lúčka	188	110
Martin	0	249
Príbovce-Rakovo	0	29
Rajec	103	29
Sklené pri Handlovej	0	97
Turany	0	3
Varín	48	2

Vrútky	0	112
Žilina	314	105
Žilina-Teplička	15	23

Of the total number 66 railway stations recorded a wagonload submission in 2018, and 17 railway stations recorded a wagonload submission in 2019. I.e. in the last year there happened more than a twice increase in the wagonload submission. Despite a comparatively fast increasing trend of the submission there were and still are railway stations where a wagonload submission for the carrier did not occur either in 2018 or in 2019.

The loading at railway stations, where the submission did not occur, could have been negatively impacted with these selected factors:

a) formation of serried trains by another carrier,
b) a shift of shippers to another kind of transport,
c) a low flexibility of the carrier.

If this trend was repeated in the following years, the haulage and distribution of load should be modified. Handling trains which nowadays drive with a calendar restriction should drive as necessary and should be engaged every time there is a shippers' demand.

Table 4 presents a proposal for handling trains driving as necessary in regard to not performing the loading at individual railway stations.

Table 4. Proposal for the introduction of handling trains as needed within the Žilina operation centre (Železnice Slovenskej republiky, 2019)

Handling train number	Handling train route	Note
85570	Kráľová Lehota – Lisková	as needed throughout the route
85571	Lisková – Kráľova Lehota	
85630	Púchov – Trenčianska Teplá	
85631	Trenčianska Teplá – Púchov	
85750	Trenčianska Teplá – Nové Mesto nad Váhom	
86500	Žilina – Makov	as needed in the section Čadca - Makov
86503	Makov – Žilina	as needed in the section Makov - Čadca
86550	Trstená – Lisková	as needed throughout the route
86551	Lisková – Trstená	
86560	Tvrdošín – Lisková	
86561	Lisková – Tvrdošín	
86620	Trenčianska Teplá – Horné Srnie	
86621	Horné Srnie – Trenčianska Teplá	
86630	Trenčianska Teplá – Lednické Rovné	
86631	Lednické Rovné – Trenčianska Teplá	
86670	Trenčianska Teplá – Rybany	
86671	Rybany – Trenčianska Teplá	
87551	Nové Mesto nad Váhom – Trenčianska Teplá	

In case of engaging trains as necessary the infrastructure manager does not provide a discount for the utilisation of a railway communication. It is also due to this reason why this measure is to be considered well and then based on the developing trend and economic profitability this measure is to be taken or not.

3. Rate of use of paper and electronic consignment note

With respect to digitalisation and automation of the company with emphasis put on making the transportations easier for customers, ZSSK CARGO carrier introduced the option to submit consignments using an electronic consignment note, as of 1 January 2019. With this step the shippers can create such a document from anywhere with the Internet signal coverage with no need to deliver in person. At the same time this step required an optimisation of jobs. The carrier merged workplaces of freight cash-desks into so called central commercial workplaces. Per Table 2 such workstations are dislocated in Žilina, Trenčianska Teplá and Ružomberok, as part of Žilina operation centre. The electronic communication with customers, in consideration of bigger volumes of transportations, is also performed in workplaces at other tariff points which, however, have remained separated from central commercial workplaces. The main task of central commercial workplaces lies in performing activities during the registration of transport performances in the area of the freight cash-desk, as well as the procedure to handle a consignment note before entering in the contract of carriage, during its period of validity and before its termination (Železničná spoločnosť CARGO SLOVAKIA, a. s., 2020).

The electronic consignment note was in a testing operation already in 2018 (the testing operation started prior to 2018). The testing operation should have eliminated shortcomings so the system failures would happen to the least extent possible after running the operation for real.

The measure of introducing the electronic consignment note should, among others, contribute to the following (Železničná spoločnosť CARGO SLOVAKIA, a. s., 2020):

a) a bigger interest in transportation by this carrier,
b) a higher comfort for the shipper,
c) better communication between the carrier and the shipper,
d) a higher satisfaction of the customer.

Figure 2 shows a graphical comparison of submission of individual wagonloads at railway stations for Žilina operation centre using a printed and electronic consignment note in 2018 and 2019.

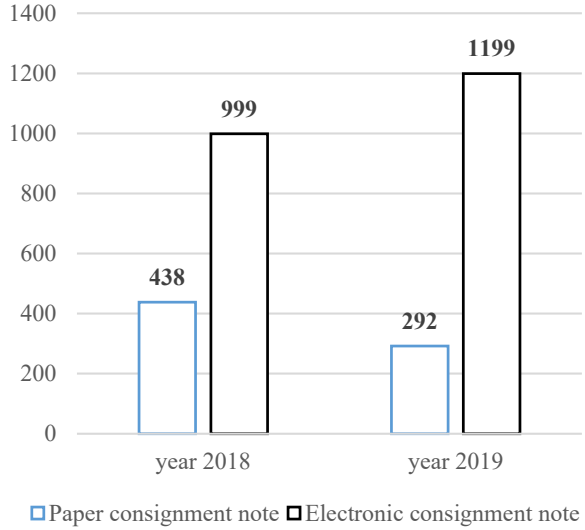

Fig. 2. Comparison paper and electronic consignment note (internal data of the railway undertaking)

The data makes it clear that even during the testing operation in 2018 the number of wagonload submissions in electronic form of the consignment note was higher than in its printed form. Altogether there were 1,437 wagonloads submitted for Žilina operation centre in 2018, out of which 999 were submitted per the electronic consignment note, which is almost 70 %.

In 2019 out of 1,491 wagonloads submitted for Žilina operation centre in 2018 there were 1,199 wagonloads submitted per the electronic consignment note, which is almost 81 %. A year-on-year increase then fluctuates at the level of almost 11 % and it conveys the information that submitting the wagonloads per the electronic consignment note is more and more popular among the customers. Thus there is a probability that the majority of tariff points where it is still possible to submit a consignment note in its printed form will have to shift to an electronic submission of wagonloads.

