

The Importance of Rail Transport for Transport Services in Peripheral Areas

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Abstract: This article focuses on the evaluation of the importance of passenger rail transport for transport services in peripheral areas. The term peripheral area is defined, and the different types of peripheral areas and their characteristics are listed. Based on the analysis of these areas in the Czech Republic, the authors generally divide passenger rail transport services in peripheral areas into three categories according to the route of the railway line within the peripheral areas and towards the centre. The authors set out the most important criteria to assess the importance of individual line categories for transport services in peripheral areas. Based on the SWOT analysis and using the TOWS matrix, specific strategies and proposals are presented to address passenger rail services in the peripheral area. The aim of this article is to evaluate the importance of rail transport in peripheral areas using the criteria selected by the authors.

Keywords: Transport services, passenger transport, peripheral area, passenger rail transport

1. Introduction

Providing transport services is a basic task of public transport and is one of the prerequisites for regional development. Transport services mean the provision of transport on all days of the week, especially to schools and educational establishments, to work, to public authorities, to health facilities, and to meet cultural, recreational, and social needs, including return transport. Transport services contribute to the sustainable development of the territory. [1]

Transport infrastructure has an impact on regional development by improving the accessibility to transport in localities concerned. The positive effects of rail transport in peripheral areas include, for example, the effect of intensive commutes and the development of tourism. The technical condition of transport infrastructure is often problematic. Existing railway lines of regional importance are often characterised by low critical running speed (40-60 km/h) [2], which means

long travel times. The location of the peripheral area in relation to the centre and the transport link between the centre and the peripheral area are important.

2. Types and Characteristics of Peripheral Areas

A peripheral area can be defined as an area that is not sufficiently integrated into the structures, processes, and systems that dominate at a given place and time. [3] This may be due to a lack of accessibility to transport, geographic barriers, economic barriers, etc. Typically, these are areas in the peripheral parts of the region (inner peripheral areas) and state (border and isolated areas) with low population density. Figure 1 shows a map with examples of different types of peripheral areas in the Czech Republic, which were analysed by the authors.

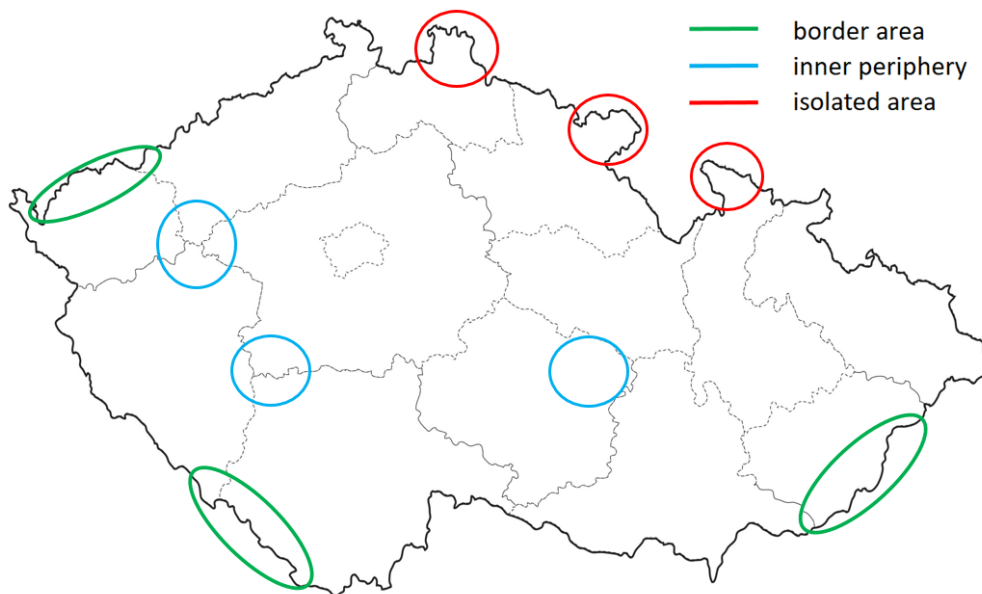


Fig. 1 Map of the Czech Republic with examples of peripheral areas. Source: authors based on [3]

The peripheral areas have certain specific features that affect transport needs. These specific characteristics include low population density, unfavourable demographic structure, limited range of education and career development, [4] distance from city centres and an underdeveloped public transport network (or lack of public transport). [5] The provision of transport services both in general and specifically in peripheral areas must be based on the demand and the modelling of their decision-making process. The passenger evaluation criteria and the passenger decision-making process are presented in [6]. The transport accessibility prevents the geographical isolation of peripheral areas. [7] Geographic isolation can lead to social exclusion. [8]

