

VERKEHRSGEOGRAPHIE

TRANSPORT GEOGRAPHY

IMPROVEMENT OF ACCESSIBILITY IN EASTERN EUROPE DUE TO IMPLEMENTATION OF ROAD PROJECTS IN THE VIA CARPATIA CORRIDOR

Piotr ROSIK, Tomasz KOMORNICKI, Sławomir GOLISZEK,
and Patryk DUMA, all Warsaw [Warszawa]*

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with 6 figures in the text

CONTENTS

<i>Zusammenfassung</i>	178
<i>Summary</i>	178
1 Introduction	178
2 Policy background. Via Carpatia route: Setting the scene	180
3 The research concept. The potential accessibility measure	183
4 Results	184
5 Conclusions	192
6 References	194

* Prof. Piotr ROSIK, PhD.; Prof. Tomasz KOMORNICKI, PhD; Sławomir GOLISZEK; Patryk DUMA, all Institute of Geography and Spatial Organisation, Polish Academy of Sciences, Twarda 51/55, PL-00-818 Warsaw, Poland; emails: rosik@twarda.pan.pl, t.komorn@twarda.pan.pl, sgoliszek@twarda.pan.pl, p.duma@twarda.pan.pl

Zusammenfassung

VERBESSERUNG DER ERREICHBARKEIT IN OSTEUROPA DURCH DIE UMSETZUNG VON STRASSENPROJEKTEN IM VIA-CARPATIA-KORRIDOR

Die vorliegende Studie verfolgt das Ziel, den Zusammenhang zwischen der fertiggestellten Via-Carpatia-Route und der potenziellen Zugänglichkeit Osteuropas als Region einzuschätzen. Dabei werden die folgenden Hilfsziele formuliert: a) Vergleich der Auswirkungen der Fertigstellung der gesamten Strecke auf ausgewählte Regionen und Städte – insbesondere in den peripher gelegenen Mittelzentren; b) Vergleich der Auswirkungen der Inbetriebnahme bestimmter Abschnitte des transnationalen Straßenprojekts, das 2025 zu einem ersten Teil (in Polen) eröffnet werden soll. Die östlichen Peripherien der Europäischen Union bleiben zu einem großen Teil ein Gebiet, in dem die Aufstiegschancen durch die unterentwickelte Verkehrsinfrastruktur verringert werden, wie dies durch die niedrigeren Indikatoren räumlicher Zugänglichkeit zum Ausdruck kommt. Die präsentierte Analyse bestätigt, dass der Bau der neuen Korridore – in diesem Fall der Via-Carpatia-Route – diese Situation verbessern kann. In territorialer Hinsicht ist der mögliche positive Investitionseffekt jedoch selektiv. Er steht auch in Zusammenhang mit anderen Verkehrs-Investitionen, einschließlich Routen in Ost-West-Ausrichtung und Diagonalverbindungen.

Schlagwörter: Potenzielle Zugänglichkeit, TEN-T-Netz, Osteuropa, Via-Carpatia-Korridor

Summary

The main objective of the present study is to assess the possible impact of the completed Via Carpatia route on changes in potential accessibility. The auxiliary objectives are: a) comparison of the effects of creating the entire route in selected regions and cities (in particular peripherally located medium-sized centres), and b) comparison of the effects of implementation of particular sections of the future undertaking. The eastern peripheries of the European Union remain, in a large part, an area with development opportunities reduced by the lagging transport infrastructure, as this is expressed by lower level of spatial accessibility indicators. The analysis here presented confirmed that the construction of the new corridors (here: Via Carpatia route) can improve this situation. However, the possible positive investment effect is selective in the territorial sense. It is also dependent on other investments, including routes having east-west and oblique orientations.

Keywords: Potential accessibility, TEN-T network, Eastern Europe, Via Carpatia Corridor

1 Introduction

The aim of development and functioning of the TEN-T network is to ensure territorial cohesion of the EU, facilitate the free movement of people and goods, and – consequently – improve the functioning of the single internal market, stimulate economic growth, and improve the competitiveness of the Member States and of the entire EU on the global

scale. Creation of a coherent and interoperable, multimodal transport network featuring uniform, advanced technical parameters is possible only in the case of ensuring the full coverage of the entire European Union. This applies, definitely, also to the areas adjacent to the eastern border of the EU (KOŁOSOV and WIĘCKOWSKI 2018). During the previous (2007–2013) and current (2014–2020) financial perspective, these areas have significantly improved their accessibility, owing to the implementation of east-west connections, linking them with the core areas of individual countries as well as with the entire Union.

At the same time, however, there persists the lack of a southward communication axis that could favour the development of peripheral areas, and at the same time play an integrating role towards the Western Balkans, Eastern Partnership countries, as well as Turkey and the Middle East. The layout of the existing TEN-T core corridors implies that the last meridian route is the Baltic Sea – Adriatic corridor, connecting Scandinavia and Poland with Southern Europe, bypassing the Carpathians from the west (via the Czech Republic). The initiative that can fill the indicated gap is the postulated Via Carpatia route (along with its branches). The respective initiative was undertaken by the authorities of several countries in the region, currently lobbying for the inclusion of Via Carpatia, also named Via Carpatia, in the TEN-T network. The Via Carpatia corridor extends through peripheral areas, which have been characterised by a relatively lower level of accessibility, both on the EU scale (European level) and within the Member States (national level). This means that the effect of implementation of this project can be significant, including the motivation for undertaking investment activities by potential investors, which should be encouraged by modern road infrastructure. On the other hand, the demand-side justification for Via Carpatia is often questioned, due to the relatively small traffic on some of its designed sections. Under these conditions, it is extremely important to correctly quantify the expected effects of Via Carpatia at the European level. Such a sound quantification would allow for an objective assessment of the legitimacy, and then the preparation of future investment projects, including their proper staging along the whole route. Despite the obviousness of this postulate, the expected road construction effects have not been verified for Via Carpatia using more advanced methods of evaluation, including the potential accessibility model.

