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## Development of railway connections in Zakarpattia

**Abstract.** The issues of supply and evacuation became acute with the outbreak of the active phase of Moscovits war against Ukraine in 2022. In this context, rail transport has demonstrated its stability and reliability throughout the country, making this study is relevant. The purpose of this study was to investigate the railway line of the Zakarpattia (Transcarpathia) region of Ukraine as a major economic, social, and cultural factor and its potential in the national and international context. The results highlighted the need for reliable transport links with the most remote western edge of the state's territory, which, among other things, has been politically isolated from the rest of Ukraine for centuries due to the lack of proper connections through the Carpathian Mountains. The study identified the possibilities and future development of the resource of railway connections between Zakarpattia and the countries of the European Union. For this, historical and geographical analyses and the method of comparing railway connections using field, published cartographic and satellite materials were used. The entire territory of Zakarpattia and neighbouring areas was analysed; the commonalities and specific features of the region's development were noted; all railway lines and the main mountain road lines were considered. The future development of railway communication was proposed, based on the principles of restoration, supplementation, extension, unification, duplication, dispersion, and variability of communication lines. Based on various aspects of the study, conclusions were drawn on the possibility of such development, which constituted the practical value of the present study. The necessity of involving research from other areas for future searches in line with the military and economic feasibility of developing railway connections in Zakarpattia was emphasised

**Keywords:** railway station; track; narrow-gauge railway; war; mountainous terrain

### INTRODUCTION

Rail services all over the world are proving to be a reliable element of transport, economy, culture, and national strategy. In European countries, railways have a long tradition that continues to provide and influence transportation and, more generally, communication in society. At the

same time, railways have become a military and political tool in international relations. The realities associated with the war in Ukraine prompt taking a closer look at the existing resource of railways in the defence and development of the region. The territory of Ukrainian Zakarpattia is the

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westernmost part of the country outside the Carpathian range, with significant transport links, including direct rail links to Slovakia, Hungary, Romania, and other European countries. This poses a particular interest and challenge that must be addressed for further development. Railways form an integral part of the country's overall transport system, which includes air and water transport in addition to another land mode, the road, and not to mention cable cars, power grids, and pipelines. Railways should be connected to these modes of transport, having their unique advantages and efficiency. All railways form the contact of this mode of transport with cities and settlements through stations, railway stations, and railway terminals. They connect the community in the urbanised space through architecture. These positions are also significant considering Ukraine's integration into the European Union, which makes the study relevant.

A series of scientific studies investigated the design, urban planning, and architectural properties of railway stations and railway terminals. I. Dreval (2019) addressed the urgent problem of the functioning of railway station complexes in Ukraine as significant structural and functional elements of a modern city. The researcher identified the essential features of the architectural and urban planning organisation of modern railway station complexes based on the analysis of experience in functional, transport, compositional, economic, and ergonomic aspects. The study by V. Timokhin *et al.* (2023) is analogous in terms of the problematic of the study, noting that the efficient use of land resources to free up pedestrian areas, separate traffic and pedestrian flows, organise shortest routes to different types of transport and evacuation when used as shelters, etc., is achieved by arranging underground spaces of transport and interchange hubs. Some studies address the development of railway station architecture.

The doctoral thesis of Y. Rotchniak (2021), apart from general development trends, also focused on regional, artistic, compositional, and other features of railway station buildings depending on the territorial distribution of these objects. The researcher considered the design, urban planning, and transport context. M. Nazaruk (2021) explored the architecture of the railway stations of Holoby and Kovel in Volyn region. The most successful and famous railway stations are presented as professional achievements. J. Gympel (2020) demonstrated and commented on the most beautiful railway stations in Germany as a reflection of the architecture of different eras.

F. Jeschke (2021) studied the formation of a 'national space' in the Czechoslovakian railways in the interwar period. It is of interest to explore the ways of building a national railway network in the physical landscape on the remnants of connections from the Austro-Hungarian monarchy. At the same time, there is a desire to create a modern international transport network of the state of that time. Zakarpattia was part of this state at that time. The monograph by R. Kellermann (2021) has philosophical and culturological foundations, covering the phenomenon of

'waiting' on the railway stations. The historical development of railway station premises reflects the dynamics of this category in 1830-1935. The acceleration of movement processes opens a new field for research in this aspect.

Y. Rotchniak (2024), based on the historical experience of countries with mountain railway connections, explored the possibility of restoring some of the narrow-gauge railways in the Carpathian region of Ukraine. Their extensions and mergers in remote mountainous areas are intended to create a complementary and alternative connection to existing railways and roads. The creation of a narrow-gauge network with connections to broad and normal gauges will contribute to the economic, social, and tourist development of the region, and in times of war will improve and change the routes of movement for the security and defence of the state.

The purpose of the present study was to identify the potential of existing railway connections in Zakarpattia (2025), determine the lines of restoration of the former tracks, propose ways to extend them, and build new ones with connections to existing railways to increase the transport resource of the state.

## MATERIALS AND METHODS

The material base of the study was primarily cartographic material from published sources in print and electronic form. Considering the limited access to more detailed information during the war, the focus was on the main lines of railway connections based on topographic maps and railway track diagrams. As of 2025, the restrictions on movement within the Zakarpattia region, security requirements in border areas, and the very nature of the railway as a state strategic facility do not allow for a more detailed study of the research topic in the field. However, official public electronic resources provide an opportunity to obtain the background data and conduct a search with sufficient accuracy.

The research methods were based on historical, geographical, and comparative analyses of railway connections using field and cartographic materials, published sources, and satellite image data. Observations of spatial patterns during travel and comparison with satellite imagery data allowed designing future railway lines. The established principles for the development of these railway lines become the basis for future implementation. This research topic was considered in the historical, territorial, technical, political, and partially in the socio-cultural aspects of the development of railway connections in Zakarpattia. It formed the basis for the implementation of the idea of creating an integral and uniform railway network of the region in the context of Ukraine and communication with foreign countries.

