THE IMPLEMENTATION OF THE PARK AND RIDE LOGISTICS TECHNOLOGY TO IMPROVE THE QUALITY OF PASSENGER TRANSPORT IN THE TATRA REGION IN SLOVAKIA

Milan Dedík University of Žilina, Slovakia E-mail: milan.dedik@uniza.sk

Pavol Meško University of Žilina, Slovakia E-mail: <u>pavol.mesko@uniza.sk</u>

Lumír Pečený University of Žilina, Slovakia E-mail: <u>lumir.peceny@uniza.sk</u>

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Abstract

There are currently a large number of traffic and parking systems to solve the complex traffic situation in city centers that mitigate the negative effects of traffic on the cities and on the lives of its residents. Many solutions of these problems associated with parking are already used in Western European countries. A tool for improving the traffic situation in the region is greater use of public passenger transport, especially rail transport. A motivational system for improving the use of public passenger transport is also a number of modern progressive logistics technologies, especially the "Park & Ride" system. This system combines the advantages of individual car traffic with public transport, priority ecological rail transport, which has the effect of improving the position of rail transport in society. The aim of the contribution is to propose their construction in the Tatra region, which is attractive tourist region in Slovakia, based on the analysis of the "Park & Ride" parking system. It mainly concerns the railway stations Štrba, Svit, Poprad – Tatry, Kežmarok with the most efficient use of the space around these railway stations. The mentioned proposal also contains a technical and economic evaluation.

Keywords: Individual car traffic; Park and Ride system; Public; Tatra region

1. INTRODUCTION

Railway transport, which has existed on the territory of the Slovak Republic for more than 170 years, which is considered as a key transport system, is currently being replaced by road transport, especially individual car transport, in the leading places in the transport system of the country. With the development of the degree of automobilization, there are also problems associated with the solution of static and dynamic traffic in cities, which are not adapted to such a high number of cars. To solve the complex traffic situation in city centers, a number of traffic and parking systems are currently proposed to mitigate the negative impact on traffic in the city and on the lives of its residents (Vidriková, 2010). Many of the solutions to the problems associated with parking are already used in the western part of Europe in countries such as Germany, Italy, Austria, the Netherlands, Sweden and many others. Nowadays good transport chain management does not mean social engineering or central planning but is based on market principles of guiding transport demand by offering more reliable, faster, better and, if possible, cheaper systems (Abramović et al., 2021). Today when a great emphasis is put on the quality and high level of provided services the application of optimization methods in logistic processes is a necessity (Pečený et al., 2019) (Lukašík et al., 2021).

The main goal of the paper is to present the concept of the Park & Ride system. The basic research question is based on the creation of a methodological procedure of the Park & Ride system and the subsequent possibility of practical application. Subsequently, the mentioned system is practically applied to High Tatras region. The network of "Park & Ride" parking lots is also an incentive system for improving the use of public passenger transport, which combines the advantages of individual car transport with public transport, especially ecological rail transport, which results in improving the position of rail transport in society. The Tatra region and the High Tatras region is the most famous tourist area in Slovakia. A tool for improving the traffic situation in the region is greater use of public transport, especially rail transport. Therefore, it is necessary to solve the mentioned issue in this region much more effectively. A suitable solution will be to propose and implement "Park & Ride" logistics technology.

There are lots of interesting and useful publications which deal with the topic of modern logistics principles and technologies, as well as the issue of Park and Ride system. A contribution (Ying and Xiang, 2009) focusing on the influence factors and the demand willingness to investigate choice behavior of Park and Ride, use disaggregated model to analyze the influence factors' importance of Park and Ride, bring forward that the main factors influence Park and Ride choice behavior are passive factors such as road traffic congestion, lack of parking space, etc. Another publication (Huang et al., 2021) deals with the park-and-ride-sharing (P&RS) which is proposed to manage morning peak hour congestion in a monocentric linear city, where there is a multilane highway with a single bottleneck connecting the residential area and the central business district. The study (Yaliniz, 2016) park and ride system as well as the other applicable scenarios have been evaluated with Analytical Hierarchy Process (AHP) method with practical application in Turkish city of Eskisehir. Other important publications on the mentioned topic (Kumar and Khani,

2021); (Wiradinata, 2019); (Shen et al., 2017); (Liang et al., 2021) contain several interesting progressive scientific outputs. However, there are several unexplored and unresolved professional and scientific topics within the mentioned issue. A brief methodological procedure for solving the issue of the Park and Ride system, including a specific practical application, is the subject of the mentioned contribution.