The problem also fits into the wider reflection on the benefits from building a linear transport infrastructure along the border, far away from the largest metropolitan centres. The impact of infrastructure on the socio-economic development in peripheral areas is sometimes questioned. There are several authors who demonstrate that the concentration of possible positive effects of new motorways and expressways is in the core rather than in peripheral areas (CIEŚLIK and ROKICKI 2013; CRESCENZI and RODRIGUEZ-POSE 2008). On the other hand, other studies put an emphasis on the progressive peripheralisation of areas characterised by a low level of spatial accessibility. High level of accessibility is not, in itself, a guarantee of an accelerated economic development, while low level of accessibility very often means isolation. This is confirmed by numerous studies, carried out in various countries. These studies show that accessibility is negatively correlated with “rurality” (CASHILI et al. 2015) and even with the production of the agricultural sector (DREWELLO 2014). There is the controversy in the literature about the nature of the impact of transport investments on medium-sized cities, that are often the main administrative

centres of peripheral areas. Assessment of the role of road projects running parallel to the highly formalised external borders of the European Union belongs also to the broader geopolitical thread, concerning the impact of permeability of the border on the development of bilateral connections (cf. KOMORNICKI 2014).

The main objective of the present study is to assess the possible impact of the completed Via Carpatia route on changes in potential accessibility. The auxiliary objectives are: a) comparison of the effects of creating the entire route in selected regions and cities (in particular peripherally located medium-sized centres), and b) comparison of the effects of implementation of particular sections of the future undertaking. The spatial scope of the study covered entire geographical Europe (together with the former USSR republics, including the European part of Russia), as well as Turkey. Such a large territorial range, encompassing both origins and destinations, distinguishes the present analysis from many previous European accessibility studies (cf. ESPON 1.2.1 Final Report 2004; SPIEKER-MANN *et al.* 2014). The applied approach allows also for assessing the effects of investments on both sides of the external EU border, and thus to identify the influence of this border, understood as a formalised spatial barrier (see RYKIEL 1990; KOMORNICKI 1999). The time horizon of the survey goes forth 10 years from the planned completion of the Polish part of the undertaking (i.e. years: 2025–2035). Thus, the analysis, including the forecasts of changes in accessibility, is performed in the long-term perspective, i.e. until 2035. It is a perspective, in which the creation of the entire route (in the standards of a motorway or an expressway) can be considered real.

The paper presents a forecast, concerning the changes in the transport accessibility of regions, through which the basic route of Via Carpatia will run, taking into account the changes in the accessibility, resulting from the implementation of road projects on individual sections of the route. Accessibility analysis was carried out first for the whole of Europe, in order to indicate the overall level of accessibility of the regions along the Via Carpatia route, as well as the accessibility changes, resulting from the extension of infrastructure. We analysed the expected shortening of travel times between all pairs of 1585 transport regions in Europe, as a result of bringing the Via Carpatia route to the level equivalent to that expected for the TEN-T network corridor, meaning at least the expressway. We assumed the *ceteris paribus* approach, leading to the so-called net effect of improving accessibility as a result of implementation of Via Carpatia. Particular emphasis was placed on accessibility changes for selected medium size cities, located along the route. At the end of the article, results are presented of 12 independent simulations, performed in order to check the effects of the accessibility improvement after the possible realisation of the 12 sections of Via Carpatia. The article is the result of research carried out under own grants, financed by the Polish National Science Centre Nos. 2014/13/B/HS4/03397 and 2012/05/B/HS4/04147.

2 Policy background. Via Carpatia route: Setting the scene

The initiative to build the road named Via Carpatia was undertaken for the first time at a meeting during an international conference, organised in Łańcut (Poland) in 2006.

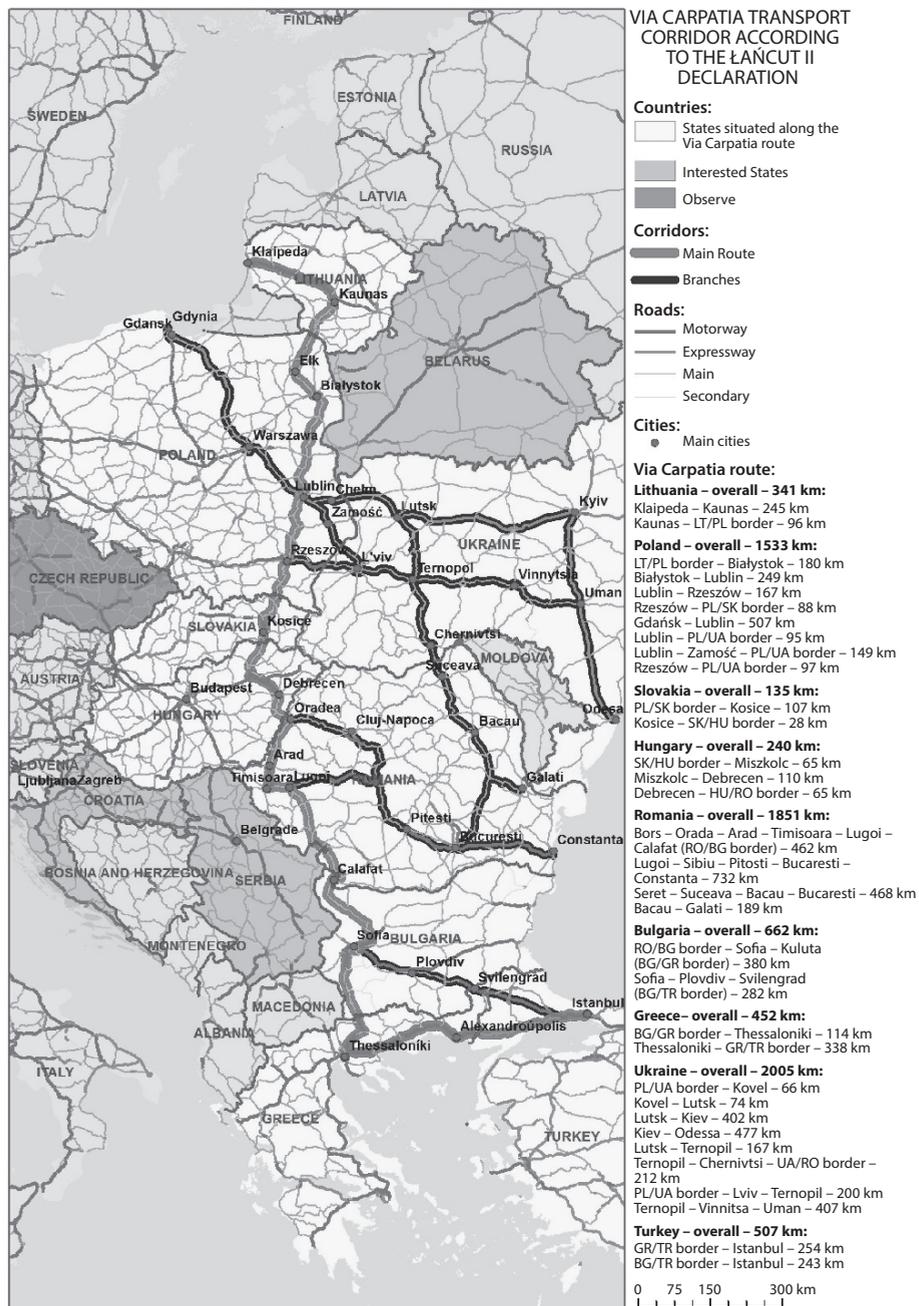
Its initiators were Poland, Lithuania, Slovakia and Hungary. The transport ministers of these countries then signed a declaration of joint efforts to include the route in the TEN-T network. In 2010, the initiative was supported by other countries (Bulgaria, Romania and Greece).

