

EXECUTIVE SUMMARY

STUDY OF THE IMPACT OF THE EGNATIA MOTORWAY ON SOUTH EAST EUROPE

INTERMODALITY OF THE TRANSPORT SYSTEM, POLYCENTRIC SPATIAL DEVELOPMENT AND CROSS-BORDER TERRITORIAL COOPERATION

1. Context and scope of the project

The project concerns the "Study of the impacts of the Egnatia Motorway in SE Europe: transport intermodality, polycentric spatial development and cross-border territorial cooperation". It aims to study the impacts of the system of the Egnatia Motorway and its vertical axes in South East Europe based on three parameters, i.e. transport intermodality, polycentric spatial organization and cross-border territorial cooperation, which are linked to its international role on two different levels: first in the context of the trans-European transport networks and the Pan-European corridors (TENs-T and TINA), and second in relation to the spatial development, territorial cohesion and sustainable mobility in the inter-regional and transnational space of South East Europe.

Exploring the relationship of the above parameters constitutes the core of the present study that adopts as its central working hypothesis that the promotion of intermodality of transport infrastructure enhances both polycentric spatial organization and the opportunities for cross-border territorial cooperation and thus strengthens further its importance.

In this context, the scope of this project includes a) the identification of the Zone of cross-border impacts through the analysis of spatial organization and regional development features as well as those of the transport system in the wider cross-border area, b) the development of the methodology for assessing the impacts constructing a theoretical model and a system of indicators for monitoring the three parameters (polycentricity, intermodality crossborder cooperation), which are associated with the steps of the model and quantify its interrelations within the model and c) the pilot application of the methodology and the calculation of selected indicators. The implementation of the study consists of five Work Packages (WP).

In WPs 1 and 2 the exact demarcation of the Zone of cross-border impacts is produced through the understanding of the development data and the dependences/flows that are created by the operation and further development of the transport system in the country's crossborder area.

WP3 concerns the consideration of the international and European experience in developing spatial impact indicators systems, as well as the selection and development of a system of indicators, finalizing, at the same time, the model for impact assessment.

WP4 refers to the pilot application of the framework of indicators (calculation) and the completion of the results' fact sheets, the application of the model of assessment and evaluation of the results and the composition of the impacts report.

WP5 involves the completion of the deliverables of WP3 and WP4, following the corrections and additions resulting from the synthesis of the calculation – application of indicators and the methodology for impact assessment.

2. Current state of the cross-border zone of impact of Egnatia Motorway in SEE

The cross-border area that is initially recognised as cross-border zone of impact includes the following areas (from east to west): Turkey - the European side (regions Istanbul, Tekirdag - Edirne - Kirklareli, Balikesir - Canakkale), Bulgaria - the whole country, FYROM - the whole country, Serbia - regions Beograd, Juzne i Istocne Srbije and Kosovo, Albania - the whole country and Italy - South Adriatic regions (Basilicata, Calabria, Campania and Puglia). The administrative division of these regions includes categorization by NUTS II and NUTS III.

The identification of the current state of the initially estimated cross-border zone of impact helps to finalize Zone V of the Egnatia Motorway and the vertical axes system. This identification is summarised below.

2.1. Development conditions, transport system and territorial cooperation dynamic

Population trends and flows

The initially estimated cross-border zone shows a trend of stabilizing the population, a fact mainly attributed to the Turkish regions, which appear to increase their population, while in almost all other regions the population is decreasing (with the exception of the large urban centres and especially the capitals, which are experiencing population boost).

- In relation to the *concentration of population*, it can be noted that in most cases the population is concentrated in the major urban centres (Istanbul, Beograd, Naples - Bari), which are characterised by the highest population densities. On the other hand, Sofia, Skopje, Tirana and Kosovo constitute a zone of medium population densities in the immediate proximity of the Greek territory and the road network of the Egnatia Motorway in particular.
- With regard to the *demographic dynamism*, the initially estimated cross-border zone shows quite dynamic demographics, since the natural population growth rate is clearly positive due to the Turkish regions, although reduced compared to a decade ago.
- Concerning the *shape of the population pyramid in particular*, the observed trend is probably stabilising with some decline of the young age group population. With regard to the issue of *migration flows* (intra-zone), the initially estimated cross-border zone of impact shows an unbalanced picture as far as the attractiveness of such flows is concerned. On the one hand, Greece (Impact Zone IV) and Italy (study area) attract major migratory populations, while on the other hand the rest of the countries and regions exhibit small attractiveness.