Conclusion

A progressive liberalisation of railway freight transport has brought many changes, whether for shippers, the infrastructure manager or carriers. Each of these entities concerned tries to react to these changes differently. The carrier must look after the biggest satisfaction of a shipper in the competitive fight for the shipper. One of the options is to improve the quality and to make the provided services faster in higher and higher quality. And the electronic consignment note can serve for the purpose of achieving such a defined objective. At the conclusion we must highlight that each railway undertaking should optimise transport-carriage processes and improve their quality so the customers will return back and utilise their services again.

Acknowledgement

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PROPOSAL OF TRAFFIC SERVICE RATIONALIZATION ON ZVOLEN – ŠAHY RAILWAY LINE

Abstract. Increasing population mobility and current trend of creating integrated passenger transport systems are opportunities for finding new possibilities to rationalization the railway passenger transport on those lines, where are no passenger trains or where the traffic service is not optimal nowadays. Precondition of reinstating the railway passenger transport is thorough potential passenger analysis, where there are actual geographic, demographic and transport characteristics of the region, where this line is situated. The contribution describes the passenger transport system, timetables rationalization and standards of traffic service in rail passenger transport. Consequently, according to these outputs and demographic and transport characteristic was proposed the rationalization of traffic service at Zvolen – Šahy transport route.
Keywords: traffic service, rationalization, standards, railway passenger transport

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Introduction

Public passenger transport in Slovakia is currently not at the desired level. It can be improved by reinstating rail passenger services on routes where they have been cancelled. This step would have positive impact on the quality of transport services in each region as well as the overall attractiveness of passenger transport from the traveling public point of view. Railway passenger transport should be a key element of the passenger transport system, therefore train operation should be reinstated in that routes, where it has got sufficient potential. An example is the Zvolen – Krupina – Šahy railway line. Railway passenger transport was reinstated in January 2019 on this railway line, but current traffic service is not very attractive and effective for passengers. Therefore, it is important to rationalize the traffic service and to change the system of particular passenger trains operation according to existing standards in rail passenger transport (Kováč, et al., 2011).

1. Timetable proposal as an important part of the rationalization of the passenger transport system

Public passenger transport problems are also addressed to a large number of transport experts and scientists. For example, the book publication "Transport Modelling" by authors Juan de Dios Ortúzar and Luis G. Willumsen (de Dios Ortúzar, et al., 2011) explains the basic principles of traffic planning and modelling. Another book publication, "Railway Timetabling and Operations" by authors I. A. Hansen and J. Pachl (Hansen, et al., 2014) describes analysis, modelling, simulation and performance evaluation. There is lots of useful information about the rationalization and optimization of railway transport operation. The scientific paper "Traffic service concepts of the area in freight and passenger transport" by authors J. Masek and M. Kendra (Kendra, et al., 2008) compares freight and passenger transport systems. The thesis "Rationalization public transport: A Euro-Asian Perspective" by Maher Niger (Niger, 2011) consists of lots of interesting data for example about the public transport rationalization and implementation and evaluation of the theoretical principles of rationalization. The diploma thesis "The proposal of the integrated cycle timetable in Slovakia in 2012" by author P. Kunik (Kuník, 2012) proposes integrated cycle timetable in Slovakia, but there are no general standards of rationalization which can be used all over the Europe or world. There was proposed general standards in international and national long-distance passenger rail transport, interregional and regional suburban rail passenger transport as well as other related transport modes in publication „Rationalization of the passenger transport system as an important transport system" (Rationalization of the passenger transport system as an important transport system, 2019) by authors M. Dedík, T. Čechovič, J. Gašparík, J. Majerčák. The mentioned contribution uses some outputs and try to

apply it on the rationalization of the traffic service at Zvolen – Šahy transport route.

1.1. Synergy effect of the transport modes

The first important output of the contribution „Rationalization of the passenger transport system as an important transport system“ is based upon the creation of the quality passenger transport system and optimal synergy effect of each transport modes. The main transport system should be a rail transport. This contribution is mainly aimed at the rationalization of passenger train timetables. Therefore, it will be important to define the different layers of transport service and to propose certain generally applicable standards within them. For attractive and efficient rail passenger transport, it is necessary to solve it within international and national transport as well as in long, medium and short-distance transport. The proposal of particular standards should be the basis for the proposal of a national or European integrated timetable transport system in the future. The basis for this system should be rail transport, which should be followed by other modes of transport. It is also very important to mention and support non-motorized kinds of transport such as transfer by foot and cycling transport. However, the most important aspect is to correctly coordinate these modes and create a maximal synergy effect among them. The scheme in figure 1 is such an example (Rationalization of the passenger transport system as an important transport system, 2019).

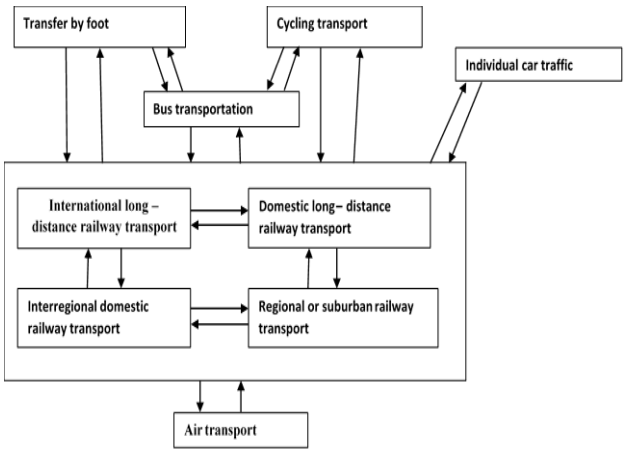

Fig. 1. Scheme of synergy effect among particular transport modes (Rationalization of the passenger transport system as an important transport system, 2019)

1.2. Standards of traffic service of interregional and regional rail passenger transport

The second important output of the contribution „Rationalization of the passenger transport system as an important transport system“ is based upon the proposal of the particular standards.