2. RAILWAY STATIONS AS "PARK & RIDE" SYSTEM

Tourist centers, city centers and other busy places in cities are congested, have a shortage of parking spaces and are also burdened with high parking fees determined by their parking policies. The construction of temporary parking lots will contribute to the relief of road traffic. International visitors, as well as domestic residents, commuting to work can reach the railway station by car, where they board a train to another city and use local public transport there. The rush hour will thus be divided between several places and the negative effects of traffic on the city, which include traffic jams and polluted air, will be eliminated. With an appropriate number and distribution of passenger rail and public transport connections, people will be able to get to work much faster, without being delayed in queues.

2.1 Legislation regulating parking

The proposal and construction of parking spaces is subject to standards and laws. The proposal and construction of parking areas is limited by the area available for short-term or long-term parking. The basis for building parking lots is to create as many parking spaces as possible, so the proposed parking spaces are made as narrow as possible to accommodate as many as possible. Laws and strategic plans determine the conditions for building parking lots. Standard STN 73 60 56 determines the minimum dimensions and other conditions for creating parking spaces. Designing and building a network of "Park & Ride" parking lots is subject to many legislative regulations valid within the Slovak Republic:

- Strategic plan for the development of the Slovak transport infrastructure for the years 2021 2028,
- Operational program Integrated infrastructure for the years 2021 2028,
- Design of static transport in accordance with STN 73 6110,
- Act no. 135/1961 Coll. on Land Communications (Road Act), as amended,
- Act no. 725/2004 on the conditions for the operation of vehicles in traffic on land roads and on the amendment of certain laws,
- Act no. 8/2009 Coll. on road traffic and on amendments to certain laws,
- Act no. 144/2010 Coll., amending Act no. 8/2009 Coll. on road traffic and on amendments to certain laws, as amended, and on amendments to certain laws,
- Act no. 56/2012 Coll. on road transport, as amended,
- Act no. 168/1996 of 17 May 1996 on road transport,
- Decree of the Ministry of Health of the Slovak Republic no. 549/2007 Coll., which establishes details on the permissible values of noise, infrasound and vibrations

and on the requirements for the objectification of noise, infrasound and vibrations in the environment, as amended by later amendments and regulations,

- Decree no. 311/1996 of October 17, 1996, implementing the Road Transport Act,
- Decree 130/2010 of March 23, 2010, amending Decree 9/2009 on traffic signs,
- Decree no. 35/1984 Coll., which implements the Act on Land Communications (Road Act),
- Decree no. 578/2006 Coll., which establishes details of some provisions of Act no. 725/2004 Coll. on the conditions for the operation of vehicles in traffic on land roads and on the amendment of certain laws as amended.

2.2 Types of parking lots and parking areas

Parking lots and parking areas are divided into several types, which include parking lanes, parking strips and separate parking areas. The transverse slope of parking and parking areas cannot exceed 5% and the longitudinal slope should not exceed 3%. In the case of parking lanes, the longitudinal slope must not exceed 6%. **Type A**: parking lanes along roads, where vehicles park parallel to the roads are shown in Figure 1. (STN 73 6056, 1987)

Figure 1 Schematic representation of parking lanes



Source: (STN 73 6056, 1987)

Type B: parking strips along roads where parking is directed perpendicularly or diagonally to the roads are shown in Figure 2 (STN 73 6056, 1987).

Figure 2 Schematic representation of parking strips

Source: (STN 73 6056, 1987)

Type C: separate parking areas where parking is controlled according to internal parking roads, mostly perpendicular or diagonal to them in one row or in several rows in a row are shown in figures 3 and 4 (STN 73 6056, 1987).



Figure 3 Schematic representation of sloping parking areas



Source: (STN 73 6056, 1987)

Figure 4 Schematic representation of perpendicular parking areas



Source: (STN 73 6056, 1987)

2.3 Technical requirements - location

Parking areas may not be designed on local roads of classes A1, A2, B2 (highspeed roads with a traffic function). On local roads of class B2 (collector with trafficservice function) only in justified cases, where the territorial conditions and the intensity of traffic allow it. The following may not be placed on other roads:

- observation fields of intersections,
- intersections of local roads along the entire length of the parking lanes,
- spaces designated for public transport stops and other bus transport,
- viewing areas of railway crossings,
- at pedestrian crossings,

• at the points of entry and exit from purpose-built roads and private lands (STN 73 6056, 1987).