Thanks to the materials used and the research methodology applied, the historical context of railway connections in Zakarpattia in terms of internal coherence and external contacts was comprehensively established. Therewith, the historical background of the construction of the main motorways of the territory as primary lines and networks of movement was considered. Roads were a prerequisite and





at the same time an indirect determinant of railway connections. The focus on the military expediency of the lines of movement provided an explanation for their position and the current state of these roads. In connection with the railway lines, the architecture of the region's railway stations was an expression of the past and present capabilities and preferences of society in different time periods and political epochs. At the same time, it was an active 'fixed' component of transport in the urban environment.

## RESULTS AND DISCUSSION

To overcome natural obstacles in mountainous areas, 'transverse' and 'through-mountain' railways were built along the general directions of movement, and 'longitudinal' lines were built to the main ridges through side valleys connecting these transverse railways. These are, relatively speaking, the two principal ways of traversing the mountains.

*Mountain railway connections in Europe.* The railway network of the Republic of Austria is a network of three track corridors across the Alps with a general north-south direction: 1) Vienna – Graz – Celovec/Klagenfurt. As part of this line, the world's first mountain railway, the Semmeringbahn, is included; 2) Salzburg – Schwarzach – St. Veit – Villach (Tauernbahn); 3) Scharnitz – Innsbruck – Brenner (Brennerbahn). In the mountainous part of the state, these transit lines intersect with the west-east main line (Bregenz – Innsbruck – Kufstein – Schwarzach – St. Veit – Bruck an der Mur). Together with the denser northern 'Danube' railways, a fairly uniform network of tracks covers the entire state. These lines originated during the monarchy and are part of a larger network that is also located in neighbouring countries.

The construction of the Galician Transversal Railway was clearly military in nature. It was completed in 1885 by connecting the existing lines and extending to the Zbruch river to the south and parallel to the older foothill private Galician railway named after Karl Ludwig. The main connections of the Karl Ludwig company: Kraków – Peremyshl (Przemysł) – Lviv – Krasne – Brody/Ternopil – Pidvolochysk(-a). In the west, the Galician Transversal Railway ran mainly along mountain ranges. The transverse track was laid farther north from the then state border with the Moscovits Empire. Its total length was 768 km from Zwardoń, Oświęcim (Auschwitz), Kraków, via Nowy Sącz, Hrybiv (Grzybów), Jasło, Korosno (Krosno), Sianik (Sianok), Zahiria (Zagórz), Khyriv, Sambir, Stryi, Stanislawiw, Buchach, to Husiatyn on Zbruch river. A significant part of the railway passed through the mountains, connecting to the Trans-Carpathian railways: 1) Oświęcim – Zwardoń – Čadca – Žilina; 2) Tarniv (Tarnów) – Hrybiv – Nowy Sącz – Lelukhiv (Leluchów) – Orliv (Orłów) – Priashiv (Prešov) – Koshytsi (Košice) – Myshkovets (Miskolc); 3) Peremyshl – Khyriv – Zahiria – Lupkiv (Łupków) – Medzilabirtsi (Medzilaborce) – Humenné – Michalany; 4) Sambir – Sianky – Uzhhorod – Chop; 5) Lviv – Stryi – Batiovo; 6) Stanislawiw – Deliatyn – Voronenka – Dilove – Vyshivska Dolyna (Valea Vișeuului) – Syhit Marmaroskyi (Sighetu

Marmației). The mountainous part of the Galician Transversal Railway is located in Poland and enters Ukraine through the Korosno (Krościenko) – Stariava border to Khyriv (Hrankin *et al.*, 1996; Bylina, 1999; Tomlin *et al.*, 2011).

Narrow-gauge railways are used to overcome the difficulties of the terrain, to pass curved lines of small radius, and to reduce the cost of construction and operation in mountainous conditions. The 'normal' ('normalised', 'standard') gauge is 1,435 mm wide (most railways in the world have it); all wider gauges are "broad" gauges (including 1,520 mm in Ukraine), and all narrower gauges are 'narrow' (750 mm in Ukraine). The use of the term 'euro gauge' to refer to the normal gauge standard is post-Soviet slang that is not used anywhere else.

One of the longest narrow-gauge connections in Europe is in Switzerland, which is located in the general west-east direction (Zermatt – Chur – St. Moritz – Tirano; 1,000 mm gauge), connecting and crossing at junction stations (Brig, Visp, Göschenen) with the transit transalpine railways in the general north-south direction (Gotthardbahn; Bern-Lötschberg-Simplon-Bahn). In the eastern canton of Graubünden, there is a network of narrow-gauge railways that are connected to this narrow-gauge line. The total length of the narrow-gauge railways in the south of the state is many hundreds of kilometres. In the northern foothill cantons, there are separate narrow-gauge lines that are connected to normal gauge tracks at junction stations. Switzerland's railways are integrated into the country's defence sector.

*Historical background of the construction of the Transcarpathian railways.* The northeastern part of the Middle Danube Lowland, as well as a significant mountainous part of the Eastern Carpathians, was inhabited by Rusyn-Ukrainians since the middle to late first millennium AD. The territory was part of or associated with the state of Rus in its various forms, and as a result of the weakening of the central government, this land came under the influence of Hungary for a long time. To some extent, this was also caused by the natural barrier of the Carpathian Mountains. At the same time, contacts with other peoples and connections with other countries created the specificity of the region. Since 1918, this territory has been known by different names and statuses of administrative units in the vicinity of its current borders: "Ruszká Krajna in Hungary (1918-1919; at the same time, there was an independent Hutsul People's Republic with its capital in Yasynia (Yasinnia) in Rakhiv region, which considerably influenced the formation of the autonomous status of the region and Ukrainian statehood); Podkarpatska Rus (Podkarpatská Rus, Subcarpathian Rus) in Czechoslovakia (1919-1939), the state of 'Carpathian Ukraine' (1939), and the administrative unit 'Zakarpattia oblast' of the Ukrainian SSR/USSR (since 1945/1946). Since 1991, this region has been part of the state of Ukraine. In a broader sense – historically, linguistically, culturally – Zakarpattia (Transcarpathia) is sometimes referred to as a larger area inhabited, developed, or associated with Ukrainians in Slovakia (Priashiv (Prešov)



region) and Romania (South Marmarosh region), where there are Ukrainian settlements on ethnographic territory, sometimes with the self-designation of 'Rusyns' (Slovakia, Romania) and 'Hutsuls' (Romania). In the modern north-eastern Hungary, there is virtually no autochthonous Ukrainian population (Vehesh, 2009; Zastavny, 2011).