The main planned route of Via Carpatia, as an international transport corridor, according to the so-called Łańcut Declaration (from 2016), runs from Klaipėda and Kaunas in Lithuania via Białystok, Lublin and Rzeszów in Poland, Slovakian towns of Prešov and Košice, to Miskolc and Debrecen in Hungary, and next to Romania, where the major route of the Via Carpatia leads from Oradea through Arad and Timisoara towards Bulgaria (Sofia) and Greek ports (Thessaloniki, Aleksandrupoli), and then further to Turkey, to Istanbul (Fig. 1). The branches of Via Carpatia lead from the Polish Baltic ports to south-eastern Poland, then joining the branches running towards Ukraine, i.e. from Lublin to Kovel, and from Lublin through Rzeszów to Lviv. In Ukraine, the branches start in the west of the country, pass Kiev, and terminate at the port of Odessa. In Ternopil, the route also branches out towards Romanian Galati and Bucharest. Moreover, in Romania, the route branches out in Oradea and Lugoj towards the port of Constanta. In Bulgaria, a branch of the route leads from Sofia to the border with Turkey and then to Istanbul. Nevertheless, in this paper we focus mainly on the accessibility analysis for the major route of the Via Carpatia. It is worth added that Via Carpatia in large sections is already part of the EU Trans-European Transport Core network. It overlaps with North Sea-Baltic Corridor in Lithuania/Poland and with Orient-East Mediterranean Corridor in Romania, Bulgaria and Greece.

It is worth adding that the Ministry of Infrastructure in Poland took the initiative to incorporate the new corridor under the name of 'Via Carpatia' to the TEN-T core network along its entire course at the time of the next update of the TEN-T. In accordance with Article 54 of the Regulations of the European Parliament and of the Council No 1315/2013 of 11 December 2013 on Union guidelines for the development of the trans-European transport network, the European Commission shall, by 31 December 2023 (EP 2013), carry out a review of the implementation of the core network.

The place of Via Carpatia in the strategic documents in countries, through which the corridor runs, varies. The states of progress regarding the planning phase or construction works also vary. In Poland, along with the shift of funds towards the Eastern Poland macroregion, the Via Carpatia route has become a high priority project, this being guaranteed by the decisions of the Council of Ministers in 2017. Yet, in the central part of the Polish section, the work is not advanced. There are also no specific investment plans and decisions for the northern part of the Bulgarian section (from Sofia to the border with Romania), while in Romania there are plans, but the actual implementation is rather limited. At the same time, construction of the route in Lithuania, Hungary, Greece and Turkey should be assessed as very advanced.

At the northern and southern fringe of Via Carpatia, its course overlaps with other corridors of the TEN-T core network, while in Poland, Slovakia, Hungary and Romania, new sections should be added to the core TEN-T network. Countries not belonging to the EU also expressed their interest in the construction of the route (Ukraine, Serbia, Belarus and Bosnia and Herzegovina). The potential accessibility analysis is important for these countries due to the fact that the layout of existing TEN-T core corridors remains strong-



Source: Own design, based on the proposal of Via Carpatia route by Ministry of Infrastructure of Poland

Figure 1: Via Carpatia – the routing scheme

ly conditioned by the course of the EU external borders (nowadays, the shortest road travel pathways from Northern Europe to Greece run through Serbia and Macedonia, not through Romania and Bulgaria). The spatial layout of the core network is still the derivative of the so-called Pan-European Corridors initiative, which was established in the early 1990s, the time of the armed conflicts in the former Yugoslavia.

3 The research concept. The potential accessibility measure

Accessibility can be measured using a number of methods (GEURS and VAN ECK 2001; ROSIK 2012). Nevertheless, the potential model is the most widely used to capture the effects of transport investments (ROSIK et al. 2015; GUTIÉRREZ et al. 2011) regarding improvements in accessibility. This method allows for simulation of changes in accessibility in spatial terms, resulting from putting any section to use or changing its parameters (e.g. a new part of an expressway or improvement of the road category on a given section). This may also concern a group of sections or an entire program (HOLL 2007; SPIEKERMANN et al. 2014). The most important assumption behind the potential model is that the attractiveness of the trip destination increases with its size and decreases as the physical, temporal or economic distance increases. In this study the distance decay factor is expressed as travel time, and the attraction of the destination is represented by a function of the population in the transport region in 2015. We construct a potential accessibility model for the whole of the European continent at the NUTS3 level. Outside the European Union, the countries considered are divided mostly according to the administrative division, for example, Ukraine, Belarus and Russia are divided into the so-called Oblasts, and in Turkey and some other countries NUTS units based on Eurostat data for neighbouring countries were adopted. In total, 1585 transport regions were considered.

The road network for the entire continent was developed by adapting the OpenStreet layer, network elements being classified into five categories of roads: motorways and expressways, including already existing sections of Via Carpatia route, dual carriageways, other national roads, other regional and local roads. The code speeds applicable in a given country were adopted, with corresponding reduction of speeds for regional and local roads. The border waiting times were also taken into account. All of the regional capitals, which include also the largest cities in the transport regions, were connected with the road network. The OGAM application developed at the Institute of Geography and Spatial Organisation of the Polish Academy of Sciences (see ROSIK et al. 2017) was used to simulate the potential accessibility pattern. The model bases on the shortest travel path algorithm between any pair of transport regions for the whole continent.