The provision of public transport primarily between the centre and the catchment area to commute to the missing elements of rural life (secondary and higher education, employment, doctors, shopping, etc.) is essential. [9] The provision of peripheral area/centre transport flows by passenger rail may not always have the effect of reducing journey times, particularly from outlying villages when transfers are required. [10] However, the comfort and connectivity of rail transport

(for example, compared to public bus transport) can benefit more frequent trips. [11] Modern rail transport to central transportation centres will maintain and even increase the demographic potential of the peripheral areas [12] and can slow or even stop the trend of depopulation. [13]

3. Transport Services to Peripheral Areas by Rail

Transport services to Peripheral Areas by Passenger Rail are categorised by the authors into three categories:

1. Network of railway lines within the peripheral area,
2. Railway line of supra-regional importance,
3. Railway line to connect the peripheral area and the centre.

These categories were established by the authors based on an analysis of the railway lines in the peripheral regions of the Czech Republic.

3.1 Network of Railway Lines within the Peripheral Area

The Czech Republic has one of the densest railway networks in the world. [14] Railway lines were built according to the needs of the time (for example coal transport, industry, etc.). [15] The routing and parameters of the lines often are not adequate for today's needs, leading to long travel times in important directions of current transport demand. The critical running speed can be limited by the technical parameters of the track, by the applied rules (in the Czech Republic, the D3, D4 and D40 rules limit the critical running speed) [16-18], the category of used signalling equipment [19], or it can be locally limited, for example, by a level crossing equipped only by a warning cross with a traffic moment of until 10 000 [20]. Part of such a line network is located in the peripheral areas.

One network of lines within a peripheral area is in south-eastern Šumava. Passenger rail transport services are provided on three lines No 194 (České Budějovice - Černý Kříž), No 197 (Číčenice - Nové Údolí) and No 198 (Strakonice - Volary). There is a 2-hourly interval of passenger trains on these lines with selected connections within the area in Černý Kříž and Volary and to the surrounding railway network in Strakonice, Číčenice and České Budějovice. [21] In 2023, a restricted running speed (10-30 km/h) was implemented on line No 194 due to the deteriorated technical condition of the tracks. Travel time was extended by up to 20 minutes, and as a result, some connections were suspended. [22] A diagram of this line network is shown in Figure 2.

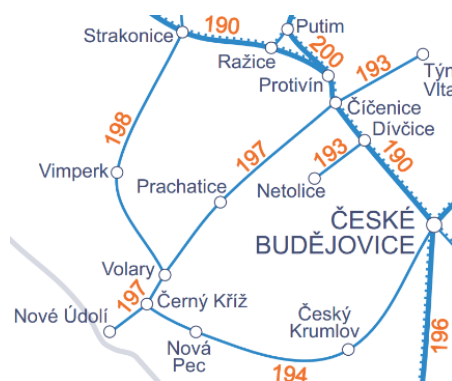


Fig. 2 Railway lines in the south-eastern Šumava. Source: [23]

3.2 Railway Line of Supra-regional Importance

A peripheral area can be served by rail passenger transport on a supra-regional significant line which passes through the peripheral area. This line is important for connecting two or more centres and serving the peripheral area. The area in the north-east of the Vysočina Region is an example. It is served by railway line No 250. The transport services to the peripheral area are ensured by fast trains at a 2-hourly interval between Prague and Brno stopping in Příbram, Žďár nad Sázavou and Křižanov, and by regional trains. The fast trains ensure a connection between the peripheral region and important centres, including Prague, Havlíčkův Brod and Brno. [21]

3.3 Railway Line to Connect the Peripheral Area and the Centre

The railway line to connect the peripheral area and the centre which ends in the peripheral area mainly exists in the Czech Republic between regional centres and protrusions. The state border still often forms an imaginary barrier, where regular trips from the region (for education, doctors, work, etc.) are concentrated almost exclusively in one direction (inland). Cross-border travelling only happens irregularly (for example for tourism purposes). [24]

Rail transport services in the Frýdlant protrusion (see the line diagram in Figure 3) were ensured in 2023 by the passenger trains Černousy - Liberec and Jindřichovice pod Smrkem - Liberec at a basic 2-hourly interval. The mutual interlacing of these trains results in an hourly interval in the joint suburban section Frýdlant v Čechách - Liberec. This interval is halved during peak hours of working days (5:00 to 8:00 and 13:00 to 17:00). The direct connection between Bílý Potok pod Smrkem and Liberec is ensured by direct carriages, which are coupled with selected trains from the Černousy/Jindřichovice pod Smrkem train at Raspenava station. Each railway station and halt in the Frýdlant protrusion is directly connected with the regional centre Liberec during the day. On the cross-border line between Černousy and Zawidów in Poland, no passenger transport was organised in the 2022/23 timetable [21], which limits the possibilities of cross-border tourism.