Labour market and employment structure

- The *percentage of the economically active population* slightly dropped between 2008 and 2011, showing significant deviations among the regions.
- The *unemployment rate* (unemployment of the active population, 15-64) increased between 2008 and 2011. It was increased in all regions, with the exception of FYROM, Kosovo and the Turkish regions where a decrease was observed.
- Regarding the *composition of employment*, the service sector represented 59% of the persons employed, while the percentage of persons involved in manufacturing

and construction was around 29% and of those involved in the primary sector was 13%.

- The *daily and short-time commuting of workers* between mainly neighboring countries with a view to work readjust to some extent the picture of the labor market in the cross-border zone, incorporating elements and characteristics that transcend national boundaries. There is considerable mobility between Greece and neighboring countries.

Economy and productive system

- In 2011 the *market size* (GDP at current prices) reached 480 billion euros, increased by 6.3% compared with that of 2009. With the inclusion of Greece, the market size in the zone increases by approximately 208 billion euros.
- In all cases, the areas of capital cities and major urban centers contribute with significant percentages to the formation of GDP (2011) in their respective countries and study areas, giving prominence to the strong elements of spatial polarisation of the national economic – productive systems.
- During 2007-2011, with the exception of the Italian regions, there has been an increase in the *per capita nominal purchasing power* in all regions of the cross-border zone.
- Regarding the composition of the *gross value added per sector*, one can observe the dominance of the tertiary sector which shows small strengthening trends, as well as the relatively high rates of the secondary sector. In general, the regions of the capital cities and the large urban centres appear to have a more 'tertiarized' structure than the others.
- In all countries of the cross-border zone, the *gross fixed capital formation as a percentage of GDP* shows a diverse picture with rates ranging between 17% and 39% over time (2007 - 2011).
- The diagnosis of *investment flows* shows that Greece and Italy are the major investors in the zone with high activity in all countries.
- In almost all countries, significant deceleration of the annual FDI inflows was recorded between 2007 and 2012. Albania and FYROM are the most dependent by the intra-zone investment funds countries, while Italy and Greece are the less dependent.
- The commercial transactions both within the zone and with the rest of the world are considerably increasing. Italy and Greece are the major trade partners of almost all countries of the zone, followed by Bulgaria and Turkey.
- With the exception of Greece, in all countries of the cross-border zone there has been an increase of tourist arrivals (2007-2012), which in some cases was impressive. Major tourist markets relating to flows within the zone (countries of origin) appear to be Italy and Greece, with Turkey recording significant dynamic.

Network of urban centres

- The urban centers in the cross-border zone are in a state of population decline or stabilisation - reflecting the observed national trends. In relation to the population data of 2011, it appears that the largest metropolitan area is that of Istanbul with a population close to 13.5 million people, followed by Naples with a population close to 4.0 million people and Athens with a population close to 3.0 million.
- The metropolitan areas of Belgrade, Sofia and Bari can be grouped together in a secondary class with populations between 1.0 and 2.0 million people, while Tirana and Skopje, along with Thessaloniki, are metropolitan concentrations of less than 1.0 million inhabitants and could be considered to constitute a third group of classification.

Territorial cooperation

- The study records, analyses and presents the projects of European territorial cooperation between Greece and other regions of the initially estimated impact zone in SEE, in the context of the relevant European programs.
- This approach is considered to be an "indication" of territorial cooperation (at the level of programs) and gives input in finalising the impact zone, complementing the findings of the socio-economic/regional development approach and the transport system approach.
- Greece participates in 378 multilateral cooperation programs, followed by Bulgaria (188) and the regions of the study area of Italy (121). These are the two areas of the initially estimated impact zone with the highest rates of involvement with regard to the cooperation projects that Greece participates in.
- The highest percentage of cooperation projects compared to the projects that the other country/region participates in, correspond to FYROM (88%), the regions of Italy (68%) and Bulgaria (63%), while the smallest dependence/intensity corresponds to the Turkish regions.