3. PROPOSAL FOR "PARK& RIDE" SYSTEM CREATION

The most famous parking system "Park & Ride" combines transport, telecommunication, and information technologies. It is based on the connection of individual car traffic outside the city and on the outskirts of cities and public urban transport to city centers. For this parking system, it is necessary to have sufficient capacity and attractive parking lots for the passenger, where public transport stops, bus and railway stations must be located in close proximity. By building temporary parking lots with the "Park & Ride" system, the traffic situation in the transport system of a city, village or region can be improved. With the growing number of residents living outside the city, the extent of individual car traffic also increases, which makes this form of transport inefficient, lengthy and unreliable. Parking lots and the "Park & Ride" system is a solution to this problem, where public transport is connected with individual car traffic. Among the advantages of the "Park & Ride" system is the price



of parking in a temporary parking lot, which is many times lower than the price of parking in city centers, or the price of parking in popular tourist spots. By using "Park & Ride" system, passengers save time that they would have spent driving and can use it for other activities. Thanks to parking near public transport stops, the costs of operating personal motor vehicles are also reduced, for example savings on maintenance, fuel and parking fees (Fabianova et al., 2020); (Stopka et al., 2019).

Based on the stated facts, it is necessary to solve the mentioned problem systematically and conceptually. Therefore, it is necessary to propose a certain methodical procedure of "Park& Ride" system creation that can be applied universally. The mentioned procedure contains several steps. Since it contains several elements of heuristics, it can be considered a heuristic procedure. The following scientific methods are used to propose the particular steps of this procedure:

- synthesis method this method, based on experience or logic, proceeds from the simplest principles to more complex ones by merging and connecting individual parts into a whole. In the case of proposals and outputs of this paper, it is a combination of partial steps of the methodological process;
- mind mapping method this method is developed method of the brainstorming method, through which the logic of the researched problem, context and priorities are developed;
- the heuristic method the method offers and discovers new ways of solving problems and inventing certain new contexts; it is a scientific activity based on a "discovery" procedure, which usually starts with a general proposal or some rough estimate, which is gradually refined; this method represents an intersection between empirical and exact methods (Dorda, 2020).

On the basis of the mentioned methods, it is possible to propose specific steps of the established procedure. The comprehensive heuristic procedure including all steps is shown in figure 5.



Figure 5 Methodical procedure for solving the problem of the PARK & RIDE system

Source: authors' own processing

The individual proposed steps are most effectively explained on a concrete example. Therefore, the explanation of the individual steps immediately includes a practical application of the raised issue in the context of the "Park & Ride" system introduction in the Tatra region. We focused in detail on the parking lot near the Poprad – Tatry railway station. The description of the particular steps is expressed in subsections 2.1 to 2.7.

3.1. Specific requirements for the "Park & Ride" system

The requirements placed on the proposal and construction of parking lots are necessary to ensure the improvement of the quality of the traffic situation in the region. The "Park & Ride" system in the Tatra region solves the problem of static traffic in the towns of Svit, Poprad, Kežmarok and the village of Štrba, as well as

problems with traffic in the High Tatras. To create and implement "Park & Ride" system in the Tatra region, the following requirements must be met (Šebest, 2018): • the number of parking spaces depending on the frequency of passengers in a given node,

• proximity to a railway or bus station,

• public transport stop in close proximity,

• fixed parking area, connection to roads,

• installation of appropriate traffic signs and marking of parking spaces according to standard STN 73 6056,

• marking of parking conditions to prevent abuse of parking spaces,

• installation of information panels on parking prices, as well as public transport and passenger train timetables,

• low price of parking, which will be more advantageous than parking in city centers or in the High Tatras,

• operational security of parking lots.