As the general formula we use the potential accessibility indicator, which takes into account different geographical layers and comprises four components:

$$A_i = M_i f(t_{ii}) + \sum_j M_j M_{ij} f(t_{ij}) + \sum_k M_k f(t_{ik}) + \sum_l M_l f(t_{il}) \quad (1)$$

where $M_i f(t_{ii})$ is the so called selfpotential of the NUTS3 region and (t_{ii}) is the internal travel time, calculated on the basis of the method proposed by RICH (1978) (see also GUTIÉRREZ et al. 2011). The sum of selfpotential and the second component $\sum_j M_j M_{ij} f(t_{ij})$

is the domestic potential, where (t_{ij}) is the travel time between any pair of NUTS3 i and j regions within the same country. The sum of the domestic potential and the third component $\sum_k M_k f(t_{ik})$ is the international potential within the Schengen area, where t_{ik} is the travel time between two NUTS3, i and k , located in different countries belonging to the Schengen area. We assume no border waiting times between the countries within the Schengen area. Ultimately, the sum of the potential of the Schengen area and the fourth component $\sum_l M_l f(t_{il})$ is the international potential on the European scale, with travel times accounting for the waiting time at the borders of the Schengen area and also waiting times in general for the other borders over the whole European continent.

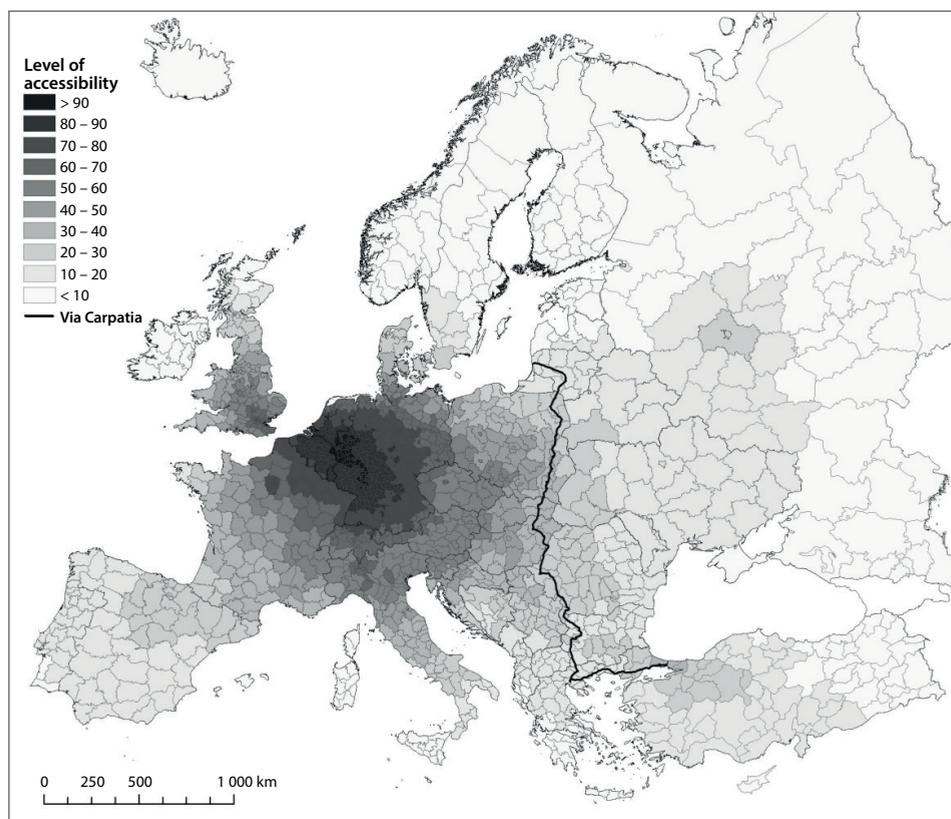
Among the most commonly used distance decay functions there are the inverse power function (HANSEN 1959; HOLL 2007; KOTAVAARA et al. 2011) and the negative exponential function (SONG 1996; HANDY and NIEMEIER 1997; HAYNES et al. 2003). The exponential curve does not decline as rapidly as the power one. Therefore, it is more suitable for longer distances at the international level (FOTHERINGHAM and O'KELLY 1989; GEURS and VAN ECK 2001; SCHÜRMAN and TALAAT 2000; SPIEKERMANN and SCHÜRMAN 2007; SPIEKERMANN et al. 2014; ROSIK et al. 2015), and so we adopt the exponential function: $f(t_{ij}) = \exp(-\beta t)$. Following ROSIK et al. (2015), in this study we assume that the β parameter equals 0.005775. For the selected function and exponent the attractiveness of the destination dwindles to half at two hours of travel, and to 10 % for about 400 minutes (6 hours and 40 minutes) of travel.

4 Results

4.1 Accessibility diagnosis

The results of the study indicate that the continental distribution of accessibility is to a large extent “centered” on the European core, the so-called “Blue Banana” (Fig. 2). The highest level of accessibility is observed in the Ruhr region. The farther away it is from the European core, the lower the level of accessibility is in all directions, whereby the pace of this decrease heavily relies on population density and the state of road infrastructure. In Poland, for example, the accessibility level is diminishing from the south-west towards the north-east, but it remains at a relatively higher level along the motorways A2 (to Warsaw) and A4 (to Cracow and Tarnów). The enclaves of higher accessibility in the peripheral areas of Eastern Europe exist mainly around the biggest cities, like Moscow and Istanbul, and to a lesser extent also St. Petersburg.

The areas along the Via Carpatia route are characterised, in general, by a rather low level of accessibility. However, this level varies from very low values at the northern and southern fringes (in Lithuania and northern Greece) to relatively high values in the vicinity of Istanbul, and in the central part of the corridor (from Lublin to Timisoara, with the “peak” in Rzeszów) (Fig. 3). The better accessibility of the Polish, Slovakian and Hungarian sections is determined by the geographical location in relation to the EU core area and better developed east-west infrastructure. Therefore, the Via Carpatia route plays an important role in connecting the areas located between the east-west motorways (Polish