Transport system

- The description and analysis of the transport system in the cross-border zone selected for the preliminary examination in the initial stage of the study refers to the wider region of South-East Europe (SEE). In this way, the study covers the whole area potentially influenced by the Egnatia Motorway and its vertical axes as well as the complementary and competitive axes of European and trans-regional range located in SEE.
- The completion of the Egnatia Motorway and the development of infrastructure along its vertical axes have a significant impact on the availability of motorway networks in Greece by improving the mobility conditions in the mainland and by restoring the gap of accessibility or low level of service provided by the railway network.
- At the cross-border level, the examined motorway network links Greece with the adjacent countries, but also these countries with each other through a common corridor which interconnects the main urban centres, the major freight seaports and the international passenger airports of the south and central Balkans and Italy.
- An increasing trend of cross-border passing through the road network is observed during the last 10 years in Greece, expressed both in the number of vehicles and the number of travelling persons. A high percentage of arrivals is originated from the neighbouring countries (Bulgaria, FYROM, Albania and secondarily Turkey). The aforementioned countries are also the main destination of trips originated from Greece.
- The aforementioned countries currently have a limited density of motorways while missing links are presented in the region's railway network leading to a relatively low share for railways in the modal distribution. Similar drawbacks are observed for the networks of Serbia, Montenegro and Bosnia and Herzegovina.
- On the contrary, at the north of the study area, the railway and inland waterway system either maintains or increases its share in freight transportation through time while at the northwest (central Europe) a high availability of motorways and other roads is observed.
- In the future, the *priorities* for the development of the transport system in the study area concern the *enhancement of multimodality* in order to develop the appropriate corridors of European and international significance as well as the *completion of the transport network in the western Balkans*.

- The development strategy of the TEN-T is focused on the connection of the western and northern Europe with the Eastern Europe, the Black Sea and the Eastern Mediterranean, using central Europe as an intermediate hub.
- At the meantime, the completion of the SEETO multimodal network in combination with the Pan-European corridors is expected to strengthen the interconnection of the system of Egnatia motorway and vertical axes with central and Western Europe as well as with the main nodes that attract or produce passenger and freight flows in the Balkans.
- The transport system of the SEE cannot be considered as an integrated multimodal network. On the contrary, it is a transport system which is currently under development, where balance has not yet been restored concerning its internal cohesion and functionality and its international accessibility.
- In the context of this evolving system, the Egnatia motorway comprises one of the main completed infrastructures. According to the potential of the region's transport system, the above analysis suggests the gradual prevalence of the *following main axes of international significance in the region*: a) East-west axis for the connection of central and western Europe to eastern Europe and the Black Sea, b) North-south axis for the connection of central and northern Europe to the Eastern Mediterranean.

3. The location and role of the system of Egnatia motorway in the cross-border zone of impact

The way that the system of Egnatia motorway and vertical axes is integrated operates in relation to the strategic location and organisation of the wider cross-border region's transport network, which is part of the SEE region's transport network, was examined. In this framework the following components were analysed: the description of the current system of Egnatia motorway and vertical axes, the projects which are under development in the system as well as the rest of infrastructure projects which were undertaken by Egnatia Motorway S.A. in the cross-border zone, the analysis of the strategic frameworks for the spatial development and the development of the transport system in the countries and regions of the study area, the evaluation of the progress in the completion and planning process of the main international road corridors and, finally, the synthetic analysis of the above in order to allocate the strategic position and role of the system in the study area.