There were proposed following standards in interregional and regional rail passenger transport (Rationalization of the passenger transport system as an important transport system, 2019):

- **Standard no. 1** - Interregional and regional suburban rail passenger transport should normally be provided by Regional Express trains and passenger trains, in exceptional cases also by fast trains.
- **Standard no. 2** - Regional Express trains should be prioritized to strengthen the busiest traffic routes (100-120 kilometres from the capital or other major city) in the rush hour for daily attendance at school and work. On the lines without fast trains or EuroCity trains, regional express trains should also partially perform the function of the express layer of the transport service.
- **Standard no. 3** - The optimal departure time of Regional Express trains from the capital city or other major centres should generally be at the earliest on the 25th and at the latest on 40th minute (due to efficient organization of the operation). In the case of the operation of Regional Express trains on other transport lines or secondary railways is necessary to adapt their time positions to the paramount layers of the transport service to preserve traffic fluency and transfers.
- **Standard no. 4** - In order to optimize this type of rail passenger transport, it should be appropriate to operate two types of Regional Express trains. The first one is a classic type of semi-fast train (something between a passenger train and a fast train) and the second should be a semi-fast train ensuring “zone operation”.
- **Standard no. 5** - Passenger trains should be exclusively reserved for regional and suburban traffic, and they should normally stop at each station. The basic operation of passenger trains should be every day in the basic clock cycle two hours. The basic clock cycle of 1 hour should be in rush hour. On overcrowded lines with a high transport potential, a basic clock cycle of a minimum 1 hour and an interval of 30 minutes, 20 minutes, 15 minutes or even 10 minutes should be implemented in rush hour.
- **Standard no. 6** - In the case of the particularly high transport potential of the large cities it would be appropriate to provide an alternate concept of the transport service where one line of passenger trains would serve half the number of stations and stops (for example even numbered stops) on the selected lines. And the next line should serve the remaining number of stations and stops (for example odd stops). The connections of the two lines should run in dense intervals.
- **Standard no. 7** - Another important element of suburban transport rationalization should be a standard about the starting and destination station of the passenger trains. These trains should not to start or finish their journey at the main station in the capital or other major city, but if it is possible their destination station should be another larger station on the outskirts of the city. These trains should pass through the main station or another larger station in the city centre. This system of operation should be

implemented due to the improved transport service. And in this case trains will not occupy the running track in the main station. They should also serve as a prototype of urban transport (called S-bahn).

1.3. Summary of railway passenger transport benefits for public mobility

Passenger transport is generally considered as an activity, which arises as the consequence of spatial division of places, where people are in exact time and their need to move. Motivators for moving could be commuting – job or education, dealing with personal or working matters, travelling for vacation – hiking, sport, health, cultural and social facilities, visiting relatives and friends. Requirements for transport of passengers originate in the need to move, while the passengers transport is dependent on the willingness of travelling. In passenger transport, there are mostly individual passengers, so it is difficult to determine all transport requirements.

The transport attendance in some area is dependent on accessibility of passenger trains in the centre of the area, and other transport hubs in this area. Transport hub is a place, where passengers enter, change or exit the transport system. Considering to railway passenger trains, transport hubs are all stations and stops, where these trains usually stop. The route of the train consists of exact number of transport hubs. All transport hubs are characterized by localization and discesion. Localization is variability of transport hubs on the route, which means the exact number of stations and stops, where trains stops. Discesion is mutual layout of transport hubs on the route to each other.

Long-haul passenger trains are intended to transport passengers mainly for long distances. Their routes usually connect regional centres with higher population. Regional passenger trains are adjusted to long-haul passenger trains transport system, therefore people from smaller towns and villages can also use long-haul passenger trains, which do not stop in their town or village.

Transport offer on new route is represented by timetable of trains. Temporal position of trains, which are listed in the timetable, must be attractive for passengers. This can be made by harmonisation of departures and arrivals. It means that the departure time from all transport hubs on the new route is always in the same minute, but the hour is different. Passengers could easily remember all departures and it also improves the transport accessibility in the selected area from temporal point of view. It means that there is the same time gap between departures of trains and thanks to periodicity of departures, the transport accessibility is increased. Timetable is created separately for both directions of trains. It must include all trains, their departures, stations and stops names, trains numbers and distances. Transport time between each stations and stops must be determined by technical specifications of selected vehicle, which would operate on the new route.

2. Practical application of the outputs on the transport service at Zvolen – Šahy railway line

The important outputs mentioned in the first chapter are applied at Zvolen – Šahy railway line, where is necessary to change current train timetable. Firstly, there is mentioned geographic, demographic and transport characteristics of the railway line and finally proposal of the timetable (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017).

2.1. Brief geographic, demographic and transport characteristic of railway line

The Zvolen – Šahy railway line passes through the Banská Bystrica and Nitra regions, the districts of Zvolen, Krupina and Levice. The railway line is marked in blue on the map of Slovak railway network (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017).

Fig. 2. The map of the Slovak railway network with marked Zvolen – Šahy railway line (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017)

This railway line is a non-electrified one-track line with normal gauge 1435 mm and length of 74 km. The highest line speed is 70 kph. Particular station safety devices are shown in table 1.

Table 1. Safety devices in particular stations at Zvolen – Šahy railway line (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017)

Station	Safety device
Zvolen passenger station	electrical
Dobrá Niva	electromechanical (Zvolen side) and mechanical (Šahy side)
Sása-Pliešovce	mechanical
Krupina	
Hontianske Nemce	
Hontianske Tesáre	
Šahy	

In addition to the towns of Zvolen and Šahy, the towns of Krupina and Dudince and other 16 municipalities are on the track. Besides Zvolen, which has got more than 40 000 inhabitants, other towns are Krupina, Šahy and municipalities Pliešovce and Dobrá Niva. The availability of stops is generally not optimal on

this track, the most remote stop from the village centre is the Bzovík stop, at a distance of more than 3 km. All towns and municipalities serving the railway line, including population numbers, availability of stations and stops and other brief characteristics are shown in table 2 (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017).