Fig. 3 Railway lines in the Frýdlant protrusion. Source: [23]

By contrast, a train connection between the Javorník protrusion and the centres is provided in 2023 almost exclusively with a change in Lipová-Lázně, which reduces the quality of transport accessibility of the region. [21]

4. Evaluation of the Importance of Rail Transport for Transport Services in Peripheral Areas

When examining the importance of rail transport in peripheral areas, the authors considered the travel time from the peripheral area to the centre, the technical condition of the railway lines, the line speed, the connection to public bus transport or individual car transport and the demographic and tourist potential of the peripheral area. For each category of line routing in peripheral areas, the authors identified strengths, weaknesses, opportunities, and threats using a SWOT analysis. The SWOT analysis for the network of regionally important lines within the peripheral area with no proximity to a major centre is presented in Table 1.

Table 1 SWOT analysis of railway lines within a peripheral area. Source: authors

Strengths	Weaknesses
Railway transport accessibility in the region Higher reliability in winter	Unsatisfactory technical condition of the lines Lack of direct connection with the centre Large number of transfers, longer travel times
Opportunities	Threats
Connection of the peripheral area with the centre Development of tourism Connection to public bus transport Reconstruction of lines and increase in line speed	Alternative modes of transport The declining population of the peripheral area Different clients (regions) and their intentions (disconnections within the peripheral area)

The SWOT analysis for supra-regional lines in a peripheral area is shown in Table 2.

Table 2 SWOT analysis of railway lines of supra-regional importance. Source: authors

Strengths	Weaknesses
Satisfactory technical condition of the lines	Transfer required for peripheral/centre
Higher line speed, shorter travel time	Transfer not always wheelchair accessible
Higher reliability in winter	Difficult accessibility of the railway transport for most of the peripheral area
Routing of the line to the centres	
Opportunities	Threats
Minimisation of the number of transfers	Alternative modes of transport
Development of an area due to better transport accessibility	The declining population of the peripheral area
Connection to public bus transport	

The SWOT analysis for a spine line connecting the peripheral area and the centre is in Table 3.

Table 3 SWOT analysis of railway lines between the peripheral area and the centre. Source: authors

Strengths	Weaknesses
Railway line routes directly to the centre	Connecting line (transfer or more demanding operation technology)
Minimisation of travel time peripheral area/centre	
Backbone function of the railway line	Dependence on demand in the peripheral area
Higher reliability in winter	
Opportunities	Threats
Development of the peripheral area	Alternative modes of transport
Connections to public bus transport	The declining population of the peripheral area
Investment in 1 line = benefit for the whole region	

Specific conclusions can be drawn from the SWOT analyses in Tables 1, 2 and 3:

- rail transport is a critical factor for transport services in peripheral areas,
- the poor technical conditions of lines (especially lines within peripheral areas) are problematic,
- the lack of interchanges leads to a lack of use of public transport in the periphery,
- the potential of connecting the peripheral area with the catchment centre is one of the factors for the development of peripheral areas.

5. Opportunities to Increase the Benefits of Rail Transport for Peripheral Areas of the Country

Strategies and proposals to increase the importance of rail transport for peripheral areas were proposed by the authors using the TOWS matrix based on the SWOT analysis. The TOWS matrix to determine strategies for transport services by rail in peripheral areas is shown in Table 4.

Table 4 TOWS matrix for transport services by passenger rail in peripheral areas. Source: authors

	Strengths (S)	Weaknesses (W)
Opportunities (O)	Integration of transport modes	Transfers to public bus transport or car transport
	Exploiting the tourist potential of the peripheral area (destination management)	Increasing the transport accessibility of the peripheral area
Threats (T)	Reducing the travel time	Investment in railway infrastructure
	Minimisation of transfers	Increasing attractiveness of railway transport

The four quadrants of the TOWS matrix represent four possible strategies:

- S-O (maxi-maxi) - using strengths to exploit opportunities,
- S-T (maxi-mini) - using strengths to counter threats,
- W-O (mini-maxi) - using opportunities to counteract weaknesses,
- W-T (mini-mini) - strategies to eliminate threats and weaknesses. [25]

Implementing any of these strategies will contribute to increasing the transport accessibility in peripheral area and can slow down or even stop the depopulation trend of peripheral areas. Specific proposals of the authors based on the TOWS matrix are presented in 5.1, 5.2 and 5.3.