Conclusively, the system of Egnatia motorway and vertical axes functions or has the potential to function as a complementary or competitive corridor to the Pan-European Corridors IV – eastern branch, VII and VIII while it accepts traffic from or channels traffic to the vertical Pane-European Corridors IV (apart from the eastern branch), IX and X as well as the Trans-European Corridor Scandinavian-Mediterranean. Through the interoperability of the aforementioned nodes as well as the main terminals and hubs, an expanded impact of the system can be observed according to the following:

- Connection at the East with the Black Sea region, Eastern Europe and Asia through maritime, road and railway corridors.
- Connection at the centre with the Eastern Mediterranean region, Middle East and North Africa, through the southern seaport network, from eastern to western Europe, through the inland waterways of the Danube region, and to northern Europe through motorway and railway corridors.
- Connection at the West with the wider region of southern and western Mediterranean and with central and western Europe, through the road and railway corridors and through the seaport network.

According to the above, the definition of the zone of potential impact of the system Egnatia motorway and vertical axes takes into account the aforementioned nodes and terminals as well as their interaction with the corresponding transport network. It is highlighted however that the multimodal transport system of the wider area is currently under development and significant segments and nodes of the network have not yet been completed.

3.1. Methodology of impact assessment: main dimensions

The composition of the methodology was based on the consideration of the national and international - European experience in developing systems of indicators for monitoring spatial impacts so as to select and develop the system of indicators and, in parallel, to finalise the model for impact assessment.

As to the *first dimension*, the study set the conceptual and methodological references, which consisted the central axes for clarifying the concepts of polycentricity, intermodality and territorial cooperation. On this basis, it attempted to link the main specifications and applications at the international and especially at the European level in relation to systems of indicators for monitoring spatial impacts of transport infrastructure, with emphasis to the case of road infrastructure. This investigation was deemed necessary in order to test the adequacy of the indicators and the compatibility of the results of the system of indicators in the cross-border zone to the national and international practices.

In relation to the conceptual - methodological framework, it was revealed that:

- Polycentricity can be quantified on the basis of three main components or parameters referred to the settlements: *the sizes of the settlements, the dispersion of settlements and the relations between the settlements.*
- Transport intermodality is approached through the evaluation of the *operational performance*, as this arises from the assessment of transport infrastructure and services as well as of their operation.
- Territorial cooperation can be reached through the diagnosis of *people's, materials' and resources' flows within the cross-border zone*, as well as through the recording of European funded programs.

The *second dimension* deals with the development of the system of indicators that can be monitored by the Observatory for the impact zone of the cross-border area. The indicators system maintains the relevance to the existing platform of the Observatory as well as to the indicators that emerged from the review of international experience. At the same time, the system of indicators itself constitutes the framework for the estimation of the cross-border impacts, while each one of the three components (polycentricity, intermodality and cross-border cooperation) constitutes a discrete Category of indicators.

Each Category of indicators includes the composite indicator, a group of core indicators and a group of supplementary indicators. The composite indicator uses the results of the core indicators as inputs to produce a total value corresponding to the degree of polycentricity / intermodality / cooperation of the macro-region under study. The core indicators are critical inputs for the quantification of the composite indicator, while the supplementary indicators are used for the qualitative understanding of certain conditions and for their interpretation.

The *third dimension* deals with the synthetic model for the assessment of the impacts of the road system of Egnatia and is based on the use of the framework of selected indicators in relation to the three key parameters discussed in this study: polycentric spatial organization, transport intermodality and cross-border territorial cooperation. Methodologically, the overall assessment of impacts can be approximated by two

directions: the quantitative method and the qualitative - interpretative method. In the first case, the indicators involved in the development of the quantitative data include the composite indicator and the framework of core indicators. In the second case, the whole framework of indicators is involved.

The two directions for the impact assessment work either independently, as they integrate with specific separate rationality and produce usable conclusions as interpretative tools, or in a complementary manner, as they can, in combination, assist the understanding of individual aspects of the broader issue of territorial cohesion in this specific macro-region.