Table 2. Analysis of each town and village (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017)

Municipality	Population	Distance between centre and station other stop [km]	Other characteristics
Zvolen	41 683	0,6	university, elementary and high schools, industrial and commercial zones, health and social facilities, tourism
Breziny	362	1,7	ambulance
Podzámčok	491	0,9	
Dobrá Niva	1 852	1,6/0,4	elementary school and ambulance
Sása-Pliešovce	928/2 358	1,8/1,8	
Bzovská Lehôtka	134	1	
Babiná	545	2,5	
Krupina	8 010	1,3/1	elementary and high schools, industrial and commercial zones, health and social facilities
Bzovík	1 145	3,2	elementary school and ambulance
Devičie	301	0,7	
Hontianske Nemce	1 519	0,7	elementary school and ambulance
Domaníky	197	0,15	
Hontianske Tesáre	924	1,3	elementary school and ambulance
Dvorníky	205	0,15	
Terany	625	0,8	elementary school
Dudince	1 458	0,7	elementary school, health and social facilities, spa, tourism
Slatina	316	1,1	
Tupá	577	0,5	elementary school
Hrkovce	288	0,7	high school
Šahy	7 368	0,5	elementary and high schools, industrial and commercial zones, health and social facilities, state border

2. 2. Proposal of the traffic service rationalization

Nowadays there are operated only 5 pairs of passenger trains at Zvolen – Šahy transport route, 3 pairs at Zvolen – Krupina transport route and 2 pairs at Dudince – Šahy transport route. All trains are operated mostly on working days. Their time position is sometimes unprofitable and are not corresponded to passenger transport needs.

Therefore, it is necessary to rationalize the current traffic service on this line, to offer as many connections as possible and to propose better traffic service. All trains are proposed to operate with the VT643, a commercial vehicle called "TALENT" from BOMBARDIER, which is currently used by many transport companies around the world and passenger operator RegioJet in Slovakia on the Bratislava – Dunajská Streda – Komárno railway line. The main priority of the proposal are regional expreses (REX trains) which will provide fast connections on the route. Timetable includes 9 pairs of REX trains run in a two-hour interval. REX trains will stop at the Dobrá Niva centre (due to more favorable position than Dobrá Niva railway station) and railway station Sása-Pliešovce. On Krupina – Šahy section, more efficient is to operate them as passenger trains, therefore they will stop all stations and stops. Bzovík and Devičie stops are skiped because the crossing of REX trains is planned in Hontianske Nemce where it is important to keep all necessary crossing intervals.

Another priority in the timetable is to create an attractive transport offer at Zvolen – Krupina section in order to increase the attractiveness of rail passenger transport. The solution is to offer a two-hour interval trains, which will run between REX trains, creating a complex one-hour interval between Zvolen and Krupina. There are used standards of traffic service of interregional and regional rail passenger transport mentioned in chapter 1.2 within the proposal the timetable. Mostly standards 1,2,4 and 5 are used. Timetable in both directions is shown in Figure 3 (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017).

153 Zvolen os. st. - Šahy - Čata

Km		Vlak.	6050	REX 1006	6052	6060	REX 1082	6062	REX 1084	6064	6064	REX 1086	6066	REX 1088	6056	6068	REX 1810	6070	REX 1812	6058	6072	REX 1814	6074	REX 1816	6076
	Zo stanice:																								
0	Zvolen os. st.			5.06		6.04	7.06	8.04	9.06	10.04	11.06	12.04	13.06		14.04	15.06	16.04	17.06		18.04	19.06	20.04	21.06	22.24
8	Breziny				x 6.12		x 8.12			x 10.12		x 12.12			x 14.12		x 16.12			x 18.12		x 20.12		x 22.32
10	Podzámok				x 6.15		x 8.15			x 10.15		x 12.15			x 14.15		x 16.15			x 18.15		x 20.15		x 22.35
12	Dobrá Niva				6.19		8.19			10.19		12.19			14.19		16.19			18.19		20.19		22.46
13	Dobrá Niva zast.			5.20	6.22	7.20	8.22	9.20		10.22	11.20	12.22	13.20		14.22	15.20	16.22	17.20		18.22	19.20	20.22	21.21	22.49
19	Sása - Pliešovce			5.28	6.30	7.28	8.30	9.28		10.30	11.28	12.30	13.28		14.30	15.28	16.30	17.28		18.30	19.28	20.30	21.28	22.57
21	Bzovská Lehôtka				x 6.39		x 8.39			x 10.39		x 12.39			x 14.39		x 16.39			x 18.39		x 20.39		23.00
25	Babiná				x 6.43		x 8.43			x 10.43		x 12.43			x 14.43		x 16.43			x 18.43		x 20.43		23.04
32	Krupina predmestie				6.51		8.51			10.51		12.51			14.51		16.51			18.51		20.51		23.12
34	Krupina			5.42	6.54	7.42	8.54	9.42		10.54	11.42	12.54	13.42		14.54	15.42	16.54	17.42		18.54	19.42	20.54	21.42	23.15
34	Krupina			5.45		7.45		9.45			11.45		13.45			15.45		17.45			19.45		21.45	23.17
36	Bzovík																						x	23.20
40	Devičie																						x	23.25
44	Hontianske Nemce			5.58		7.58		9.58			11.58		13.58			15.58		17.58			19.58		21.58	23.32
46	Domaníky		x	6.01		x	8.01	x	10.01		x 12.01		x 14.01			x 16.01		x 18.01			x 20.01		x 22.01	x	23.35
54	Hontianske Tesáre			6.10			8.10		10.10		12.10		14.10			16.10		18.10			20.10		22.10		23.44
55	Dvorníky		x	6.12		x	8.12	x	10.12		x 12.12		x 14.12			x 16.12		x 18.12			x 20.12		x 22.12	x	23.46
58	Tekany		x	6.16		x	8.16	x	10.16		x 12.16		x 14.16			x 16.16		x 18.16			x 20.16		x 22.16	x	23.50
60	Dudince			6.19			8.19		10.19		12.19		14.19			16.19		18.19			20.19		22.19		23.53
62	Slatina		x	6.23		x	8.23	x	10.23		x 12.23		x 14.23			x 16.23		x 18.23			x 20.23		x 22.23	x	23.57
66	Tupá		x	6.30		x	8.30	x	10.30		x 12.30		x 14.30			x 16.30		x 18.30			x 20.30		x 22.30	x	0.04
69	Hrkovce		x	6.33		x	8.33	x	10.33		x 12.33		x 14.33			x 16.33		x 18.33			x 20.33		x 22.33	x	0.07
74	Šahy			6.40			8.40		10.40		12.40		14.40			16.40		18.40			20.40		22.40		0.14
74	Šahy		5.17		6.58					10.59					14.59				19.00						
83	Vyškovce nad Ipľom		5.27		7.08					11.09					15.10				19.10						
89	Ipeľský Sokolec		5.35		7.16					11.17					15.17				19.18						
93	Bielovce		5.40		7.21					11.22					15.22				19.23						
96	Pastovce		5.45		7.26					11.27					15.27				19.28						
101	Zalaba		5.51		7.32					11.33					15.33				19.34						
106	Čata		5.57		7.38					11.39					15.40				19.40						
	Do stanice:																								

