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

Jozef Gašparík¹

¹ Faculty of Operation and Economics of Transport and Communications University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3434; jozef.gasparik@fpedas.uniza.sk

Milan Dedík²

² Faculty of Operation and Economics of Transport and Communications University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3434; milan.dedik@fpedas.uniza.sk

Martin Vojtek³

³ Faculty of Operation and Economics of Transport and Communications University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3434; martin.vojtek@fpedas.uniza.sk

Adrián Šperka⁴

⁴ Faculty of Operation and Economics of Transport and Communications University of Žilina, Univerzitná 8215/1, 010 26 Žilina; +421/41 513 3434; adrian.sperka@fpedas.uniza.sk

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
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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 skipped 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	St.	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010	0011	0012	0013	0014	0015	0016
Za stanice																	
10 Zvolen os. st.		5.06															
9 Babin	x	6.12	6.04	7.06	6.04	8.06		10.04	11.06	12.04	13.06		14.04	15.06	16.04	17.06	18.04
10 Podbátok	x	6.15	x	8.15				x	10.15	x	12.15		x	14.15	x	16.15	x
12 Dúbrava		6.19		8.19				10.19		12.19			14.19		16.19		18.19
13 Dúbrava zást.	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
19 Šása - 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
21 Hontianske Lúčky	x	6.35	x	8.35			x	10.35	x	12.35		x	14.35	x	16.35	x	18.35
25 Šahy	x	6.43	x	8.43			x	10.43	x	12.43		x	14.43	x	16.43	x	18.43
32 Krupina predmestie		6.51		8.51			10.51		12.51			14.51		16.51		18.51	19.51
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
34 Krupina	5.45		7.45		8.45		10.45		12.45			14.45		16.45		18.45	19.45
36 Babin																	20.45
40 Devica																	21.45
44 Hontianske Nemce	5.58		7.58		8.58		10.58		12.58			14.58		16.58		18.58	19.58
45 Domany	x	6.01	x	8.01	x	10.01		x	12.01	x	14.01		x	16.01	x	18.01	x
54 Hontianske Teslie	6.10		8.10		10.10		12.10		14.10			16.10		18.10		20.10	21.10
55 Domany	x	6.12	x	8.12	x	10.12		x	12.12	x	14.12		x	16.12	x	18.12	x
59 Terany	x	6.16	x	8.16	x	10.16		x	12.16	x	14.16		x	16.16	x	18.16	x
60 Dúbrava	6.19		8.19		10.19		12.19		14.19			16.19		18.19		20.19	21.19
62 Šahy	x	6.23	x	8.23	x	10.23		x	12.23	x	14.23		x	16.23	x	18.23	x
66 Terany	x	6.30	x	8.30	x	10.30		x	12.30	x	14.30		x	16.30	x	18.30	x
69 Krupina	x	6.33	x	8.33	x	10.33		x	12.33	x	14.33		x	16.33	x	18.33	x
74 Šahy	6.40		8.40		10.40		12.40		14.40			16.40		18.40		20.40	21.40
74 Šahy	5.17	6.58			10.58				14.58							18.58	19.58
83 Vyškovce nad Ipľom	5.27	7.08			11.08				15.08							19.08	20.08
89 (pešík) Solčice	5.35	7.16			11.17				15.17							19.17	20.17
93 Babin	5.40	7.21			11.22				15.22							19.22	20.22
95 Babin	5.45	7.26			11.27				15.27							19.27	20.27
99 Terany	5.51	7.32			11.33				15.33							19.33	20.33
100 Čata	5.57	7.38			11.39				15.40							19.40	20.40
Do stanice																	

153 Čata - Šahy - Zvolen os. st.																	
Km	St.	0001	0002	0003	0004	0005	0006	0007	0008	0009	0010	0011	0012	0013	0014	0015	0016
Za stanice																	
1 Čata		4.30		6.07			7.50						13.55				
3 Zúžava	x	4.38	6.13			7.56							14.01				
10 Pliešovce	4.42	6.19			8.02								14.07				
13 Babin	4.47	6.25			8.07								14.12				
17 (pešík) Solčice	4.53	6.31			8.13								14.18				
23 Vyškovce nad Ipľom	5.00	6.38			8.20								14.26				
25 Šahy	5.11	6.49			8.31								14.38				
32 Šahy	5.51	6.54		7.14		8.14	11.14	13.14		15.14			17.14		19.14	21.14	
37 Pliešovce	x	5.58	x	5.21	x	7.21	x	9.21	x	11.21	x	13.21	x	15.21	x	17.21	x
40 Tupa	x	6.01	x	5.24	x	7.24	x	9.24	x	11.24	x	13.24	x	15.24	x	17.24	x
44 Šahy	x	6.06	x	5.29	x	7.29	x	9.29	x	11.29	x	13.29	x	15.29	x	17.29	x
48 Pliešovce	x	6.10	x	5.33	x	7.33	x	9.33	x	11.33	x	13.33	x	15.33	x	17.33	x
48 Terany	x	6.13	x	5.36	x	7.36	x	9.36	x	11.36	x	13.36	x	15.36	x	17.36	x
51 Domany	x	6.16	x	5.39	x	7.39	x	9.39	x	11.39	x	13.39	x	15.39	x	17.39	x
52 Hontianske Teslie	x	6.19	x	5.42	x	7.42	x	9.42	x	11.42	x	13.42	x	15.42	x	17.42	x
60 Domany	x	6.27	x	5.50	x	7.50	x	9.50	x	11.50	x	13.50	x	15.50	x	17.50	x
62 Hontianske Nemce	4.30	6.01			8.01		10.01		12.01		14.01		16.01		18.01		20.01
66 Devica	x	6.36			8.13								16.13		18.13		20.13
70 Babin	4.41				8.13		10.13		12.13		14.13		16.13		18.13		20.13
72 Krupina	4.44	6.13			8.13		10.13		12.13		14.13		16.13		18.13		20.13
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
74 Krupina predmestie	4.49		7.08		8.08		10.08		12.08		14.08		16.08		18.08		20.08
81 Babin	x	6.07	x	7.15	x	8.15	x	9.15	x	10.15	x	11.15	x	12.15	x	13.15	x
85 Babin	x	6.01	x	7.20	x	8.20	x	9.20	x	10.20	x	11.20	x	12.20	x	13.20	x
87 Šása - 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
93 Dúbrava zást.	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
94 Dúbrava	5.21		7.41		8.41		10.41		12.41		14.41		16.41		18.41		20.41
96 Podbátok	x	6.24	x	7.44	x	8.44	x	9.44	x	10.44	x	11.44	x	12.44	x	13.44	x
98 Terany	x	6.27	x	7.47	x	8.47	x	9.47	x	10.47	x	11.47	x	12.47	x	13.47	x
100 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
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 Šása - 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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