The quantitative method deals with the typological representation of the territorial cohesion degree of the macro-region, based on the assumption that the road network of the Egnatia Motorway acts as a catalyst for reconfiguring the conditions affecting it: impacts regarding the polycentricity of space, the intermodal operation of transport and the enlargement of cross-border cooperation. It takes advantage of the composite indicators that were estimated for each of the above components: Indicators POL00, INT00 and CBC00.

The interpretative method deals with the estimation - assessment and evaluation of the analytical steps of a theoretical model, where the sequence of steps is linked to the three basic parameters discussed in this study, via their matching with the system of the proposed indicators.

4. Application of the system of indicators

During the application of the system of indicators, the need for more detailed zoning of the study area emerged, in order to proceed to further specification of territorial units. These refer to: (a) Impact Zone V, which deals with the whole study area as this was finalised on WP1 and also with the whole Greek territory, (b) the zone of border areas that deals with the areas on both sides of the borders of all countries in the Impact Zone V and (c) the zone of Corridors (trans-European transport networks) which deals with the areas which they pass through.

Another element of the methodological approach which should be noted in particular is associated with the time reference when calculating the indicators. The wide range of the requested data in many indicators, the heterogeneous nature of the sources and the well-known problems on the completeness of the time series from the sources, lead to the adoption of a wider time horizon. This means that the time frames that are actually approached deal with data from the early 2000 (2001 - 2004) and early 2010 (2010 - 2013), where the intended comparisons are based on. Intermediate values are evaluated and used depending on the feasibility and availability.

4.1. Review of the application of the system of indicators

At first, the sum of the *core* and supplementary indicators in the Categories of polycentricity (POL), transport intermodality (INT) and territorial cooperation (CBC) were estimated.

Category of polycentricity indicators (POL)

The category of polycentricity indicators consists of a composite indicator, 7 core indicators and 8 supplementary indicators. The composite indicator uses the results of the core indicators as inputs to produce a total value which constitutes the polycentricity degree of Impact Zone V.

Composite indicator

POL00. Polycentricity degree

Core indicators

POL01. Population of urban centres

POL02. Market size (GDP)

POL03. Gross Domestic Product per capita

POL04. Population

POL05. Benefited population

POL06. Potential attraction of cities

POL07. Time-distance of cities

Supplementary indicators

POL08. Enterprise allocation

POL09. Movements (origin - destination)

POL10. Urban sprawl

POL11. Non active population participation

POL12. Level of unemployment

POL13. Long-term unemployment

POL14. Gross Value Added per sector of production

POL15. Employed persons per sector of production

Category of transport intermodality indicators (INT)

The category of transport intermodality indicators consists of a composite indicator, 3 core indicators and 4 supplementary indicators. The composite indicator uses the results of the core indicators as inputs to yield a total value which constitutes the intermodality degree of Impact Zone V, which is defined by the potential accessibility of cities to the transport terminals.

Composite indicator

INT00. Potential accessibility between cities and transport terminals

Core indicators

INT01. Time-distance between cities and transport terminals

INT02. Passenger volume at passenger transport terminals

INT03. Freight volume at freight transport and intermodal terminals

Supplementary indicators

INT04. Density of land transport network per surface

INT05. Number of transport terminals

INT06. Density of motorways & volume handled at terminals

INT07. Decoupling of freight transport from economic growth

Category of cross-border cooperation indicators (CBC)

The category of territorial cooperation indicators consists of a composite indicator, 4 core indicators and a supplementary indicator. The composite indicator uses the results of the core indicators as inputs to produce a total value which constitutes the degree of territorial cooperation in the study area. It should be noted that the composite and the core indicators of territorial cooperation refer to the total territory of the countries of Impact Zone V, while the supplementary indicator refers to the countries/regions that constitute Impact Zone V.

Composite indicator

CBC00. Territorial cooperation degree

Core indicators

CBC01. Investment flows

CBC02. Trade flows

CBC03. Tourism flows

CBC04. Migration flows

Supplementary indicators

CBC05. Intensity of territorial cooperation

The estimation of each indicator takes into account the Datasheet, data input, the results of the elaboration along with the methodology per indicator and visual material (tables, diagrams, maps), depending on the requirements for documentation and presentation.