153 Čata - Šahy - Zvolen os. st.

Km		Vlak.	6051	REX 1081	6053	6003	REX 1083	6005	6055	REX 1085	6007	REX 1087	6057	REX 1089	6057	6011	REX 1811	6013	6059	REX 1813	6015	REX 1815	6017	REX 1817
	Zo stanice:																							
0	Čata			4.30		6.07			7.50						13.55				16.00					
5	Zalaba			4.36		6.13			7.56						14.01				16.06					
10	Pastovce			4.42		6.19			8.02						14.07				16.12					
13	Bielovce			4.47		6.25			8.07						14.12				16.17					
17	Ipeľský Sokolec			4.53		6.31			8.13						14.18				16.23					
23	Vyškovce nad Ipľom			5.00		6.38			8.20						14.25				16.30					
32	Šahy			5.11		6.49			8.31						14.36				16.41					
32	Šahy		3.51		5.14			7.14		9.14		11.14		13.14			15.14			17.14		19.14		21.14
37	Hrkovce	x	3.58		x 5.21			x 7.21		x 9.21		x 11.21		x 13.21			x 15.21			x 17.21		x 19.21		x 21.21
40	Tupá	x	4.01		x 5.24			x 7.24		x 9.24		x 11.24		x 13.24			x 15.24			x 17.24		x 19.24		x 21.24
44	Slatina	x	4.06		x 5.29			x 7.29		x 9.29		x 11.29		x 13.29			x 15.29			x 17.29		x 19.29		x 21.29
48	Dudince		4.11		5.34			7.34		9.34		11.34		13.34			15.34			17.34		19.34		21.34
48	Tekany	x	4.13		x 5.36			x 7.36		x 9.36		x 11.36		x 13.36			x 15.36			x 17.36		x 19.36		x 21.36
51	Dvorníky	x	4.16		x 5.39			x 7.39		x 9.39		x 11.39		x 13.39			x 15.39			x 17.39		x 19.39		x 21.39
52	Hontianske Tesáre		4.19		5.42			7.42		9.42		11.42		13.42			15.42			17.42		19.42		21.42
60	Domaníky	x	4.27		x 5.50			x 7.50		x 9.50		x 11.50		x 13.50			x 15.50			x 17.50		x 19.50		x 21.50
62	Hontianske Nemce		4.30		6.01			8.01		10.01		12.01		14.01			16.01			18.01		20.01		22.01
66	Devičie	x	4.36																					
70	Bzovík	x	4.41																					
72	Krupina		4.44		6.13			8.13		10.13		12.13		14.13			16.13			18.13		20.13		22.13
72	Krupina		4.46		6.18		7.05	8.18	9.05	10.18	11.05	12.18	13.05	14.18		15.05	16.18	17.05		18.18	19.05	20.18	21.05	22.18
74	Krupina predmestie		4.49				7.08		9.08		11.08		13.08			15.08		17.08			19.08		21.08	
81	Babiná	x	4.57				x 7.15		x 9.15		x 11.15		x 13.15			x 15.15		x 17.15			x 19.15		x 21.15	
85	Bzovská Lehôtka	x	5.01				x 7.20		x 9.20		x 11.20		x 13.20			x 15.20		x 17.20			x 19.20		x 21.20	
87	Sása - Pliešovce		5.05		6.33		7.31	8.33	9.31	10.33	11.31	12.33	13.31	14.33		15.31	16.33	17.31		18.33	19.31	20.33	21.31	22.33
93	Dobrá Niva zast		5.12		6.40		7.38	8.40	9.38	10.40	11.38	12.40	13.38	14.40		15.38	16.40	17.38		18.40	19.38	20.40	21.38	22.40
94	Dobrá Niva		5.21				7.41		9.41		11.41		13.41			15.41		17.41			19.41		21.41	
98	Podzámok	x	5.24				x 7.44		x 9.44		x 11.44		x 13.44			x 15.44		x 17.44			x 19.44		x 21.44	
98	Breziny	x	5.27				x 7.47		x 9.47		x 11.47		x 13.47			x 15.47		x 17.47			x 19.47		x 21.47	
106	Zvolen os. st.		5.35		6.54		7.55	8.54	9.55	10.54	11.55	12.54	13.55	14.54		15.55	16.54	17.55		18.54	19.55	20.54	21.55	22.54
	Do stanice:																							

Fig. 3. The proposal of the timetable for both directions (Proposal for reinstating of railway passenger transport at Zvolen - Šahy, 2017)

Conclusion

The contribution proposed traffic service change at Zvolen – Šahy railway line based on passenger transport system rationalization and existing standards of traffic service in interregional and regional rail passenger transport.