The railway connection in the Carpathians correlates with the roads that were built based on ancient trade routes. The H-13 road through the Uzhok Pass (852 m) is the closest to the Sambir – Uzhok – Uzhhorod – Chop railway. The roads through the Latorytskyi M-06 (770 m) and Serednyo – Veretskyi (Voritskyi) T-1409 (841 m) passes are the closest to the Stryi – Beskyd – Batiovo mainline railway. Analogous is the road H-09 through the Yablunyskyi/Tatarskyi pass (921 m) to the Ivano-Frankivsk – Deliatyn – Voronenka – Dilove railway. The road P-21 Dolyna – Vyshkivskyi Pass (931 m) – Torunsky Pass (941 m) – Mizhhiria – Khust forms an 'independent' mountain crossing (15 mountain passes..., 2021). Thus, three motorways with two tracked mountain crossings between Lviv and the western part of Zakarpattia make up a dense network of roads, while in the east of Zakarpattia, in the neighbouring Ivano-Frankivsk region, there are two motorways, and one tracked road. Other roads through the passes of the Main Watershed Range in Ukraine are not equipped and do not meet the safety requirements for road transport.

The construction of the railways in Zakarpattia took place against the backdrop of industrialisation, after the revolution of 1848-1849 in Europe and the establishment of the dual monarchy of Austria-Hungary in 1867. The region, rich in raw materials (salt, wood, etc.) and agricultural products, needed a reliable means of transportation that would surpass the possibilities of horse-drawn transport and river rafting. To supply and manage the region, railways were built centrally across Hungary with the new capital in Budapest. The star-shaped form of the tracks around the metropolis reflects the shared processes of railway construction as in other capitals such as Berlin, Vienna, London, and Paris. Therewith, a surge in the construction of railway stations took place, which are well preserved, continue to perform their functions, and have become symbols of many cities (Rotchniak, 2021).

The first railway line on the territory of the modern Zakarpattia region appeared in 1872, connecting Dobrochyn (Debrecen) – Kholmiv (Halmeu) – Korolevo – Syhit Marmaroskyi (Sighetu Marmăției). In the same year, the railway line Slovenské Nové Mesto (Sátoraljaújhely) – Chorna nad Tysouy (Čierna nad Tisou) – Chop – Batiovo – Korolevo was put into operation. This line to Syhit Marmaroskyi is a part of the former Hungarian Transversal Railway from the times of the empire. Back then, it connected Chop with Uzhhorod and Batiovo with Mukachevo. In 1873, Chop station was connected to Záhony station. In 1880, a narrow-gauge railway connected Solotvyno via a bridge over the Tysa (Tisza, Tisa, Theiß) river with Câmara Sighet near Syhit Marmaroskyi; later, a normal gauge railway was laid here.

According to the chronology of construction, the railway crossings of the Carpathian Mountains of Ukraine and the adjacent Ukrainian ethnographic territories are as follows: 1) 1872-1874: Peremyshl – Nyzhankovychi – Khyriv – Staryava – Zahiria – Lupkiv – Medzylabirtsi – Michalany, now: Poland – Ukraine – Poland – Slovakia; 2) 1873-1876: Tarniv – Lelukhiv – Orliv – Priashiv, Lemkivshchyna; now: Poland – Slovakia; 3) 1885-1887: Stryi – Lavochne – Volovets – Mukachevo; (in 1872 Mukachevo – Batiovo); 4) 1894-1895: Khryplyn – Deliatyn – Voronenka – Syhit Marmaroskyi; 5) 1904-1905: Sambir – Sianky – Velykyi Bereznyi (1894: Velykyi Bereznyi – Uzhhorod) (Hrankin *et al.*, 1996; Bylina, 1999).

In 1887, the trans-Carpathian branch line Mukachevo – Skotarske – Beskyd – Stryi, built in turns, came into operation, which since the mid-20<sup>th</sup> century has been double-tracked, electrified, and used as a main line and is part of the Fifth International Transport Corridor. It was the first railway to cross the Carpathians within the modern borders of Ukraine and the third on the Ukrainian ethnographic territory. In 1891, a track was laid from Teresva station along the right bank of the Tysa river to Solotvyno and Velyky Bychkiv. In 1894-1895, from Syhit Marmaroskyi, the track ran along the left bank of the Tysa river to Dilove, and then through Rakhiv, Yasynia through the Watershed Ridge tunnel to Voronenka station in Galicia. In 1913, the station Vyshivska Dolyna was connected to Borsha (Borşa) in South Marmarosh. In 1949, a railway was launched from this branch from the station Vişeu de Jos to Salva in Romania.

In 1905, the trans-Carpathian branch line Uzhhorod – Uzhok – Sianky – Sambir, which was built in turn, came into operation and was electrified. In 1920-1921, the Uzhhorod – Pavlove – Matiovtsi (Mat'ovcë) – Velyky Kapushany (Velke Kapušany) – Trebyshiv (Třebišov) railway was established to avoid the vulnerability of the Chop station on the Hungarian border, which was the only railway connection between Slovakia and Pidkarpatska Rus at that time. In the interwar period, the young multinational state of Czechoslovakia created a modern railway network based on the Austro-Hungarian system. Thus, the railway connections in Zakarpattia (Pidkarpatska Rus, Carpathian Ukraine) became part of the new transport space (Jeschke, 2021).

After the Second World War and with the establishment of new state borders, the tracks of the Zakarpattia region were converted to the standard of the then Soviet width of 1,524 mm. Since then, the main border railway junction of Chop has been providing both wide gauge (now 1,520 mm) and normal gauge (1,435 mm) transport to Slovakia (Chorna nad Tysouy) and Hungary (Záhony). There is a normal gauge line from Chop through Korolevo to Diakove to Romania (Kholmiv). In 1966, a combined normal and broad-gauge railway was built from Uzhhorod via Pavlove to Matiovtsi and to Haniska near Koshytsi in Slovakia, replacing the previous one from 1920-1921. Since 1984, there has been a connection between Svoboda and Eperjeske to Hungary.