3.2. Choosing the location of the parking lots of the "Park & Ride" system

Parking lots and parking areas in the Tatra region are most advantageously located in the areas around railway stations, which represent the transport hubs of the region with a high passenger frequency on weekdays, consisting of workers commuting to work, as well as with a high passenger frequency during weekend days, consisting mainly of visiting tourists High Tatras. The most mined nodes in the region include:

• Štrba railway station: express station, which is the starting station for the cogwheel railway (the fastest and

cheapest way to the High Tatras by public transport),

• Svit railway station: a station where only passenger trains stop, located in the Tatra region center, in proximity

to an important enterprise for the region,

• Poprad – Tatry railway station: a railway station of international importance, where trains of all categories stop,

it is the starting point for the Tatra Electric Railways, as well as for the regional line heading to Stará Ľubovňa,

also known as the gateway to the High Tatras,

• Kežmarok railway station: a city with importance for the region, the proximity of the railway station to the city.

At each of these railway stations, it is advantageous to place temporary parking lots, i.e. a total of four. The proposal for the location of parking lots in the region is shown in Figure 6.



Figure 6 Proposal for the location of parking lots



Source: processed by the authors based on www.google.maps.sk

"Park & Ride" system location in Poprad – Tatry railway station

The temporary parking lot of the "Park & Ride" system at the Poprad – Tatry railway station is advantageous to place next to the railway station, opposite the bus station and the Hotel Europa. One part of the parking lot will be along Jiří Wolker Street, continuing towards the Poprad – Tatry station track. Currently, vehicles are parked on this area, but the parking area and parking spaces are not marked.

By building a new temporary parking lot, 20 parking spaces will be created on the area along Jiří Wolker Street on a parking lane that is separated from the road and is elevated, and the parking method will be longitudinal to the road. An additional 30 parking spaces will be created on the area located from this longitudinal parking lot towards the railway track. Parking will be arranged perpendicular to the track and perpendicular to the approach road in two rows. One row along the track at a sufficient distance from the cross section and the other row facing Jiří Wolker Street. In total, 50 parking spaces for the "Park & Ride" system will be created in this space. The access road will be one-lane and one-way, only passenger motor vehicles will park here, so according to STN 73 6056, its width of 2.50 meters will be sufficient. The dimensions of these parking spaces are in accordance with STN 73 6056. Based on the terms of Decree 532/2002 Coll. 5% of the built-up parking spaces will be designated for persons with reduced mobility. The proposal of the parking lot at Poprad – Tatry railway station is shown in Figure 7 (Maslaric et al., 2012).



Figure 7 Proposal for the location of the parking lot at Poprad - Tatry railway



Source: authors' own processing based on www.google.maps.sk

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The detailed characteristics of the parking lot at the Poprad – Tatry railway station are expressed in table 1.

Table I Characteristics of the detention parking	g lot near Poprad – Tatry railway
station	
Site name	Poprad – Tatry railway station

Poprad – Tatry railway station
Poprad – city center
2.30 m
5.30 m
20
30
50
2.50 m
50 m
45 m

Source: prepared by the authors based on his own analysis

In addition to this parking area, there is also one modern parking lot at the Poprad – Tatry railway station, where 89 passenger motor vehicles can be parked. This parking lot is part of the pre-station area and is located in front of the Slovak Post office. However, this parking lot is owned by the city of Poprad. Parking and the parking price list are governed by the price and parking policy of the city of Poprad. The area is included in the urban parking zone 2, where the hourly parking fee is $\notin 0.40/1$ hour and the operating hours of the parking lot during the working week are limited from 8:00 a. m. to 4:00 p. m. On the weekend and all holidays, the parking lot is opened and parking is free. This parking area can also be used free of charge at the peak of the rush of passengers, which is on weekends and holidays. During the



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working week, the proposed parking lot of the "Park & Ride" system will also be sufficient for parking vehicles (Šebest, 2018).

3.3 Parking system proposal for the parking lot at Poprad – Tatry railway station

It is possible to build one "Park & Ride" parking lot near the Poprad – Tatry railway station. With this parking lot, it will not be necessary to remove any greenery, it will only be sufficient to modify and reinforce the existing parking area, which is currently not paved. It is necessary to mark the horizontal traffic markings to determine the space for parking vehicles, mark the entrance and exit lanes for vehicles and complete the necessary vertical traffic markings. In terms of space, it is possible to use only one parking barrier for the entrance from the bus station on Jiří Wolker Street and the second parking barrier for the exit near the railway station building on the same street. In the parking lot, one-way traffic will be determined by traffic signs. The parking barriers will be equipped with a screen designed to display the necessary information for parkers and it will also be possible to use it to display advertisements. The proposed barrier is approximated in Figure 8.