5.1 Network of Railway Lines within the Peripheral Area

Local specificities are an important factor for the railway lines of regional importance. Infrastructure investments to ensure fast and reliable transport on railway lines are to be assessed in cooperation with the transport client's intentions to achieve the backbone function of rail transport in the transport service of the region. With the integration of public bus transport (lines from surrounding villages to the railway station) and private transport (Park and Ride, Bike and Ride, Kiss and Ride at railway stations), people from all over the region get to their destination. A representation of transport services for the fictitious peripheral area is shown in Figure 4.

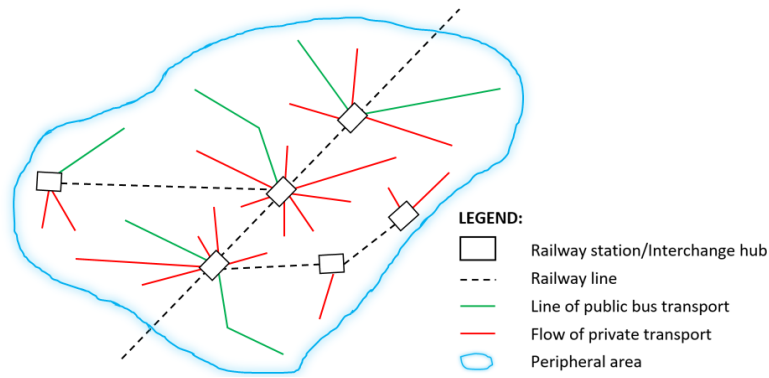


Fig. 4 Routing of transport flows by the railway line network. Source: authors

5.2 Railway Line of Supra-regional Importance

The travel time of trains on a railway line which connects two major centres and routes through the peripheral area must be as short as possible, so train stopping points must be eliminated. Depending on local specificities, one interchange point can be provided where the regional transport services of the peripheral area will be connected. This point should be optimal for minimising travel times between all settlements in the peripheral area and the centre, considering the infrastructure possibilities of building a transfer hub and the traffic flows within the peripheral area. The authors' proposal for a fictitious peripheral area is shown in Figure 5.

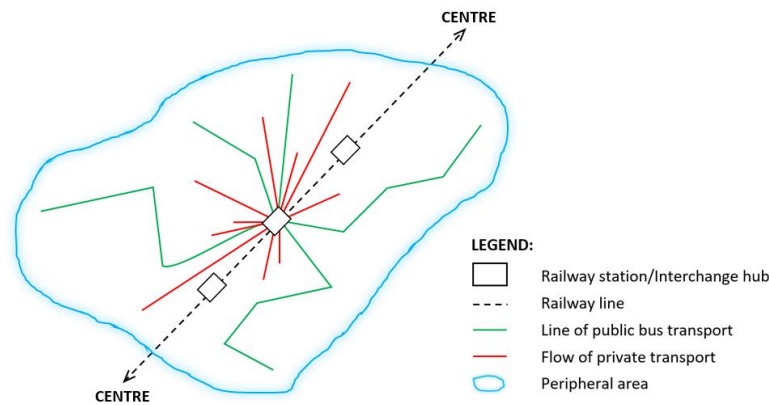


Fig. 5 Routing of transport flows by the supra-region railway line. Source: authors

5.3 Railway Line to Connect the Peripheral Area and the Centre

On a backbone railway line connecting the peripheral area and the centre, it is desirable to run direct trains from the peripheral area to the centre without changing trains. Passengers must change in the peripheral area (change from car or bus to train). Each additional transfer reduces the quality of transport and leads to a refusal to use public transport. Ideally, the railway line is routed directly from the peripheral area to the centre. If the railway line from the peripheral area is only a feeder line to another 'main' line, then the transport needs of the peripheral area residents can be met in one of the following ways:

- a) interchange of trains from the peripheral area and the 'main' line on a common section close to the centre,
- b) coupling trains originating from the peripheral area and the 'main' line at a connecting station.

Both methods meet the transport demand, which generally increases as the distance to the centre shortens. Option a) will provide a shorter interval of trains for suburban areas, while option b) will provide higher capacity trains in the section close to the centre. For these trains, the authors assume frequent stops in the peripheral area (to serve the peripheral area). The frequency of stops decreases as the centre is approached. The design of the traffic flows for the fictitious peripheral area is shown in Figure 6.