The railway tracks and facilities in the Zakarpattia region of Ukraine are part of the Lviv regional branch of the



Ukrainian Railways. Most of the tracks belong to the Uzhhorod Directorate of Railways, while in the eastern part of the region, the Dilove – Lazeshchyna – Voronenka section belongs to the Ivano-Frankivsk Directorate of Railways (Kartohrafiia, 2008). Three gauges are in use – mostly the national “wide” gauge of 1,520 mm, partly the “normal” gauge of 1,435 mm, which is dominant in Central European countries, and partly the “narrow” gauge of 750 mm on the Borzhava railway and the Uzhhorod Children’s railway (Hrankin *et al.*, 1996; Tomin *et al.*, 2011).

The architecture of railway stations in Zakarpattia deserves special attention. It is a spatial and constructional embodiment of the perceptions and capabilities of society in different historical periods and, at the same time, continues to exist and serve the modern community. Railway stations and their buildings form a wide palette of types, sizes, styles, and compositional techniques. They are unique to Ukraine and need to be studied, preserved, and developed (Rotchniak, 2021) (Figs. 1-6).



**Figure 1.** A typical station building of the Hungarian State Railways (MÁV) from the late 19<sup>th</sup> and early 20<sup>th</sup> centuries in Batiovo  
**Source:** photographed by Youri Rotchniak (2015)



**Figure 2.** The building of the Karpaty railway station (also the eponymous modern sanatorium) of the former palace complex of the Schönborn Counts in the late 19<sup>th</sup> century near Chynadiievo  
**Source:** photographed by Youri Rotchniak (2010)



**Figure 3.** Platform of narrow-gauge trains at the Vynohradiv station in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries  
**Source:** photographed by Youri Rotchniak (2016)



**Figure 4.** Khust railway station building  
**Notes:** photograph of 1920-1930 from the exhibition stand of the Lviv Museum of the History of Religion  
**Source:** photographed by the authors of this study (2024)



**Figure 5.** Building of the Velykyi Bereznyi station in the late 20<sup>th</sup> century  
**Source:** photographed by Youri Rotchniak (2016)



**Figure 6.** Complex of the new (left, 2004) and historic buildings (right, 1905) of the Uzhhorod railway station  
**Source:** photographed by Youri Rotchniak (2016)

*Geographical and spatial features of railway connections in Zakarpattia.* The territory of Zakarpattia occupies the flat steppe part of the Middle Danube Lowland along the Tysa river basin – in fact, ‘beyond the Carpathians’ (‘trans the Carpathians’) in relation to Kyiv and most of the country, and in contrast to ‘Prykarpattia’ (by the Carpathians) – the southwestern foothill part of Galicia and Bukovyna. Zakarpattia is also the mountainous area to the south and southwest of the Main Carpathian watershed of the Tysa river basin. Overall, based on the topography, the main railway lines of Zakarpattia can be divided into plain and mountain lines.

Plain railway lines: 1) Chop – Batiovo – Korolevo – Solotvyno – Velykyi Bychkiv (‘Potysnianska’ or ‘Tysa’ railway). As of 2025, the Solotvyno – Velykyi Bychkiv section of the railway is dismantled. The once united village of Velyky Bychkiv has been divided by a border along the Tysa river since 1919/1920; it is now part of Romania’s Bociuiu Mare. Chop station has direct connections to Chorna nad Tysoyu in Slovakia and Záhony in Hungary. This line is connected by a branch line from Esen to station Solovka and then across the border to Eperjeske in Hungary. 2) Korolevo – Diakove; Diakove station connects to Kholmiv station in Romania.

Mountain railway lines (part of the Trans-Carpathian railway): 1) Chop – Uzhhorod – Uzhok – Sianky. From Uzhhorod station there is a broad-gauge branch to Pavlove station and then across the border to Matiovtsi station in Slovakia. 2) Batiovo – Skotarsko – Beskyd; 3) Dilove – Lazeshchyna – Voronenka. From Dilove down the left bank of the Tysa river, a wide railway track enters the territory of Romania, reaching the junction station Vyshivska Dolyna, and then through Velykyi Bychkiv, Syhit Marmaroskyi and Dovhe Pole (Câmpulung la Tisa) via the border bridge “returns” to Ukraine to the Teresva station. Therewith, in Romania, from Vyshivska Dolyna to Syhit Marmaroskyi, there is a parallel or combined track (combined track consists of four rails on one sleeper for bogies of different standards – wide and normal gauge). There were two railway lines between Teresva and Velykyi Bychkiv stations,

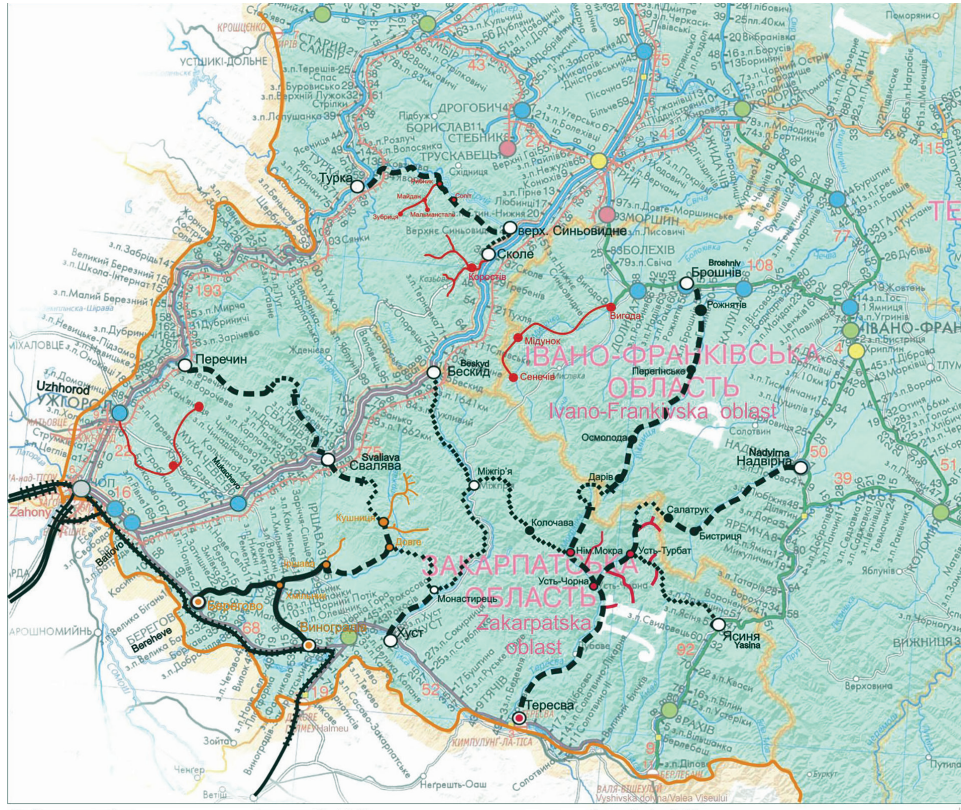
about 30 km away, on both sides of the Tysa river, connected by three bridges. The only one in operation is the border railway bridge over the Tysa river between Teresva and Dovhe Pole. The bridge in Velykyi Bychkiv – Bociuiu Mare and the Solotvyno – Câmara Sighet bridge near Syhit Marmaroskyi have been dismantled, although they are still marked on some maps (Kartohrafiia, 2008). On the territory of Romania, the railway line along the Tysa river is fully preserved.