Source: Own design

Figure 2: The potential road accessibility to population in 2013

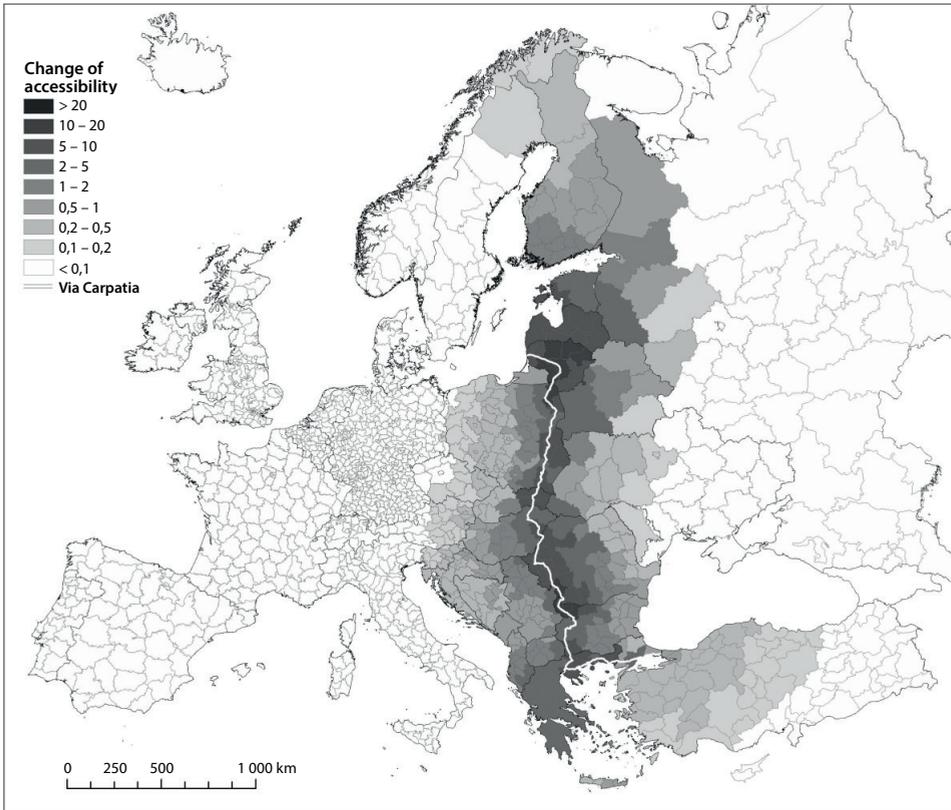
A4, Slovakian D1, Hungarian M3) with these routes. The improvement of the accessibility indicator can therefore take place as the cumulative effect of Via Carpatia and east-west motorways, proving that the north-south system cannot be seen as an alternative to the east-west one. The two kinds of routes are complementary, and, in fact, do complement each other in improving the accessibility of the eastern borderlands of the European Union. In this context, it is advisable to complement Via Carpatia with perpendicular routes, as is the case with, for instance, the eastern section of the Polish A2 motorway.

4.2 Changes in accessibility. Via Carpatia route

The results of simulation of changes in accessibility after the realisation of Via Carpatia route along its whole length from Lithuania to Turkey indicate that the range of impact of the investment is extensive territorially and stretches from the north of the continent

(northern Finland, and even Sweden and Norway) to central Turkey. On the western side, improvement of accessibility exceeding 0.1 % is visible more or less between the eastern side of the Polish-German border and Slovenia. The largest beneficiaries of the project are the Bulgarian-Romanian and Polish-Lithuanian border regions (improvement in Kaunas by 14.3 %), but the large effects of improved accessibility (over 5 %) are also visible in Latvia and Greece. In fact, generally, there are regions in all countries considered where accessibility rises by more than 5 %. The smallest changes are, due to obvious reasons, recorded along these sections, which already at the end of 2015 had the status of expressway or motorway, and no further improvement has been envisaged there (Miskolc, Sofia, Istanbul, Thessaloniki) (Fig. 3).

What attracts attention is the noteworthy improvement in accessibility in some of the countries outside the European Union. Interestingly, this applies more to Belarus and northern Russia (St. Petersburg region) than to Ukraine. Physical remoteness causes that



Source: Own design

Figure 3: The change in road accessibility to population after implementation of Via Carpatia corridor

the new undertaking improves accessibility in northern Russia, just like in Finland. Being located closer to the European Union core, Ukraine is not affected positively enough to offset the negative effect of its poorly permeable border. Notwithstanding that, the impact of the Via Carpatia is visible in the entire western Ukraine, up to, and including, Kiev. On the eastern side of the Dnieper the impact is not conspicuous any more. Benefits from the undertaking should be also gained by Moldova, this being potentially an argument for its inclusion into the system of auxiliary corridors. In a longer perspective, it may also be purposeful to integrate Belarus (depending on the geopolitical situation), which may be an important beneficiary of the corridor.

Naturally, the western Balkans, in particular Serbia and Macedonia, are beneficiaries of the route (increase in Vojvodina by 5 %). However, improvements by 0.5–1 % reach as far as to the Adriatic coast (in Albania). Generally, among the countries situated to the west of the Via Carpatia (and which are not on its course) the benefits are recorded in all the countries of the former Yugoslavia, in Albania, as well as in the eastern parts of Austria and the Czech Republic. The analysis of the potential accessibility provides arguments for increasing the number of countries involved in project implementation by adding Serbia, and then Macedonia and Albania.

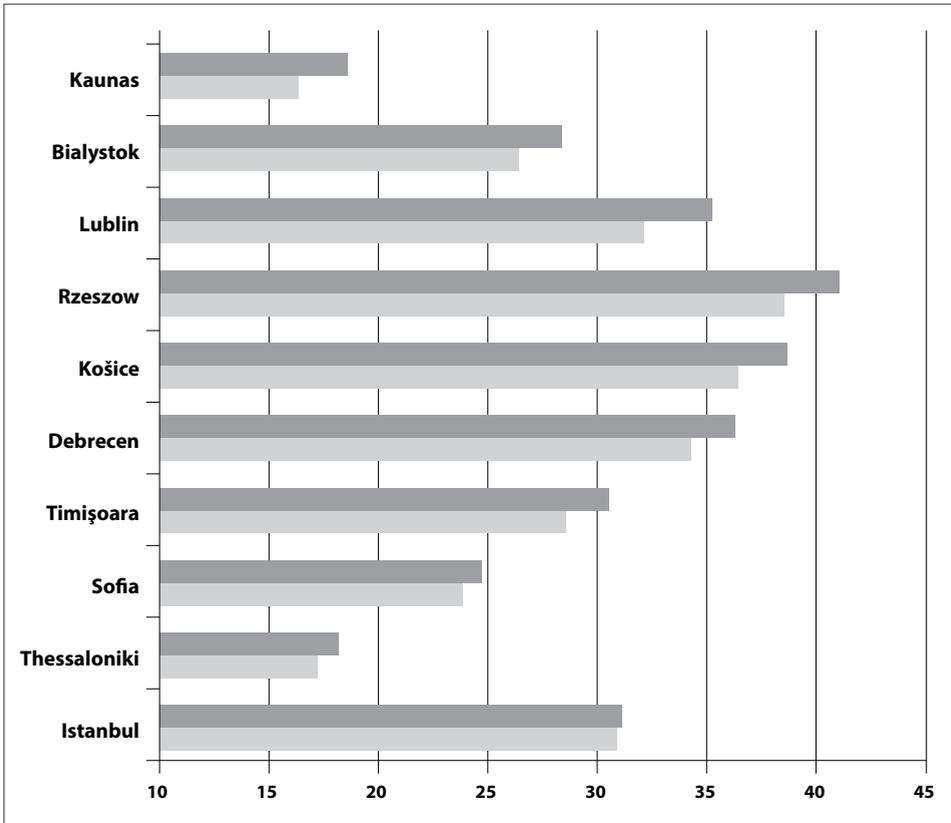
Improvement in accessibility provides an opportunity for development, owing to the synergy effect, i.e. by combining the potentials of middle-sized towns of the eastern borderlands of the European Union. It can be provisionally referred to as the process of creating the “Carpatian network metropolis”, connecting towns and cities of south-eastern Poland, Slovakia, Hungary, western Romania and, maybe in the future, also Ukraine.