This intention offered one of the ways in which the resumption of passenger transport at Zvolen - Šahy railway line could be improved. The aim was to create a high-quality transport offer to attract new passengers and to ensure high-quality transport services for the region by rail passenger transport as the main transport system. However, it should be noted that with regard to the technical base of the track and stations, the maximum speed of 70 km / h and the low permeability, travel time is relatively long, which may not be attractive compared to bus and individual car traffic.

For this reason, the intention should be supported by the measures of the railway infrastructure manager to increase the line section's permeability or to modernize the station security devices in Sása - Pliešovce, Krupina, Hontianske Nemce and Šahy railway stations. An important measure should also be the upgrading of entrance edges in stations and stops and the opening of station buildings to the public. After the implementation of the afore mentioned measures and the subsequent interest of the passengers, the proposed offer could be further increased or optimized by other means. It would also be beneficial and efficient to adapt suburban buses to the proposed train.

It is also necessary to think that it cannot be expected from the outset to large traffic streams, because getting used to a new transport concept in a certain region is a long-term issue. Therefore, an active marketing policy and effective acquisition activity would be needed to maximize this process. In this case, there is also a higher expectation of increasing the mobility of the population, and hence the increase in the quality of logistics in passenger transport (Vojtek, 2017).

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LOGISTICS AUDIT IN A TRANSPORT COMPANY

Abstract. Logistics audit is an effective tool of logistics management of a company, which serves to analyze and control the efficient and economic implementation of logistics activities. Today, more and more companies apply logistics audit in their practice, because it appears to be a very effective tool in today's turbulent business environment. Such a tool assesses the state and performance of the management of the company's logistics activities. The logistics audit determines changes and settings of individual processes that will lead to an increase in the quality and performance of the logistics system as a whole. Which means increasing the competitiveness of the company. The article focuses specifically on the application of logistics audit within the transport company. Because so far this tool has been applied mainly in the conditions of manufacturing companies and focused on optimizing the logistics of production processes. The article describes the procedure of performing a logistics audit and analyzes the main processes in a transport company.
Keywords: logistics, audit, logistics system, logistics audit methodology, process

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Introduction

More and more companies are using logistics audit services, because in today's competition, details really matter. This type of audit provides an opportunity for a company to plan and reorganize its operations so that nothing is left to accident. The logistics audit is responsible for assessing the state and performance of management with regard to the set of logistics activities defined by the department. It also has the task of determining such changes and settings that will lead to an increase in the quality and performance of the logistics system and thus to an increase in the competitiveness of the company. The basic goals of a logistics audit can to be specified according to the specific logistics needs of the company. The scope of the audit, of course, depends on the size of the entity concerned, its product and process activities. During the implementation, it is necessary to pay attention to the precise preparation and organization of the audit.

Within the Slovak Republic, the Chamber of Logistics Auditors associates logistics auditors, promotes their interests and guarantees the professional level of logistics audits. For the professionalization of logistics services in the Slovak Republic, professional meetings of logistics are organized every year.

The logistic audit is:

- standardized analytical and project process, which is focused on the logistical functions of the corporate management system;
- is a standardized analytical procedure with its own methods, defined content, procedures, goals and outputs. It focuses on the primary functions of the company (purchase, production, sales) and analyzes them from the perspective of material and information flow. (Chamber of logistics auditors)

A logistics audit is not just a statement of the state of a company's logistics performance, it provides procedures and instructions on how the situation can change to the desired state. He answers the questions "what needs to be changed?" "How to change it", "who will make the changes" and "how much will it cost". The purpose of the logistics audit is to diagnose the state of the logistics system in the company and define a program to increase its productivity. The project nature of this program allows for the implementation of immediate organizational interventions leading to rapid effects, as well as fundamental conceptual changes in logistics processes.

The basic principles of the logistics audit are its methodological structure (results when repeating the audit may be comparable), objectivity and independence of the auditor, confidentiality of business data, controllability of inputs. The audit monitors both quantitative (measurable parameters that characterize the investigated logistics processes by numerical value) and qualitative indicators (subjectively evaluated parameters such as staff qualifications, level of communication between departments).

1. Logistics audit procedure

In general, the logistics audit is performed in the following steps:

1. Presentation of the logistics audit methodology according to which it will be performed.

2. Preparation of a logistics audit - the interview itself and measurement within the company. In this step, the auditor identifies what are the main and supporting processes in the company, which processes contribute most to the fulfillment of the company's mission.

3. Setting audit objectives - based on the set objectives, it is decided whether the subject of the audit will be the entire logistics chain or only a specific part of it (selected logistics processes).

4. Audit processing. In this step, it is necessary to identify all relevant processes in the company, describe their running, or compile a process map. This step consists of two phases.

- The first is an analysis of the current state of the company. Here, all relevant information is gathered on the basis of the selected objectives in order to examine the factors that influence the achievement of the set priorities. In this phase, the auditor creates an objective picture of material, financial and information flows, their interrelationships, through observation, communication with employees and the company's management.
- The second phase is the evaluation of the current situation. Based on the set qualitative and quantitative indicators, the auditor processes and evaluates the obtained data.

5. Processing of results and evaluation of relevant documentation - evaluation of collected data, proposal of measures, recommendations and verification of conclusions.

6. Presentation of results - internal discussion, formulation of assignments for the project of logistic changes. The auditor proposes a measure to eliminate "bottlenecks" and may prescribe to the company activities for their application in the company. The activities will then be carried out according to priorities (necessary, moderately urgent and recommended activities).