*Specific features of narrow-gauge connections in Zakarpattia.* In some countries, narrow gauge railways are dominant (New Zealand, South Africa, Japan, etc.), while in others they are used on an equal footing with others (Australia, Argentina, Bolivia, Switzerland, etc.). There are technical, economic, historical, military, and political reasons for the existence of different gauges. In Zakarpattia, narrow-gauge railways of different gauges have been in existence since 1880. At the turn of the century, the 760 mm gauge, the “Bosnian gauge”, which existed as a standard in Austria-Hungary and was under special attention of the military, dominated (Wendelin, 2006). The name is associated with the largest narrow-gauge network of the empire in Bosnia, annexed in 1908, which was 665 km long (Kubinszki, 2009).

The narrow-gauge railways in Zakarpattia region were built and used primarily in mountainous conditions for the transport of timber under different economic systems, political regimes, and wars until the 1960s and 1980s. They led to the curtailment of timber rafting along rivers, making the supply and processing of materials year-round and reliable. The lines continued to be built after the Second World War, starting at railway stations or timber processing farms on normal/wide gauge tracks and running along rivers and streams high into the mountains. Along the way, places were arranged for travel and loading of materials. Narrow-gauge railways played an important economic and social role in the orderly development of mountainous areas. Other raw materials and supplies were also transported by narrow-gauge; by the mid-20<sup>th</sup> century, some tourist trains were launched, and later regular passenger trains were launched in the valleys of settlements. The total length of the narrow-gauge tracks in Zakarpattia at that time was about 990 km, and in the Ukrainian Carpathians as a whole – about 1,410 km (Klapchuk, 2009; 2016) (Fig. 7).

In the mid-20<sup>th</sup> century, all narrow-gauge railways in Zakarpattia were converted to the all-Union 750 mm narrow-gauge standard, which is still in use in Ukraine. Starting in the 1980s and into the early 2000s, many narrow-gauge railways in the region were degraded and dismantled due to low efficiency, poor management, lack of awareness of their value, and theft by some owners and local residents. The only operating railway with restrictions is the Borzhava narrow-gauge railway, which connects the stations of Berehove, Khmilnyk, Irshava, and Vynohradiv in the Borzhava river basin. It is a part of a large network that once reached the slopes of the Polonyna Borzhava.





Railway tracks: narrow track 750 mm normal track 1,435 mm

— existing track  
 - - - dismantled, renewable track  
 — existing track  
 ..... projected track

**Figure 7.** Scheme of narrow-gauge railway lines in the Carpathian region of Ukraine based on the map of the Lviv railway  
**Source:** created by the authors of this study based on data from Kartohrafiia (2008) and Y. Rotchniak (2024)

The children’s railway (750 mm) in Uzhhorod starts at the Molodizhna station near the Philharmonic (former synagogue) in the city centre and runs for 1.1 km to the Parkova Station along the right bank of the Uzh river to the eastern part of the Uzhhorod Botanical Garden. It was opened in August 1947 in the wake of the construction of analogous Children’s Railways as a centre for teaching children railway skills and as an attraction for recreation in city parks. In total, 9 Children’s Railways are recognised as operating in Ukraine, 11 are closed, and 2 are not implemented. Due to the martial law and uncertainty, some of them are not operating.

The role of the railways in the history of Ukraine, and particularly in its wars, is discussed in a series of studies and theses, which demonstrate the significance of this mode of transport in the political and military aspect. I. Agiyenko (2011) focused on the early period of the emergence and development of railways in Ukraine as part of two empires and specifically emphasised the military and political component of this process. S. Bohatchuk (2000) investigated the socio-economic aspect of the railway transport of Ukraine in the second half of the 19<sup>th</sup> century and the early 20<sup>th</sup> century. O. Kryvopishyn (2011) covered the construction and role of the Bender-Galatian (between cities Bender, now in Republic of Moldova, and Galați in

Romania) railway in the military operations of 1877-1878 and in the economic context. The location of this line and its connection to the tracks of the territory of modern Ukraine are vital for understanding the role of military and political visions. Historical aspects of the formation and development of railway transport in the east and south of Ukraine in the second half of the 19<sup>th</sup> century and the early 20<sup>th</sup> century were covered in the theses of R. Ponomarenko (2007) and S. Prymuk (2010). In his thesis, I. Tolokniiov (2001) studied the railway transport of Ukraine during the First World War. V. Klapchuk (2009; 2016) explored the railway connections and transport of Galicia and the Carpathians in their economic and political contexts. These academic sources comprehensively covered the historical basis for the development and role of railway connections in different regions of Ukraine and, to varying degrees, addressed the military context. However, in this vein, there are no separate studies on the railways of Zakarpattia.