Figure 8 Single-arm parking barrier for vehicle entry

Source: <u>www.1pohony.cz</u>

Two camera systems can be used in this parking lot. The first camera system will be a recognition one, located at the entrance parking barrier, which will record the registration number of the parked vehicle and store it in the database of the parking system, and the second camera system will be located on the lighting poles and will be surveillance, which will supervise the safety of the parking lot, the safety vehicles and for the safety of passengers or pedestrians on the adjacent sidewalk around the parking lot. Due to the greater distance from the station, two automatic parking ticket offices will be located at the "Park & Ride" Poprad – Tatry parking lot. One will be located at the exit near the railway station building, and the other will be located next to the construction materials building in the extended parking area near the station tracks. The parking system will be based on the use of ChipCoin parking tokens, when the entry ticket will be issued when the vehicle enters the parking area through the entrance parking barrier, and the exit ticket will be issued when paying at the

automatic parking cash register. The parking ticket office will accept cash or credit card payments. It will also be equipped with a reader of QR codes on travel tickets. After reading the QR code of a valid ticket, it will issue a free exit token to leave the parking lot. The proposed automatic parking ticket with a QR code reader is shown in Figure 9 (Šebest, 2018).

Figure 9 Automatic parking ticket office for P+R Poprad – Tatry



Source: www.trnava-live.sk

In addition to parking barriers and automatic parking cash registers, it is advisable to supplement this parking lot with information boards in the number of two pieces. We propose to place one at the intersection of Alžbeta and Hviezdoslav streets, and the other at the intersection of Jiří Wolker and Railway streets. The proposed information boards will display the total number of parking spaces and the number of free parking spaces. Information boards will be placed together with the parking sign "Park & Ride".

3.4 Parking policy proposal at "Park & Ride" parking lots

A correctly chosen parking policy of P+R parking lots will help to use temporary parking lots at railway stations, to solve static traffic in cities, to solve overcrowded city centers or centers in the High Tatras, to motivate commuters to use public transport. Nowadays the biggest problem is not the high price of public transport tickets, but the absence of parking rules, as people can park their cars anywhere, where it complicates traffic and where there is a possibility of damage to them. Parking policy is an effective tool to increase the use of public transport, to increase the attractiveness of rail transport as well as to reduce travel costs. We therefore propose free parking for passengers using rail transport at the proposed "Park & Ride" car parks. Free parking will also be available for everyone for the first hour after entering the parking lot, which will be intended for people waiting for their



loved ones from the trains, or who drove them to the trains. The "Kiss & Ride" system will be applied. Other parkers who will not use the services of passenger rail transport will be charged for parking. There is proposed a parking price for these people based on an analysis of parking prices in this region. The parking price list and free parking conditions are shown in table 2 (Šebest, 2018).

Table 2 Price list for parking at "Park & Ride" parking lots

Parking, using rail transport, equipped with	th a valid Free
travel ticket	
Parking up to 1 hour ("Kiss & Ride")	Free
Railway employees	Free
Parking without using rail transport (1 hour)	0.20€
Parking without using rail transport (1 day)	2.00€

Source: authors' own processing

3.5 Calculation of investment costs for the parking lot at Poprad – Tatry railway station

One variant of building a "Park & Ride" parking lot is proposed near the Poprad-Tatry railway station and the costs of its construction are expressed in the following tables 3, 4 and 5.

Description of activity	Measure	Quantity	Unit	Total price		
	unit		price (€)	(€)		
	Earthw	orks				
Removal of bushes and trees	m^2	0	1.21	0		
Excavation work (up to 0.5 m)	<i>m</i> ³	192.5	8.21	1,580.43		
Pipe lining	<i>m</i> ³	0.5	10.84	5.42		
Aggregate for the bed	t	5.2	19.23	100.00		
Adjustment of the plan	m^2	385	0.2	77.00		
Subsoil compaction	m^2	385	0.26	100.10		
Horizontal structures						
Bed of pipes, drains, small	m^3	0.5	40.27	20.14		
objects						
	Communi	ications				
Foundation, underfill,	m^2	385	2.66	1,024.10		
compaction						
Asphalt cover (4-5 cm)	m^2	385	12	4,620.00		
Installation of a drainage	m	70	13,83	968.10		
channel						
Drainage channel	m	70	87	6,090.00		
Pipeline						
Pipeline assembly	m	11	0,98	10.78		