All audit conclusions are contained in the logistics audit report and three paragraphs are formulated for each area examined:

1. Statement of the current state of the area.

2. Assessment of the state and potential of the area.

3. Proposal of changes that will lead to the realization of the potential.

Within the project of logistic changes, the purpose and goals of the program, specification of activities and changes, including their prioritization, determination of the scope and ongoing evaluation time, organizational and technical support, schedule and budget with a forecast of economic return are always formulated. (Chamber of logistics auditors)

2. Logistics system

Logistic processes are included in all technological, production and economic activities of human action. Therefore, it is appropriate to identify and investigate these processes, as their management and optimization can reduce economic costs without reducing product quality. Logistics is understood as a scientific field, which is characterized by a systems approach. Which means that the individual elements that the system contains and the links between them are examined. In the case of the logistics system, the elements and links are given by activities and processes associated with the material, respectively intangible flow from the source (production, extraction) to the point of consumption. It is a flow of material (or services), finances and information that together form a whole and interact with each other.

The main essence of the logistics system is the relationship between the manufacturer and the customer. In terms of material flow, it is transport and storage from the place of production to the customer. This means that the goods must almost always be removed from storage, loaded onto a means of transport and transported to the customer via the transport network, where they are usually unloaded from the means of transport and stored in a warehouse or they travel directly to production.

3. Process approach in a transport company

The key basis for the implementation of a logistics audit in every company is the examination of processes and the compilation of process maps. Because a uniform description of processes leads to their successful optimization and increased system performance. In-house processes should be a tool to fulfill the vision and goals of the business. They must follow each other, and every process must have meaning. Therefore, setting process goals and measurable indicators is very important. We need to know what the process should be aimed at and monitor how the process fulfills the goal (measure the result). Furthermore, it is essential to monitor whether the fulfillment of the process goal contributes to the overall fulfillment of the goals of the entire company. It follows that the definition of goals must begin at the level of the company's top management and gradually move to the lowest level in the form of sub-goals for individual processes. Therefore, in the third phase of the logistics audit - Setting goals, the strategic goals that the company wants to achieve by meeting the partial goals of the audit should also be proposed.

For a successful audit, it is necessary to identify the main processes in the company, which create value in the form of a product / service for the customer and are formed by a chain of benefit, which is a key area of the organization's business. The main processes therefore directly contribute to the fulfillment of the company's mission. (Pernica)

3.1. The main processes of the transport company

We will take a closer look at the example of a transport company focused on road transport, the company has its own means of transport and has a forwarding (sales) department - so it can resell some

orders and thus use outsourcing of transport services of other companies. Then the main processes in the company can look like this (fir. 1):

Step 1.1: The customer orders shipping for a certain price and under certain conditions. The order can be made by phone, fax, email.

Step 1.2: The order proceeds for assessment by the sales department, which decides whether to accept the order (step 2.1) or not to accept it (step 2.0).

Step 2.1: On the part of the transport company, the sales department accepts the order and in the next step 2.2 it is decided whether to execute the order with its own means of transport or to use the services of another carrier. In the case of a new unverified customer, the sales department will request customer references from other companies. If the customer wants to verify the transport company, he can request references, check the Community authorization, CMR insurance, the allocation of the CEMT authorization, etc.

Step 2.3: The sales department decides that the order will be executed within the company and forwards it to the dispatcher. The dispatcher must choose the appropriate means of transport and the optimal route for the given transport. In the case of expensive goods, the customer (telephone or e-mail communication) must also approve the proposed means of transport and the route. In case the sales department decides to use the services of another carrier, steps 2.5 and 2.6 follow, the next steps 4.1 to 5.4 are similar to the steps 2.4 to 3.4 described below.

Step 2.4: After approving the means of transport and the route of transport, the dispatcher assigns the task to the driver, he sends to driver the transport itinerary (SMS-message, fax, email, communication on-board unit).

Step 3.1: The driver brings the vehicle to the place of loading, checks the loading and securing of the load, and receives the documents related to the transport (CMR consignment note - if it is an international transport, delivery note - if it is a national transport, or customs documents).

Step 3.2: Moving the load - the transport is performed by the driver. During transport, if necessary, the cargo can be cleared through customs (step 3.3), there are additional costs involved: CEMT authorization, international freight authorization, TIR carnet, certificate of origin, etc.

Step 3.4: When bringing the vehicle for unloading, the driver hands over copies of transport and customs documents to the customer and sends a notice to the dispatcher about the unloading of the goods. After the transport, the driver hands over the original documents to the economic department of the transport company. After processing the submitted documents, the economic department sends the confirmed original documents to the customer and issues an invoice for payment.

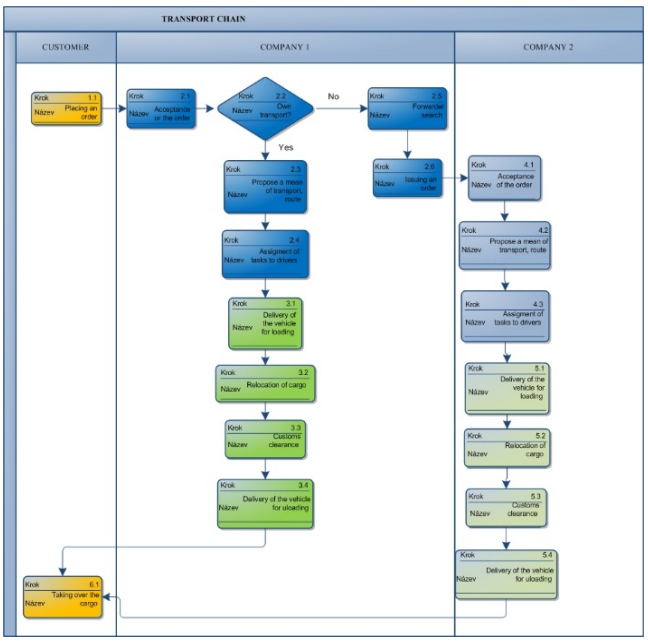

Fig. 1. Transport Chain

3.2. Main process

The main process in a transport company that brings profit and customer satisfaction is the actual transfer of cargo from place A to place B. Company A sells the goods to company B and company C arranges the transport from the starting point to the destination.