Since 2014, Ukraine has been waging a defensive war against imperial aggression, which is based on the principles and methods of the 19<sup>th</sup> and early 20<sup>th</sup> centuries. As in the past, the tools of warfare stay the same, despite the seemingly more effective means of attack and destruction. The needs and advantages of railway communication are used for both offensive and defensive purposes. This means

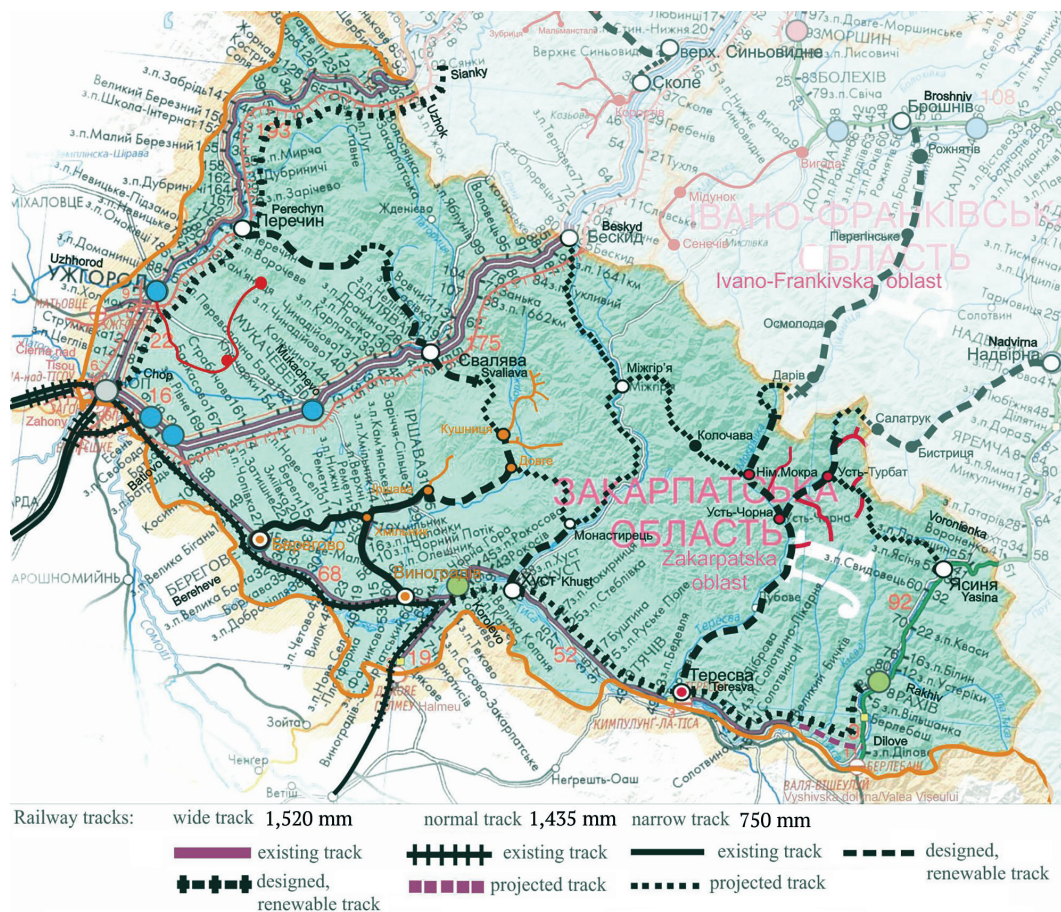


that the historical experience of using railways must be studied and applied regardless of time, territorial distance, or seemingly peaceful conditions. Based on the presented results, a series of positions were outlined, according to which the future development of railway connections in Zakarpattia is seen. By analogy with F. Jeschke (2021), the territory of Podkarpatska Rus – Carpathian Ukraine, which in 1919-1939 belonged to Czechoslovakia, was considered in this study as the Zakarpattia region of Ukraine and, accordingly, from the perspective of Kyiv’s political, economic, and military interests.

Based on the experience of laying railway lines in the military-political context, it was concluded that multi-line communication is necessary for the security of the state’s territories (Bylina, 1999). Specifically, it is known from history that in the absence of an alternative railway connection of Bukovyna (Bukowina, Bucovina – the easternmost crown land of the monarchy) through the Carpathians to Semyhoroddia (Transilvania) before the First World War, the region twice fell victim to occupation and devastation from the Eastern invasion (Hrankin *et al.*, 1996). At that time, the crown land of Galicia and Volodymyriia (Volyn) had 6 railway crossings of the Carpathian Watershed Ridge with connections to the sub-Hungarian territories of the empire (Kubinzski, 2009). In-depth studies of different

ways of communication and connections in Zakarpattia are needed, following the example of V. Klapchuk (2009; 2016), which concern Galicia and the Ukrainian Carpathians. Apart from economic reasons, it is advisable to focus on the political and military component of railway communication, as some railways were built for war and during the war.

The railway lines in Zakarpattia mentioned above in this study form a developed network mainly in the plains and along the state border. There are two equidistant branches crossing the Carpathians to Galicia in the western part of the region: 1) Chop – Uzhhorod – Sianky – Sambir and 2) Batiovo – Mukachevo – Beskyd – Stryi. The tracks along the western and southern border and the incomplete branch crossing the mountains through Ukrainian territory to Galicia in the eastern part of the region are distinguished. There is a noticeable convergence of lines and interstate railway crossings with Slovakia and Hungary in the west of the region in the Chop – Batiovo area; and in the east – with Romania in the Teresva – Dilove area. Thus, there are two railway crossings with Slovakia, two railway crossings with Hungary and three with Romania. The preserved Borzhava narrow-gauge railway on the Berehove – Irshava – (Dovhe) section runs roughly parallel to the Batiovo – Svaliava main line (Fig. 8).