Table 3 Construction costs for the Poprad - Tatry parking lot

The implementation of the park and ride logistics technology to improve the quality of passenger... *Milan Dedík, Pavol Meško and Lumír Pečený*

Sewer pipe	pcs	1	7	7.00
Connection of the trap with				
the drainage of the parking lot	pcs	1	35	35.00
0	Other constr	ructions and	works	
Fitting the curb into the bed	m	88	5.02	441.76
Flower bed border (100x5x20	pcs	88	3.5	308.00
cm)	-			
Bed under the curb	m^3	4.23	95.63	404.51
A fee for depositing soil at a	t	68	20	1,360.00
landfill				
Rental of temporary fencing	m	130	9	1,170.00

Description of activity	Measure unit	Quantity	Unit price (€)	Total price (€)
Installation and assembly of	pcs	6		113.70
vertical traffic signs	-		18.95	
Traffic signs	pcs	6	55.9	335.40
Horizontal traffic marking	m	160	2.51	401.60
Price for construction works w	19,173.03			
VAT 20%				3,834.61
Total price for construction we	23,007.64			

Source: prepared by the authors based on www.scheidt-bachmann.sk, 2023

Table 4 Costs of the parking system in Poprad - Tatry parking lot

Device description	Device description Measure unit		Total price	
			(€)	
Control computer	pcs	1	4,304.00	
Entry terminal	pcs	1	4,691,00	
Departure terminal	pcs	1	4,425.00	
Automatic barrier	pcs	2	3,094,00	
Automatic cash register	pcs	2	24,496.00	
Intercom server	pcs	1	301.00	
Other devices	pcs	1	2,081.0	
Installation of the parking system		1	5,339.00	
Price for the parking system without	48 731,00			
VAT 20%			9,746.00	
Total price for the parking system y	with 20% VAT		58.478.00	

Source: prepared by the authors based on www.scheidt-bachmann.sk, 2023

Description	Price (€)
Total price for the realization of the parking lot without VAT	67,904.03
VAT 20%	13,580.61
The total price for implementation including 20% VAT	81,485.64

Table 5 Total investment costs for Poprad – Tatry parking lot

Source: authors' own processing

Comparison of investment costs (construction costs and costs of parking facilities) for individual "Park & Ride" parking lots at the Štrba, Svit, Poprad – Tatry and Kežmarok railway stations are shown in Figure 10. Parking facility costs are highlighted in orange and construction costs are highlighted in blue.

Figure 10 Investment costs for individual variants of parking



Source: authors' own processing

3.6 Calculation of the operating costs for the parking lot at Poprad – Tatry railway station

Operating costs include all costs associated with electricity consumption, summer and winter maintenance of the parking lot, snow and ice removal, cleaning of the parking area. Other significant costs are the costs of maintenance and possible repair of damaged parts as well as the costs of remuneration for inspection and operational maintenance workers. For the evaluation of operating costs for the purpose of the contribution, the offer prices of the service company Vetron s.r.o. are used and are expressed in table 6. These operating costs apply to all designed parking areas, as they are almost the same in size and technical equipment (Šebest, 2018).

Description of activity	Total price with VAT
	(€)
Annual regular maintenance and inspection	1,056
Professional examination and inspection of parking	624
systems	
Surcharge for an hour of work of technicians outside	24
working hours	
Annual operating costs	1,200
Total annual costs of operating the parking lot	2,880 €

 Table 6 Annual operating costs for the parking lot

Source: prepared by the author based on www.scheidt-bachmann.sk, 2023

3.7 Comparison of travel costs without and with the use of "Park & Ride" system

Among the important factors for the decision to use public passenger transport and the "Park & Ride" parking system is certainly the saving of travel costs. For the parking incentive system, the costs associated with traveling must be lower than traveling the entire journey by car. The following tables (7 - 9) show the costs of traveling the entire route by car and the costs of traveling the entire route by a combination of individual and public passenger transport. For the purposes of this thesis, a Kia Cee'd passenger car and selected transport route within the Tatra region are used as a model example. The passenger car will be occupied by one person (Šebest, 2018).