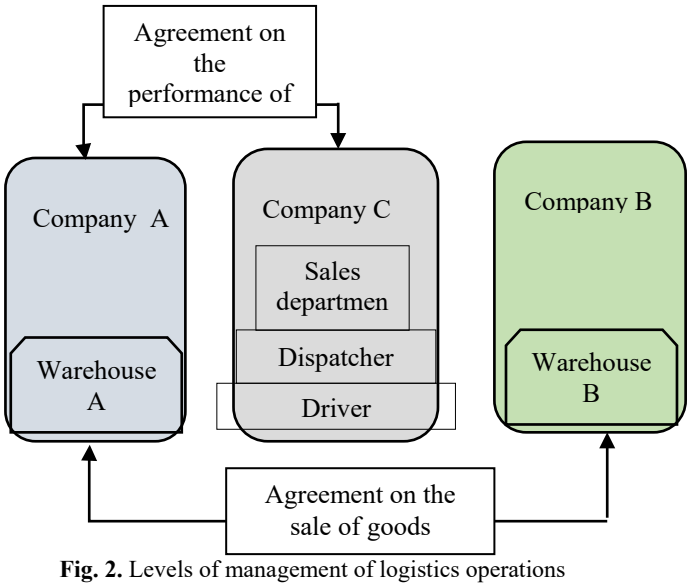

Fig. 2. Levels of management of logistics operations

From Figure 2 we see that the order concerns three levels of management in the company:

1. strategic level of management - agreement on the reason for transport between companies;
2. tactical level of control - the dispatcher processes the order and assigns tasks to the driver to bring the vehicle;

3. operational level of management - the driver adapts his activity to the assigned tasks and the current traffic situation in the transport network.

This example shows why it is necessary to communicate with a number of company employees from different levels of company management in order to perform a successful logistics audit. Each employee has his or her own view of the process, determined by his or her position in the process hierarchy, with operational staff often seeing deeper into the process than the superior level of management, so to speak, at the epicentre. The role of the auditor is to examine the process as a whole and, based on the findings, to determine the optimal changes and settings of the process.

$$\text{power of process} = \frac{\text{benefit}}{\text{associated costs}} \qquad (1)$$

If the result of the ratio (1) is greater than 1, it is a profitable process, otherwise it is a loss-making process. In such a situation, it is necessary to assess whether the process can be eliminated or whether optimization of the process and its costs is required.

Logistics audit makes extensive use of reengineering and process optimization techniques to simplify some activities while maintaining output quality and reducing costs where possible.

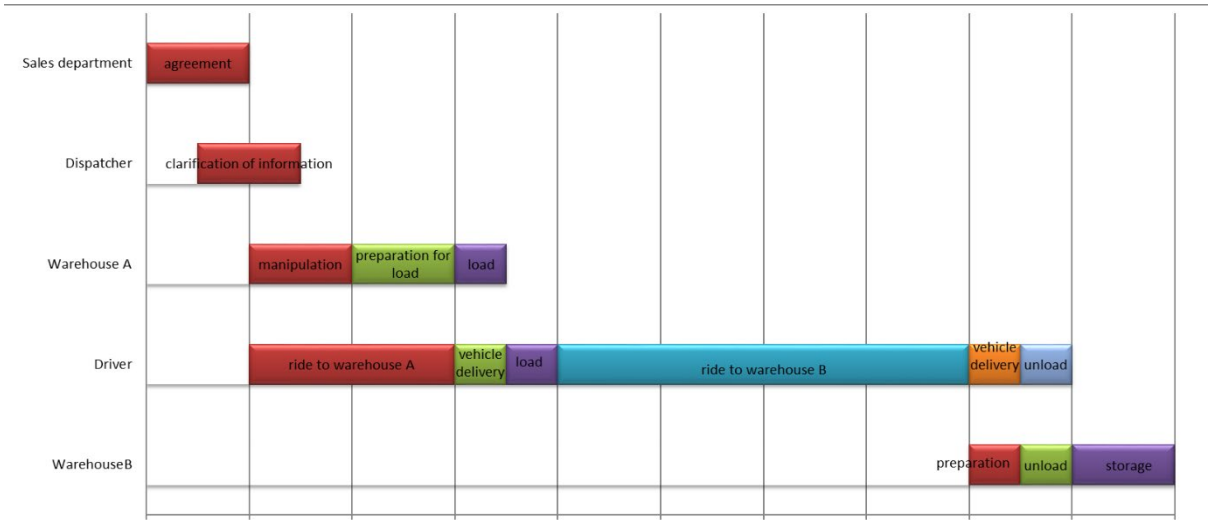

Fig. 3. Grantt diagram of order

When commissioning a transport, the time of its execution plays a big role, which in turn depends on the cooperation of individual subjects, the continuity of individual operations and other facts. The running of the order and the sequence of actions is shown in Figure 3 using a Grantt diagram.

As the most risky part of this process due to time and delay, we consider the transfer of a vehicle from the vehicle station to warehouse A and then to warehouse B. This is due to the higher risk of unforeseen events within the public infrastructure. This delay can be avoided by means of optimal tracing and interactive control (sensing of road situations and subsequent information for the driver) or operative modification of the route and itinerary.

In this way, the auditor assesses each major process of the company and, based on the results, offers the company's management an overview of the current situation, possible bottlenecks and solutions.

The evaluation of processes is based on the assumption that the benefits provided by the main process outweigh the costs associated with the activities incurred to carry it out. We can write this relationship as follows:

Conclusion

For effective management of the logistics system, it is necessary to know this system well. In this case, the logistic audit appears to be a useful tool for getting to know the system in detail, locating bottlenecks in individual processes. In addition, it offers options for resolving the situation.

It is crucial for every business to benefit from its strengths and try to eliminate weaknesses. To do this, however, it is first necessary to name these strengths and then be able to use them effectively.

In the case of weaknesses, it is necessary to identify them, delimit them and offer a proposal for changes in order to improve or eliminate them. Logistics audit is an effective tool that can be used for these purposes.

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