4.2. Implementation of the methodology (model) in the assessment of impacts

The methodological approach for overall impact assessment includes an analysis and evaluation process through the implementation of a theoretical model , which is completed with a quantitative assessment process.

The approach allows on the one hand the estimation of an overall – final value of the change in territorial cohesion, as a result from the synthesis of the three examined pillars, and on the other hand the investigation of the specific contribution of each composite indicator. Moreover, it is possible to correlate the core indicators, used to calculate the composite indicators, with the steps of the theoretical model and produce hypotheses explaining the way that they contribute to the observed quantitative and qualitative changes.

During the quantification process of the methodology, the core indicators are taken into consideration, while, during the qualitative evaluation process, all the indicators are taken into account, i.e. core and supplementary.

Theoretical model of impact assessment

This refers to a model of 7 steps which correspond to the parameters of the relation between transport infrastructure and spatial development. The model constitutes a modification of the model which was initially developed by Bruinsma et al. (1997) and refers to the relation between transport infrastructure and the location of economic activity, with the main difference that transport accessibility in the suggested model is not expressed as a separate feature but it is embedded in the concept of the generalised transport cost.

The sequence of steps of the theoretical model is related, through its correspondence to the system of proposed indicators, with the three main pillars which are examined in the study.

Step 1: The available transport infrastructure, which according to its ongoing development, affects the operation of the various transport modes leading thus to the development of the area's multimodal transport network that contributes to the spatial organisation of activities through the change of the accessibility conditions.

Step 2: The change in accessibility of space, which is due to the change in the provision of transport infrastructure, affects the features that: a) determine the time-distance between the network of urban centres and the network of terminals but also the potential accessibility between them (intermodality), b) influence the degree of polycentricity, i.e.

features such as benefited population, potential attraction of cities and time-distance of cities, and c) affect the opportunities and capabilities for the development of cooperation and networking, such as the cooperation in the framework of European Territorial Cooperation Programmes.

Step 3: The increase in mobility. The enhanced accessibility affects directly the **travel demand and mobility**, whose increase constitutes either a precondition for the prioritization of intermodality enhancement or a result from the operation of an efficient intermodal network, as it is outlined by the increase of people travelling through the network of passenger terminals. Furthermore, the improvement of mobility is a precondition for the enhancement of the polycentricity of space, which can be expressed either by the increase of the trip volumes or the diversification of origin-destination pairs. Finally, the increase in mobility affects the intensity of cooperation activities, such as the volume of **tourist flows**.

Step 4: The increase in mobility of people and goods, essentially the productivity factors, formulates the conditions for the **increase in productivity** of each of the productive systems in the zone of impact, a fact that can be described by the development indicators: market size, GDP per capita, non active population participation, unemployment level, long-term unemployment, Gross Value Added per sector of production and employed persons per sector of production, while the increase in productivity for the transport system is expressed by the increase in freight volumes, due to the economic growth and the growth of the population's purchasing power, and for the cross-border cooperation by the change in the indicators of the investment and trade flows.

Step 5: Change of the distribution of the population and activities. The increase in productivity leads in a medium and long term time horizon in the change of the spatial **concentration of people and activity**, which leads to **new travel demand**. The enhancement of intermodality aims at the improvement of the efficiency of the transport chain through the combined use of modes in order to increase the effectiveness of each trip and to constrain the rate that the total volume of trips increases, so as to reduce the impacts on the environment and the quality of life. At the specific level, the indicators for evaluation refer to the efficiency of the intermodal network's spatial organization, which can be qualitatively described by the simultaneous mapping of the motorway density and the volume handled by the transport terminals, as well as by the decoupling of freight transport from the economic growth. Moreover, the redistribution of the concentration of population, activity and transport flows express the conditions for the change in the polycentricity of space, which is evaluated by the indicators: population of urban centres, market size, population of administrative units and urban sprawl. Finally, the change in the distribution of population is related with the increase of immigrant flows.

Step 6: change in the travel demand, which generates the **demand for new transport infrastructure**.