Table 7 Travel costs for a car trip

Passenger	Consumption	Fuel	Distance	Fuel	Total		
car	liter/100 km	price	(km)	consumed	journey		
		(€)		(l)	costs (€)		
		Štrba - K	ežmarok				
Kia Cee'd	7.1	1.34	35	2.49	3.34		
	Štrba – Štrbské Pleso						
Kia Cee'd	7.1	1.34	10.5	0.86	1.13		
	Št	rba – Pop	rad - Tatry				
Kia Cee'd	7.1	1.34	20.1	1.43	1.92		
Poprad – Tatry – Štrbské Pleso							
Kia Cee'd	7.1	1.34	28	2	2.68		
	Kežmarok – Štrbské Pleso						
Kia Cee'd	7.1	1.34	42.2	3	4.02		

Source: authors' own processing

Train	Distance (km)	Fare price	Parking price	Total costs			
		(€)	(€)	(€)			
	Štrł	oa - Kežmarok					
601/8309	33	1.90	0	1.90			
	Štrba	– Štrbské Ple	80				
8002	5	1.00	0	1.00			
	Štrba -	– Poprad - Ta	try				
3451	19	1.02	0	1.02			
	Poprad – Tatry – Štrbské Pleso						
8102	29	2.00	0	2.00			
	Kežmarok – Štrbské Pleso						
8302/8106	43	1.82	0	2.86			

Table 8 Trave	l costs	for	a trip	by	public	trans	port
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Source: authors' own processing

Table 9 Comparison of travel costs

Transport	The train	The trip car	The
route	journey costs	costs (€)	difference/savings
	(€)		(€)
Štrba - Kežmarok	1.90	3.34	1.44
Štrba – Š. Pleso	1.00	1.13	0.13
Štrba – Poprad-	1.02	1.92	0.90
Tatry			
Poprad-Tatry – Š.	2.00	2.68	0.68
Pleso			
Kežmarok – Š.	2.86	4.02	1.16
Pleso			

Source: authors' own processing

From the previous analysis of travel costs, it follows that the use of the "Park & Ride" car park system and public transport combined with individual personal transport on these selected transport route leads to significant cost savings on each trip made.

4. CONCLUSIONS

Based on the analysis of the current state of the traffic situation in the Tatra and the High Tatras region, it is possible to conclude that the problem with increasing the share of individual car traffic is significant and causes considerable problems with the organization of transport. The problem of a high proportion of passenger cars in the centers also causes time, social, economic, but especially ecological damage. To eliminate these negative impacts and reduce problems, it is necessary to look for modern, progressive and effective solutions for static and dynamic traffic in the cities. Analyses of the current situation show that the biggest problems are the insufficient number of parking spaces and their unsatisfactory condition.

Several alternatives are being prepared to solve these problems. The most suitable way to solve traffic problems in the centers and in important traffic hubs is the implementation and subsequent use of the "Park & Ride" system at the railway stations in Štrba, Svit, Poprad - Tatry and Kežmarok, which are important for this region. The "Park & Ride" system, i.e. park and go by public transport, contains several measures and motivation for drivers and passengers and thus solves an inappropriate traffic situation.

This contribution proposes the most suitable locations for the location of a network of these parking lots near four important railway stations, in order to facilitate the connection of public passenger transport and individual passenger transport and to make railway transport the supporting transport system of the region, thus reducing the load on road communications, which should positive economic, social and ecological effects. For the efficiency and functionality of this system, it is necessary to connect with dense and high-quality urban public transport. Basic scientific claim is proposal of the generally applicable methodological procedure, which contains individual steps for solving the raised issue in the first part of the proposals. The mentioned scientific questions from the introduction of the paper regarding the creation of a methodological procedure and subsequently its practical application were answered and thus the goal of the paper was fulfilled and achieved. Specifically, detailed practical outputs of the mentioned system were developed for the parking lot at the Poprad - Tatry railway station. Suggestions for further research will consist of more detailed analyzes and the development of other specific logistics technologies that could be used as an alternative to individual motoring. The limitation of this research may consist in the problematic linking of these systems to the current state of passenger transport, current transport infrastructure, as well as its financial demands.

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