**Figure 8.** Scheme of railway lines of the Zakarpattia region of Ukraine based on the map of the Lviv railway  
**Source:** created by the authors of this study based on data from Kartohrafiia (2008) and Y. Rotchniak (2024)



*Ways to develop railway connections in Zakarpattia.* The future development of railway communication is based on the following principles: restoration, addition, extension, merger, duplication, dispersion, and variation of lines. The principles are implemented by the following means: renewal of existing tracks, rebuilding of former tracks, extension and merging with other railways, connection to stations and railway stations, construction of new railway lines. It is necessary to restore the Solotvyno – Velykyi Bychkiv railway line and rebuild two railway bridges in the Upper Potyssia between Ukraine and Romania – 1) Velykyi Bychkiv – Bocicoiu Mare in the first place and 2) Solotvyno – Syhit Marmaroskyi (Cămara Sighet), if possible. The duplication of different gauges of combined track along the border on each side of the Tysa river can considerably increase and diversify passenger and freight traffic. The construction of a new railway line of normal and wide standards from Velykyi Bychkiv station on the right bank of the Tysa river, on Ukrainian territory, to Dilove station, will completely independent the railway connection in Zakarpattia. Thus, trains from Uzhhorod would use the Potysnianska railway to reach Rakhiv without two border crossings. From there, they would continue through the Lazeshchyna – Voronenka passage to the east to Galicia and then to the rest of Ukraine's railways.

A new railway line of normal and wide gauge from Velykyi Bereznyi to the border and on to Stashtchyn (Stakčín) in Slovakia would ensure reliable transport in agreement with that country. This third railway crossing to a neighbouring country would further diversify interstate transport. The political will of the government of Carpathian Ukraine to build this railway was reported in the study by M. Vehesh (2009) in the context of changes in Zakarpattia in 1938-1939. The construction of the Perechyn – Svaliava – Khust narrow-gauge line using former dead-end sections (Perechyn – Turya river valley, Svaliava – Polyana, Svaliava – Rososh, Khust – Monastyrets) made it possible to connect settlements along the rivers to these broad-gauge stations. Connecting these towns by rail would have been an implementation of this idea since the autumn of 1938, when, along with the Potysnianska railway, the southern regions of Pidkarpatska Rus (Zakarpattia), as well as the southern regions of Slovakia, were occupied by Horticult Hungary. The connection of Velykyi Bereznyi with Stashtchyn on a wide and normal gauge is part of this older idea (Vehesh, 2009).

At Dovhe station, the line would connect to the Borzhava narrow-gauge railway. The Khust – Monastyrets – Mizhhirya – Beskyd narrow gauge along the valleys of the Rika, Rypynka, and Studenyi rivers would connect to the Beskyd broad gauge station before the tunnel on the Galician side of the double-track international highway. The former narrow-gauge railway Teresva – Dubove – Ust-Chorna – Ruska Mokra – Ust-Turbat – Brustury and its branch Ust-Chorna – Nimetska Mokra are viewed as crucial for development. This network should be extended through the Carpathian passes and connected to analogously non-existent narrow-gauge

railways in Galicia along the Broshniv – Rozhnyativ – Perehinske – Osmoloda – Dariv line (to the line at Nimetska Mokra) and the Nadvirna – Rafailova (Bystrytsia) – Salatruck line (to the line at Brustury). These two lines would have enabled the fourth crossing of the Watershed near the Nimetskyi (German) Pass (1,177 m) and the fifth near the Legion Pass (before 1914 – Velyki Rogodze; 1,110 m) to cross the Carpathians, connecting stations on different branches of the broad gauge lines – Teresva, Broshniv, and Nadvirna. A possible name for these two lines is “Trans-Gorgonian Railways”. A connection between Mizhhirya – Kolochava – Ust-Chorna – Yasynia would complete this proposed network of narrow-gauge railways in Zakarpattia. This line runs roughly parallel to the Watershed Ridge and, together with the revitalisation of a series of abandoned forest roads, would create another transport reserve in the north-eastern parts of the Zakarpattia region. These considerations are based on the findings of Y. Rotchniak (2024) on the development of narrow-gauge railways in the Carpathian region of Ukraine in the context of the war.

*Strategic resource in the development of railway connections in Zakarpattia.* Thus, the three existing branches of the Trans-Carpathian broad-gauge railways would be complemented by a fourth, and with a branch and a fifth branch, by the Trans-Carpathian narrow-gauge railways. They would all have been connected by transverse narrow-gauge lines much further from the state borders in the mountains of Mizhhirya, Tyachiv, and Rakhiv districts within Ukrainian Zakarpattia. Overall, there would be junction stations with interchange/reloading of wide and narrow-gauge trains – Perechyn, Svalyava, Teresva, Khust, Yasynia, together with the existing Berehove, Vynohradiv in Zakarpattia region, and Beskyd and the former narrow-gauge interchange Broshniv, Nadvirna in Galicia. The existing part of the Borzhava narrow-gauge railway needs to be restored to the platform of the Berehove railway station. From a strategic perspective, this is a key to increasing mobility, diversifying supply lines, and enhancing safety in rail transport. The use of narrow-gauge platform bogies allows partially transporting “large” wide gauge and normal gauge wagons on narrow gauge tracks. This further contributes to the manoeuvrability of rail transport. These positions will help to increase the mobility of residents, develop tourism, and manage forest lands (Kovalyshyn *et al.*, 2023). The restoration of former dead-end narrow-gauge railways, such as Antalovetska near Uzhhorod; Dubrynychi – Liuta; Bilo-Tysnianska (Vydrychka – Shchaul river) near Rakhiv; near Lazeshchyna, and others would be fragmentary and would facilitate local track connections for local passenger transport, tourism, and partly economic purposes.

The children's narrow-gauge railway in Uzhhorod is a separate educational and cultural segment of the railway connections and can be connected by extending this narrow gauge through the preserved former railway bridge near the power plant to the passenger stop at the Domanyntsi station on the Uzhhorod – Perechyn section. Boarding passengers at this stop in the suburbs of Uzhhorod would



provide an alternative access to the city centre, bypassing existing rail and road routes, and would be worthwhile for sightseeing and recreational trips along the picturesque Uzh.

The introduction of narrow-gauge railways in the Zakarpattia region will markedly improve access and connectivity between various recreational and sporting areas. A series of settlements along the Polonyna Borzhava (Volvets, Podobovets, Pylypets, Mizhhiria), Polonyna Krasna (Kolochava, Ust-Chorna), Polonyna Svydovets, Drahobrat (Chorna Tysa, Yasynia), etc., will improve contact with the existing railways of the Uzh, Latorytsia, Borzhava, Chorna Tysa, and Tysa river valleys. The approach and two crossings of the Gorgan massifs will help regulate the use of natural areas and make these ranges easier to access for tourism. In addition, as a result of the narrow-gauge railways crossing the Carpathian Watershed, there will be contact with the railways of Galicia in the areas of the Prut river (stations and settlements: Vorokhta, Tatariv, Bukovel, Yaremche), Limnytsia river (Osmoloda), and Opir river (Slavske, Skole, Tysovets, Plavie-Plai) basins, etc.