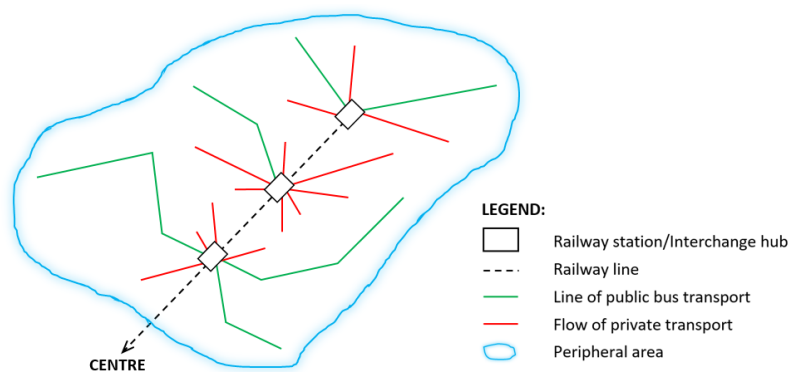


Fig. 6 Routing of transport flows by the railway line to the peripheral area. Source: authors

6. Results and Discussion

The importance of rail transport in peripheral areas must always be assessed according to the type and characteristics of the peripheral area. In border areas, the network of lines is generally routed within the peripheral area, and there is no connection to the centre. In this case, it is advisable to ensure the connection to the centre by linking rail transport to other regional transport at a suitably selected interchange point (for example, in a larger municipality on the periphery of the peripheral area, or a suitably selected interchange within the peripheral area).

Transregional lines are only relevant to peripheral areas if stopping points and connections to regional transport are chosen appropriately. In this case, it is appropriate to ensure that the peripheral area is connected to the centre with a minimum number of interchanges. In the case of interchanges, accessibility, suitable transfer times, and interchange facilities must be ensured.

The lines connecting the area to the centre are the most important in peripheral areas. Ensuring a fast, reliable, and direct connection between the peripheral area and the centre contributes to the development of the peripheral area and to slow or stop the depopulation trend of peripheral areas. The key factors of rail transport for the transport services in peripheral areas are:

- routing of traffic flows within the peripheral area and to the nearest regional centres,

- investment in railway infrastructure and its barrier-free accessibility,
- appropriate timetable – timing of connections, minimisation of travel time and transfers,
- connections to public bus transport or individual transport (building Park and Ride, Bike and Ride, Kiss and Ride at railway stations).

When deciding on the concept of transport services to peripheral areas by rail, it is always necessary to consider the local conditions and specific characteristics of this area. The aim is to ensure the backbone function of rail transport in the public transport system mainly between the peripheral area and the centre (the largest traffic flows). This is beneficial for the travels of residents of the peripheral region to and from the centres and, conversely, for the promotion of tourism in the peripheral region, while minimising the burden of car transport.

The results of this article can be used in the Jeseník region, for example. The authors propose to ensure transport services by fast trains on the Olomouc - Šumperk - Hanušovice - Lipová Lázně route at a 2-hourly interval using two BEMUs, which would split in Lipová Lázně to Javorník ve Slezsku and Mikulovice via Jeseník. These fast trains would complement present fast trains from Brno to an hourly interval and stop in Uničov, Šumperk and everywhere between Hanušovice and Lipová Lázně. It would ensure a direct connection between the Jeseník region and centres (Šumperk and Olomouc) for most municipalities in the region, whereas today only Jeseník and Lipová-lázně have direct connections.

7. Conclusion

In this paper, the importance of rail passenger transport for the transport serviceability of peripheral areas was addressed. The authors divided peripheral areas into 3 types: border areas, inner peripheral areas, and isolated areas (protrusions) and analysed the railway lines in each type of peripheral area. Based on a SWOT analysis, a TOWS matrix was established which presents specific proposals and strategies to address rail transport services in peripheral areas. Opportunities and key factors to improve and enhance the contribution of passenger rail to transport services in peripheral areas were identified. The output of the article can be used for planning rail transport services in peripheral areas: the authors propose to classify the area into one of the types, according to the link between the peripheral area and the centre, to set the planned concept of transport services and plan investments in infrastructure and rolling stock accordingly. The aim is to connect most of the municipalities of the peripheral area and the centre with a maximum of one interchange (bus/car and train interchange within the peripheral area), and the transport service model for each type of peripheral area is proposed in the article.

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