Step 7 (Step 1): return to Step 1 for the construction of new transport infrastructure.

The implementation of the model can lead to the connection of the three pillars that formulate the level of territorial cohesion in the zone of impact V (the macroregion examined by the study), i.e. polycentric spatial organization, intermodality of the transport system and territorial cooperation, with the road network which is formed by the completion and operation of the Egnatia motorway.

The model, as it is presented and applied in the study, stands between theory and reality by using indicators that monitor and analyse the empirical observations into values and relations between its main parameters. In the specific study the model embeds a set of parameters that are linked, among others, with the composition and distribution of population, the structure of production and employment and the spatial organization of activities and land uses. The usefulness and efficiency of the model depend on the appropriateness of the selected indicators and the validity of the available empirical data.

Depending on the case study and the specific requirements, this synthetic model can be used as a tool for the description, analysis, estimation and/or forecasting of the real-life conditions. Nonetheless, the description, interpretation, prediction and forecasting are based on the theoretical concepts and hypotheses of the model and, thus, should not be considered as a complete and independent image of reality.

Overall composite indicator of the level of territorial cohesion in the Zone of Impact V

It refers to the quantification of the typology that describes the level of territorial cohesion in the study's macroregion with the assumption that the system of the Egnatia motorway has a decisive impact on the formulation of its main parameters, i.e. impact on the polycentricity of space, the intermodality of transportation and the expansion of cross-border cooperation.

The input for the attempt to quantify this typology derives from the values of the composite indicators, which were calculated during the analysis of each pillar, i.e. the indicators POL00, INT00 and CBC00. These values, which have no measurement units, are calibrated and put into a "spider" diagram in order to calculate the surface that they cover.

A change of the diagram's covered surface through time would suggest a trend for the corresponding change in cohesion within the examined macroregion, which, according to the theoretical model and the indicators' calculation process, can be attributed to the influence of the system of the Egnatia motorway and vertical axes and the macroregion's transport system in general. Nonetheless, it should be highlighted that the overall change does not derive exclusively from the parameters, which are examined in the specific study but also from other variables of the development potential.

A null surface ($E=0$) means the maximum separation (segregation) of the study area with null values for polycentricity, intermodality and cooperation. On the contrary, if all indicators are equal to 100 (and the surface is considered $E=100$), then the highest possible territorial cohesion is observed in the area with the maximum values for polycentricity, intermodality and cooperation.

The percentile ratio of the surface of the triangle formed by the median values of the composite indicators of the three main pillars to the maximum value of the surface comprises the level of territorial cohesion in the zone of impact.

The value of the overall composite indicator of the territorial cohesion in the zone of impact can be calculated at regular time intervals and it can be compared to the corresponding values for previous time periods or it can be estimated for various alternative scenarios in order to produce forecasts and to set the appropriate policies towards specific targets.

5. Impact of the Egnatia motorway on the territorial cohesion of SE Europe

A main finding of the study is that the system of the Egnatia motorway and vertical axes improved the accessibility of northern Greece to the markets, the urban agglomerations

and the cross-border movements of the wider Balkan mainland, creating the conditions for a new pattern of mobility and a new role for the area's transport system. This improvement is more evident along the spatial units within which the afore-mentioned system extends, but it is also significant for the areas that are indirectly benefited by its operation.

It should be highlighted however that the subsystem of the motorway and its vertical axes is integrated to a wider system of similar road infrastructures and services which operate either in a competitive or a complementary way or even independently from the examined subsystem or other transport infrastructures.

Thus, the role of the motorway and its vertical axes upon the level of cohesion in SE Europe is significantly depending on the synergy and complementarity of the existing transport subsystems regarding the service of flows and the interconnection of urban centres and production activities.