Thus, the giant railway arc along the state border in Zakarpattia should be supplemented by a wide and normal gauge track on the Solotvyno – Velykyi Bychkiv – Dilove section. This arc should be joined by internal and international tracks. The existing two-track Batiovo – Mukachevo – Stryi railway, which is far from the borders, should stay a wide two-track line, while the two trans-Carpathian single-track lines 1) Chop – Uzhhorod – Uzhok – Sianky – Sambir and 2) Vyshivska Dolyna – Dilove – Lazeshchyna – Voronenka – Deliatyn – Kolomyia should become combined – with one wide and one normal gauge. Narrow-gauge lines and a network of narrow-gauge railways will be an alternative and complement to the main railway connections.

The construction of normal and broad-gauge railways in Zakarpattia in parallel or combined will provide for more options for travel. Connecting narrow-gauge railways to junction stations requires the same approach – the restoration and development of narrow-gauge railways is viewed as a promising way to create a narrow-gauge railway network in Zakarpattia region in areas that are remote from existing broad and normal gauges and from state borders. The basis is the remnants of some narrow-gauge lines and the traced lines with the lower track structure. The use of the three-gauge standards should turn from a current challenge into an advantage – Ukraine is unique in this regard in the context of rail connections. At the same time, railway stations and interchange facilities should be arranged at railway stations and railway stations, which is the responsibility of planners, engineers, and architects. Accordingly, the connection of road access to stations and railway stations will revitalise the overall transport system of the region.

## CONCLUSIONS

Historically, the development of railway connections in Zakarpattia began in the 1870s. At the beginning of the

20<sup>th</sup> century, a network was established that reflected the economic, administrative, political, and military interests of Budapest and Vienna. Subsequently, the political background led to changes in the directions and volumes of traffic, but there are no noticeable traces of them on the railway lines. The territorial development of railway connections in Zakarpattia initially took place along the Tysa river, and other rivers for connections in the Middle Danube Lowlands. The purpose of the tracks in the valleys was to reach the Watershed Ridge to Galicia. The scattered trans-Carpathian lines were connected to the Potysnianska railway within the region. A network of individual narrow-gauge railways was formed, where the connections were densified. The laying of the railways in the mountains created a grid-like pattern with the main lines crossing the mountains. In the northwestern part of the region, the railway network is denser.

The technical development of railway connections in Zakarpattia was in line with scientific advance: railways were built, main lines were doubled and modified; the latest control and signalling systems were introduced; two trans-Carpathian lines and part of the Potysnianska line were electrified in the west of the region. There are three-gauge standards in place; the dominant one is the national gauge. The strategic development of railway connections in Zakarpattia corresponded to political conditions and military interests: imperial (Austria-Hungary), interwar democratic (Czechoslovakia, Carpathian Ukraine), and authoritarian (Hungary, the USSR). With the restoration of Ukraine's independence, there is a state of inertia in preserving, modernising, and adapting. The railway connections require rethinking and active action in the context of statehood.

The socio-cultural development of railway connections in Zakarpattia is most pronounced in railway stations. Many architecturally distinctive buildings were created before the mid-20<sup>th</sup> century. Social contacts on the railway reflect industrial, domestic, linguistic, and other relationships; they are a significant layer of culture. The future development of railway connections in Zakarpattia is based on the economic, social, and strategic needs of the state through the restoration, supplementation, extension, unification, duplication, dispersion, and variation of lines. The idea of a continuous railway connection can be implemented by connecting tracks of three standards to hub and border stations. The diversity and multidirectionality of the lines adds to the reliability and controllability of railway traffic.

The potential of the existing railway connections was studied, the lines of restoration were identified, and the ways of extensions with connections to the existing ones were proposed, indicating the possible development of future railway connections in Zakarpattia. It is based primarily on defence needs, which may not be in line with economic feasibility. New lines will increase the significance of cities, towns, and territories. Therewith, environmental, monument protection, legal, and other requirements will





adjust the above provisions. Long-term development of railways requires political will, motivation, and a state vision. The following scientific research should be conducted as a basis for design and implementation.

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## Розвиток залізничних сполучень Закарпаття

**Анотація.** Питання постачання та евакуації гостро постали з вибухом активної фази московської війни проти України у 2022 р. У цьому контексті залізничні перевезення продемонстрували свою стійкість та надійність на усій території держави, а тому дане дослідження є актуальним. Мета статті полягала у дослідженні лінії залізничних сполучень Закарпатської області України як великого господарського, соціального та культурного чинника і її потенціалу в державному та міжнародному контексті. У результатах звернено увагу на потребу надійності транспортних сполучень із найвіддаленішим західним краєм території держави, який у тому числі й через відсутність належних зв'язків через карпатські гори на багато століть опинився у політичній ізоляції по відношенні до решти України. Виявлено можливості та майбутній розвиток ресурсу залізничних сполучень Закарпаття з країнами Європейського союзу. Для цього було використано історичний і географічний аналізи та метод порівняння залізничних сполучень з використанням польових, опублікованих картографічних і супутникових матеріалів. Було проаналізовано усю територію Закарпаття та сусідніх територій, зазначено спільність та особливості розвитку краю; розглянуто усі лінії залізничних сполучень та основні гірські автомобільні. Запропоновано майбутній розвиток залізничного сполучення, який виходить з принципів: відновлення, доповнення, продовження, об'єднання, дублювання, розосередження, варіантності ліній сполучень. На основі різних аспектів дослідження зроблено висновки про можливість такого розвитку, що становить практичну цінність цієї роботи. Наголошено на необхідності залученням досліджень з інших сфер для майбутніх пошуків в руслі військової та економічної доцільності розвитку залізничних сполучень Закарпаття

**Ключові слова:** вокзал; колія; вузькоколія; війна; гірські терени