The medium-sized cities such as Lublin, Rzeszów, Košice, Miskolc, Debrecen and Timisoara can be regarded as the main beneficiaries of the route construction (Fig. 4). These centres are located in peripheral, often depopulating regions. The route is unlikely to stop the negative demographic processes, but it may be a development stimulus for some of the regional growth poles.

The results of the potential accessibility simulations show that the existence of cities along the route, such that the passage time between the neighboring cities of this rank is at up to 2 hours, may favor the networking of the regional economy. The level of networking, measured by the intensity of functional connections, is generally low in the regional cities of Central and Eastern Europe and needs strengthening (on the example of Poland, this is demonstrated by KORCELLI 2011; KOMORNICKI et al. 2013). The above-mentioned cities are, at the same time, important nodes, located at the junctions of the existing east-west and planned north-south corridors.

However, it must be strongly emphasised that the analysis of the indicators of accessibility leads to one important conclusion, namely that the Via Carpatia provides just an opportunity for creating this type of network systems. In actual practice, the economic links between the above-mentioned towns/cities are weak and their development must be stimulated also by means of other regional policy instruments. This may happen, for example, within the common strategic activities for the Carpatian Macroregion of the European Union.

Big cities (such as Istanbul or Sofia) will experience lower accessibility improvements. These cities function in the continental and global systems. Connections to smaller centres



Source: Own design

Figure 4: The levels of accessibility before and after implementation of Via Carpatia (analysis for selected towns/cities on Via Carpatia route)

of Eastern Europe will remain secondary to them. High benefits will be noted in Lithuania (and particularly so in Kaunas), in view of the fact that along the Polish-Lithuanian section, Via Carpatia coincides with the Via Baltica route. This route is the basic corridor of the TEN-T North Sea-Baltic corridor, which is the only connection between the Baltic states and the rest of the European Union.

This leads to the general conclusion that expectations of individual countries and regions related to Via Carpatia may be in a natural way different. In peripheral areas (northern and southern ends of the corridor, but also their branches to the east – Ukraine) the expectations boil down to better communication with Central Europe and, indirectly, with Western Europe. In the central part of the corridor a justification of its construction should be rather sought in the acceleration of economic development through better use of endogenous potentials (less dependent on the western part of the Community).

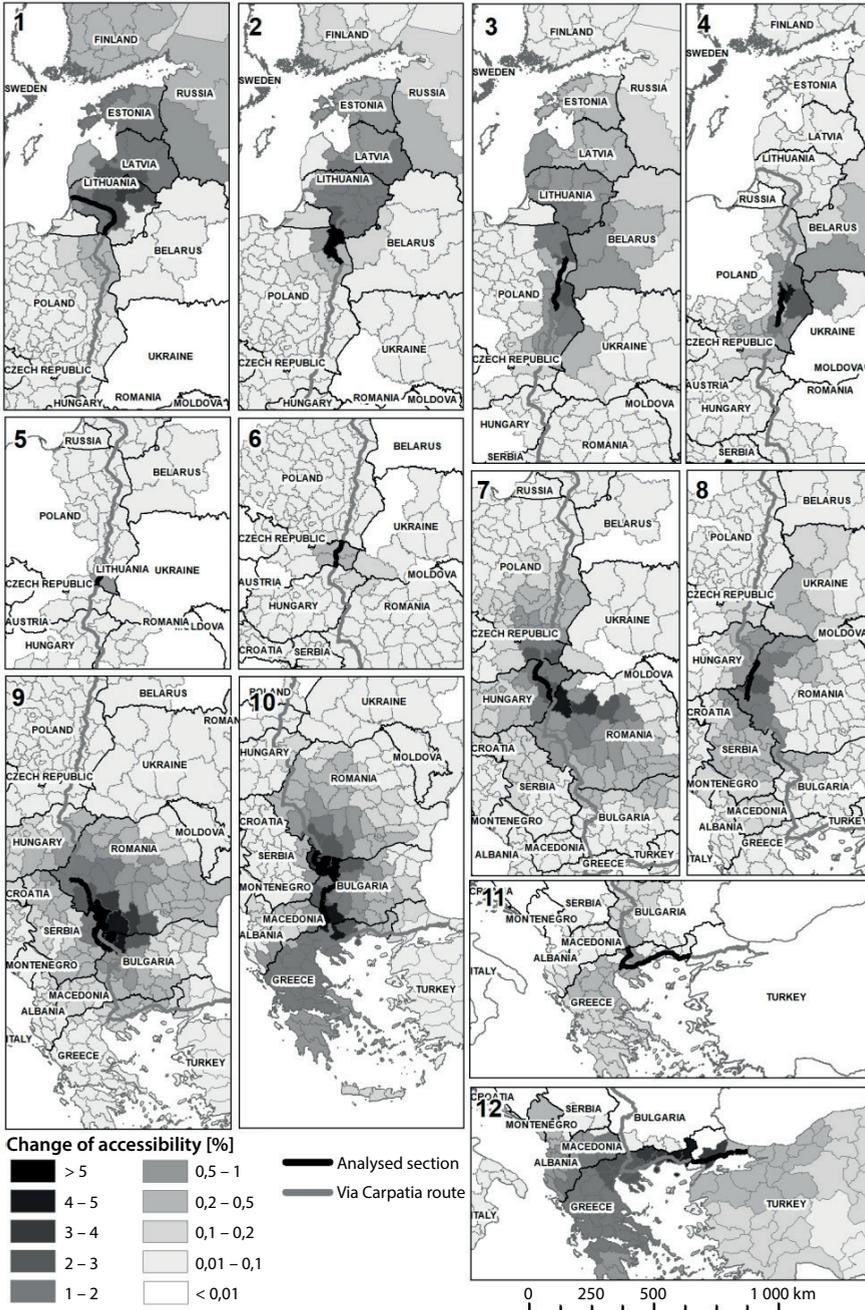
4.3 Changes in accessibility. Sections of Via Carpatia route

We have carried out an analysis on the detailed scale and regarding the spatial spillovers from the outcomes of constructing the particular sections of Via Carpatia route. The analysis of this type indirectly shows the role of particular sections and may be the basis for further phasing and prioritisation of the project stages. It also enables identification of the so-called “distant beneficiaries”, i.e. regions, which are not directly adjacent to a particular route, situated in another part of the affected area or completely outside of it, yet clearly improving their accessibility level (Fig. 5).