The application of indicators in relation to the steps of the model leads to a set of conclusions that are summarized as follows:

Step 1. Analysis of the available transport infrastructure

The analysis of the available transport infrastructure is assessed through the indicators "density per surface of the land transport network" and "number of transport terminals". According to the indicators' results it can be concluded that the contribution of the examined motorway on the supply of transport infrastructure (motorways) of the region is significant and, moreover, that the role of the system Egnatia motorway and vertical axes to the provision of access towards the intermodal gateways is important for the whole region of SE Europe and, mainly, for the Balkan mainland (Albania, FYROM, Bulgaria), which has no direct access to the main maritime corridors.

Step 2. Change in accessibility

According to the indicators' results the following remarks can be outlined:

- The system of Egnatia plays a major role in the improvement of accessibility and the increase of the benefited population – especially for trips with a total time-cost up to 3 hours (such as trips from Bulgaria and also FYROM and Albania to Thessaloniki).
- Regarding the potential attraction of urban centres the system of Egnatia as an infrastructure expands throughout the SE European space with the result of increasing the potential attraction of cities which in the past had no access to the main intermodal terminals of the Balkan region.
- Decrease of time-distances between cities of the Balkan region and a large number of transport terminals. Thus, a relatively lower value of time-distance is observed for the regions of Bulgaria and FYROM concerning their access to main terminals – a significant portion of which is located in Greece.
- The outcome from the indicator of the intensity of territorial cooperation based on EU co-funded programmes lead to the conclusion that there is a strong relation between Greece and Bulgaria and Greece and FYROM, a fact that can be explained partially by the recently improved conditions of mobility between the aforementioned regions (and consequently the strengthening of their relations) – as a result from the operation of the system of Egnatia.

Step 3. Increase in mobility

According to the results of the indicators it can be concluded that:

- The most significant origin-destination pairs refer to northern Greece and mainly the region of central Macedonia with the regions of FYROM, Bulgaria and Albania while an overall positive impact of the corridor to the mobility of people.

- Moreover the improvement of mobility enhances the territorial cooperation among the countries of SE Europe, which results at the increase of the volume of tourist flows.

Step 4. Increase in productivity

According to the results of the indicators:

- Regarding the GDP (market size and per capita), an increase is observed for all the countries of SE Europe apart from Greece and Italy, which seem to have been affected negatively by the economic crisis.
- The impact of Egnatia on the levels of income and employment and the organization of productivity within the region can only be assessed in an indirect way, as it can be related to the improvement of the mobility of productive factors and the access to wider flows of people, means and materials, a fact that leads to the re-orientation of local economies according to the presented opportunities.
- The improvement of the income level, on the one hand, and the problems related to the organization of the economy and productivity, on the other, suggest that more time is needed for the role of such an infrastructure in the development potential of SE Europe to be fully achieved.
- Similar conclusions may derive from the indicator of freight volume as well.
- Regarding the investment and trade flows within the region, the system of Egnatia realizes the main corridor for their service and development (Albania, FYROM and Bulgaria are located in a position of direct access to the motorway and the vertical axes).

Step 5. Change in the distribution of population and activities and creation of new travel demand

According to the indicators' results:

- The significance of the national capitals and main urban centres is highlighted concerning the maintenance and increase of population but also the spatial aspect of development, as it is perceived by the change in the land cover from natural – seminatural to urban – built land. Thus, the Egnatia motorway and its vertical axes play a major role in the interconnection of urban centres, such as Thessaloniki and Athens with Sofia, Skopje, Tirana, Istanbul and Belgrade.
- The enhancement of the capitals and the major urban centres' development potential affects the location choices of the region's immigrant population. The most significant trends in the zone of Egnatia's direct impact refer to the migration of Bulgarians and Albanians to Greece and mainly to Athens and Thessaloniki.
- Finally, a worthmentioning remark concerns the allocation of enterprises along the Greek borders and outside the country (in Bulgaria, FYROM and Albania). The role of Egnatia to the location choice is important because it allows for the direct distribution of the products to the local markets and the markets of the wider region.

In conclusion, the implementation of the proposed model, through a system of indicators that quantify the contribution of the transport system towards intermodality, polycentric spatial development and cross-border cooperation, outlines the impact of the Egnatia motorway and the vertical axes – without separating this impact from the overall transport system of SE Europe.