The construction of the Lithuanian section of Via Carpatia (see map 1 in Fig. 5) brings benefits mostly to Lithuania but, characteristically, to other Baltic states, as well (Latvia and Estonia), and even to Russia and Finland. Benefits in Poland are modest. Even the borderline region of Podlasie seems to be benefiting from this section as much as remote Helsinki. Similarly, the construction of the northern Polish part (between Lithuanian border and Bialystok) (map 2, Fig. 5) provides benefits for Lithuania, Latvia and Estonia in the first place. In Poland only the accessibility of the subregion of Suwalki, where the respective investment is directly located, gets much better. Bialystok gains little (improvement below 0.5 %). The section from Bialystok to Lublin (map 3, Fig. 5) proves moderately advantageous but, on the other hand, its impact range covers virtually all of Eastern Poland and Lithuania. Clearly, western Belarus benefits from this section, too. This means that the regions of that country benefit more from the links to the southern network than if they were linked to northern Europe. Out of the most peripherally-located centres of the section, Bialystok is the biggest beneficiary.

The section Lublin – Rzeszów (map 4, Fig. 5) brings the biggest benefits, but these, in turn, are spatially concentrated, predominantly in the region of Lublin and in Rzeszow itself. However, this section is also still beneficial to the Podlaskie Voivodship, to regions of western Belarus, Volyn in Ukraine and northern Slovakia. In Poland, the effect is spreading towards the west (up to Cracow), as the result of connection of the envisaged Via Carpatia with the east-west A4 motorway. The analysis of changes in accessibility for the Polish sections demonstrates that east-west links play an important role in the ultimate impact that Via Carpatia has on spatial accessibility. Noticeably, the following observation can be formulated: benefits to the direct neighbours of the route are often smaller than to the extremities of a particular section or even to areas beyond it. This amounts to advocating the supra-regional nature of the potential endeavour.

Surprisingly limited effects were found of the construction of the subsequent Via Carpatia sections, from Rzeszow to the Slovakian border (map 5, Fig. 5) and in Slovakia (map 6, Fig. 5). This is probably due to the presence of D1, running across Slovakia, and to the relatively low population density there. Moreover, Polish regions do not benefit from the construction of the Slovakian section, nor do Slovakian regions benefit from the implementation of the Polish section. Since the overall increase in accessibility upon implementation of the whole Via Carpatia was relatively high on this section, it can be conjectured that no summary effect of realisation of different parts of the corridor is to be expected. Thereby, this is the area which will be more than the other ones positively affected by the envisaged implementation of the whole route. Moreover, the effect observed on the Pol-



Source: Own design

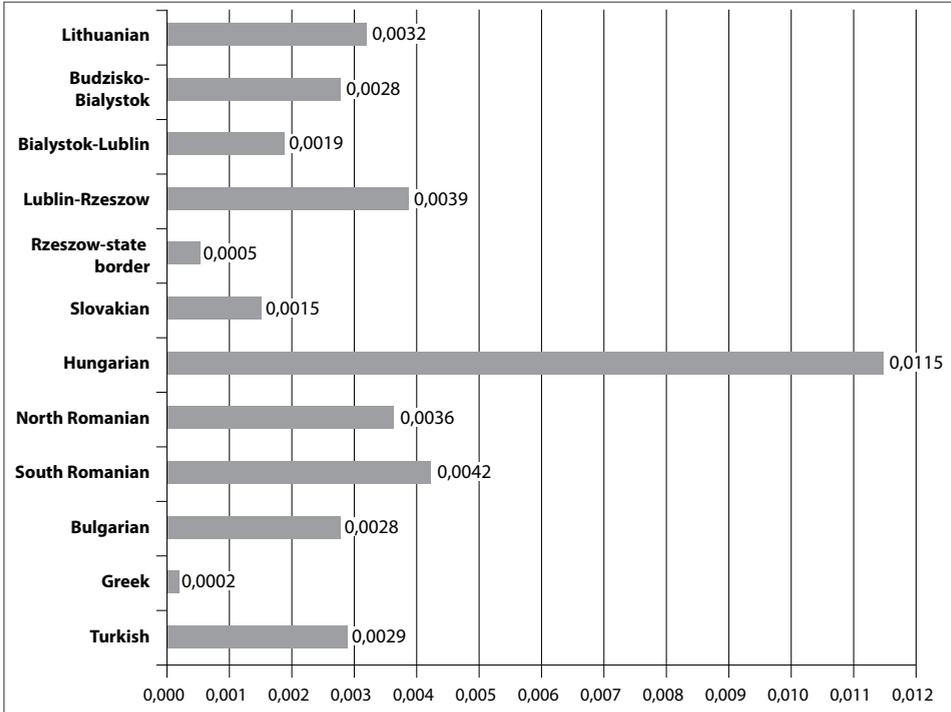
Figure 5: Improved accessibility due to implementation of different sections of Via Carpatia

ish-Slovakian border is most likely the effect of the reciprocal dependence of investments in the two neighbouring countries.

Construction of the Polish section without any investment on the Slovakian side will not bring any desired effects in Poland. By the same token, the construction of the Slovakian section only, with no investment in Poland, will not yield positive results in Slovakia. This is a very potent argument for close bilateral cooperation on cross-border sections of transport corridors, including the Via Carpatia corridor (DOŁZBASZ 2018). On the other hand, Hungarian investments, though, turn out to be very effective (map 7, Fig. 5). They improve accessibility, first and foremost, in Slovakia and Romania, and only then in the east of Hungary itself. The effects, experienced by the neighbouring countries, are probably due to the links that this section has with the east-west system of Hungarian motorways, which, in turn, directly provide access to Budapest, Vienna and Western Europe. The sectional analysis leaves no doubts that for eastern Slovakia the connection to the system of Hungarian motorways is far more important than the connection to Polish motorways.

The northern part of the Romanian section (map 8, Fig. 5) yields gains mostly to western Romania (distribution of traffic from east-west routes) and then to western Hungary, as well as, essentially, to Vojvodina and virtually the whole of Serbia. Minor benefits are also noted in northern Bulgaria and in Ukraine (probably via other routes, directly connecting the two countries). The section from Arad to the Bulgarian-Romanian border (map 9, Fig. 5) brings relatively very important increments in the indicator of potential accessibility. This arises partly out of the low base effect (poor accessibility of the region, where the Romanian, Serbian and Bulgarian borders intersect). Smaller benefits are experienced by almost entire territory of Romania and Bulgaria, as well as by western Hungary and Serbia. The implementation of the whole Bulgarian section (map 10, Fig. 5) also brings spectacular effects. Besides Bulgaria and Romania, there is also practically all of Greece, where one-percentage-digit growth in accessibility is observed. Macedonia is another beneficiary here; and, interestingly, south Albania as well. The Greek section (map 11, Fig. 5) changes the accessibility very little, but since it has practically been completed, only a small, few-kilometre-long section of the route is subject to any change. The Turkish section (map 12, Fig. 5) brings effects primarily in Greece and then in Albania, Macedonia and southern Bulgaria. As opposed to other parts of the Via Carpatia, these effects are due to the better connection with the agglomeration of Istanbul (rather than the European direction). In this case, a huge population of this metropolis appears to be the decisive factor.

Fig. 6 presents the absolute increase in accessibility levels, resulting from the completion of the Via Carpatia investment per 1 km of the route, with reference to the number of people. It can be treated as the approximation of the Europe-wide accessibility efficiency in terms of financial expenditures on each section (with the proviso that the differences in costs, caused by the engineering issues during construction are not taken into account). At the moment, the Hungarian section seems to be particularly useful from the international point of view (which can be identified, for example, with the purposeful allocation of the EU structural funds). The south Romanian section and the Lublin-Rzeszow section in Poland also appear as quite effective. The Greek additions and the Polish-Slovakian borderline sections are relatively the least effective.



Source: Own design

Figure 6: Total average improvement in accessibility in Europe (per 100,000 inhabitants) per 1 km route for selected Via Carpatia sections

5 Conclusions

Accessibility should be understood as the existence (creation) of an opportunity for social and economic development in the regional and local dimensions. It is a measure of the extent, to which the transport network fulfils the conditions necessary for development. From this point of view, the eastern peripheries of the European Union remain, in a large part, an area with development opportunities reduced by the lagging transport infrastructure, as this is expressed by lower spatial accessibility indicators. The analysis here presented confirmed that the construction of the new corridors (here: Via Carpatia route) can improve this situation. However, the possible positive investment effect is selective in the territorial sense. It is also dependent on other investments, including routes having east-west and oblique orientations. The here considered endeavour is not an alternative to them, but appears as complementary.

The above-mentioned selectivity of the obtained effects is clearly visible at the level of individual cities along the Via Carpatia route. The improvement of accessibility is of particular importance for medium-sized cities, located in the central part of the route (e.g.

Lublin, Rzeszów, Košice, Debrecen). They are characterised by relatively weak own potential and good initial accessibility (geographic proximity of the core of the European Union and the existence of new east-west road routes). The new route may be an additional development impulse for them, resulting not only from the connection along the north-south axis, but also from better communication with their own hinterland. Earlier research results, concerning the impact of transport infrastructure extensions on development, indicate that this impact concentrates rather in metropolitan centres and large cities, and remains problematic in the periphery and rural areas. On the other hand, in the already formed large metropolises (in the analysed case Istanbul and to some extent also Sofia), the effect of the new road investment, measured by the improvement of the potential accessibility, is moderate. This leads to the conclusion that the main beneficiaries of the route may be those medium-sized cities, which are potential growth poles in the eastern periphery of the EU.

The conducted study indirectly also showed the importance of cross-border cooperation in coordinating road investments. The efficiency of expenditures into individual sections is strongly dependent on simultaneous action in the neighbouring countries (e.g. on the Polish-Slovakian border).

It is important to conclude that the Via Carpatia route is potentially beneficial not only for the members of the European Union, but also for the so-called neighbourhood of the Union. It reaches Istanbul – the largest city of Turkey, and its branches spread out into Ukraine. The countries concerned are (apart from Turkey and Ukraine) Serbia and Bosnia and Herzegovina, as well as an EU member – Croatia. In the immediate vicinity of the route there are also Macedonia and Belarus. Moldova is located between the branches of the route in Romania and Ukraine. In the described system, Via Carpatia is an opportunity for the development of many regions located in the east of the European Union, not only as a single route, but also as the axis of the transport system, serving the entire eastern borderland of the EU. Via Carpatia will also have a significant contribution to integrating EU and neighbouring countries, especially Ukraine and Turkey.

The study demonstrated clearly the negative impact of a highly formalised border (the eastern border of the EU and the Schengen area) on the improvement of accessibility, caused by transport investments. This is particularly visible on the Polish-Ukrainian and Slovak-Ukrainian borders. The construction of the new routes (including Via Carpatia) thus creates a hidden development potential that could be activated with the liberalisation of border regimes. This confirms the earlier propositions, regarding the mutual impact of the infrastructural barrier and the formal and legal barrier as the basic elements limiting the permeability of borders (KOMORNICKI 1999). For some centres, located in the neighbourhood of the eastern border of the European Union, new network connections with other cities of the region may be the only chance to maintain their socio-economic position, in particular in the times of demographic crisis.

The transport infrastructure, including routes such as Via Carpatia, can be seen as a way to reach the boundary values of development that allow networking (cf. CAPELLO and CAMAGNI 2000). Changes in the spatial organisation of cities, associated with the departure from the hierarchical system towards the networking system, are considered as the effect of shrinking space-time distances (DOMAŃSKI 2018). City networking is also one of

the so-called territorial keys, allowing for practical territorialisation of Community policies, including cohesion policy (cf. BOHME et al. 2011; ZAUCHA et al. 2014). Therefore, new transport initiatives, such as Via Carpatia, should be assessed not only in the context of trans-European networks, but also (and perhaps most importantly) as a regional policy tool, taking into account the cross-border dimension. The accessibility study performed has shown indirectly that transport investments in peripheral areas can bring benefits to individual centres when they are well coordinated and form a part of broader development strategies (PONTAROLLO 2016).

6 References

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