



Ex-post study of support to the transport sector in IE OP 2007-2013

SYNTHESIS

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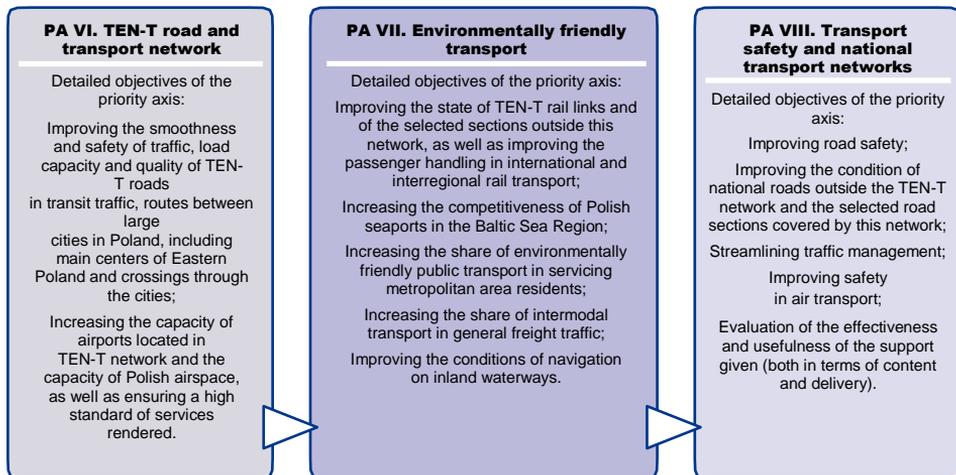
The photos on the cover are from the archives of the Center for EU
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1. Foreword

Transport sector under the Infrastructure and Environment Operational Program (IE OP) has benefited from the largest pool of financial resources available under the Program (Priority Axes VI-VIII). The aim was to improve the investment attractiveness of Poland and its regions through the development of technical infrastructure while protecting and improving the environment, health, preserving cultural identity and developing territorial cohesion.

The growing role of infrastructure investments - both in the context of building Poland's international competitiveness and the amount of EU support directed to this industry in 2007 - 2013 - necessitates an assessment of effectiveness thereof and therefore of the long-term impact of projects, which should be based on actual experiences from previously implemented investments. As part of the study, the effectiveness and complementarity of transport projects were summarized and their usefulness was examined through the prism of transport specific objectives recorded in the program documents and 2007-2013 strategic perspectives (mainly IE OP and NSRF) The effects of the expansion of the transport network can be seen both in terms of demand (usually short-term, occurring during the investment process), as well as in terms of supply (usually long-term).

The evaluation study entitled *Ex-post study of support to the transport sector in IE OP 2007-2013* was carried out by CUPT evaluation experts in the period of September 2016 - March 2017. The territorial scope of the study covered the whole territory of Poland, and the data were presented at both NUTS1 and NUTS2 level. The time range of analysis was limited to the years 2007–2015+. The objectives of IE OP in the transport area were implemented through VI, VII and VIII Priority Axis (see below)



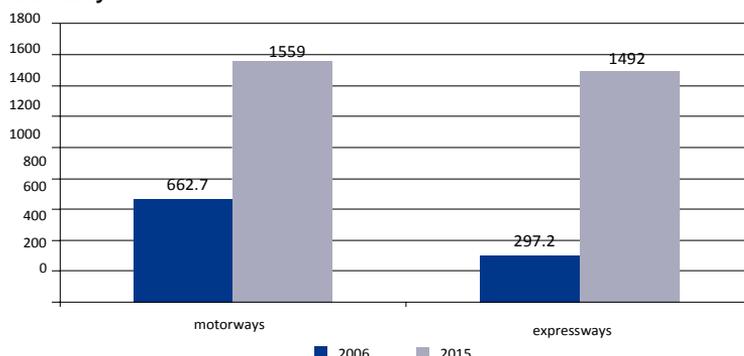
Under IE OP, in the years 2007–2013 approximately EUR 27 billion were allocated to the roads and railways, passenger railways for interregional services, airports, seaports and inland waterways, urban transport and intermodal transport. As much as 58% of the funds were spent on the development of road transport.

Basing on the evaluation carried out, it is possible to conclude that in Poland in the years 2004-2013 (2015), the opportunity (associated with EU membership and availability of EU funds) was properly utilized, as implemented with the use of EU funds were those investments which would be difficult to implement on such a scale without EU support. Evaluation of the effects of the development of transport infrastructure in the context of the effectiveness of the implementation of the strategic objective and sub-objectives of NSRF 2007-2013 is positive and supported by a number of analyses indicated in the Report. The completed transport projects have resulted in the development and improvement of the quality of transport infrastructure. This provides the basis for increasing the capacity to use territorial potentials. **It is necessary, however, to further continue to promote the development of transport infrastructure, as the progress achieved in this area is still insufficient, since it pertained mainly to metropolitan areas, voivodship centers, and in a spatial layout to a greater extent to Western Poland than Eastern Poland.** An important challenge remaining is also the imbalance between road and rail transport and the unsatisfactory importance of public transport associated, among others, with consumer preferences for individual car transport. In addition, it is necessary to underline that, despite the **improvement noted, the safety of roads and railways users remains unsatisfactory.** Ensuring the allocation of investment resources and funds for the maintenance of already existing transport infrastructure will require, among others, improvement in the quality of investment process management in the field of road and rail infrastructure, as well as strengthening of public transport management mechanisms in cities. Priority should be given to the integration of different transport modes, the development of passenger and freight intermodal transport.



While pointing to the still existing needs, it should be emphasized at the same time that Poland was, at the beginning of its accession to the EU, the country that was the least accessible in communication. In the years 2007–2013 a number of investments that visibly and significantly improved this condition were carried out. This would not have been possible without EU funds (especially within the IE OP).

Graph 1. Comparison of the length of expressways and motorways in 2006 and 2015 (in km). Source: own study



Currently, Poland is the third EU country with the highest increase in the number of motor vehicles compared to 2006 (after Romania and Bulgaria) and within the group of four EU countries (with Germany, France and Great Britain) with the highest weight of goods transported by car. Over the period of 8 years, Poland experienced a 3-fold increase in the density of expressways and motorways. However, it has one of the least developed motorway networks (0.5 km per 100 km²). Lower rates (0.3 km per 100 km²) are recorded only in Romania (which became a member of the EU three years later than Poland), Finland (a country with low population density) and Estonia. At the same time, Poland is one of the three EU countries with the highest (2.5-fold) growth of this rate. Motorway density increased more (over 3 times) only in Romania and Ireland. In other EU countries, the value of this rate did not exceed 55%¹.

Despite low motorways density rates, the availability of road transport in most regions of Poland improved significantly over the studied period (thanks to the implementation of IE OP projects). In 6 voivodships the length of motorways increased compared to the year 2006 (mostly in the Łódź and Silesian voivodships - by over 100 km, and in Małopolskie voivodship - by about 90 km). In another 5 regions of NUTS2 new motorways were constructed, the longest sections in Kujawsko-Pomorskie voivodship – over 160 km, Podkarpackie voivodship – over 110 km and Lubuskie voivodship – nearly 90 km. The motorway network is complemented by expressways systematically expanded in the years 2006-2014. In 2014 such roads were present in all voivodships, except Opolskie voivodship. The longest sections of expressways run through the Łódź voivodship (220 km more than 170 km) and mazowieckie voivodship (more than 170 km) and Wielkopolskie, Lubuskie and Warmińsko-Mazurskie voivodships (more than 140 km each).

Significant increase in the length of expressways, which took place since 2006, occurred mainly due to the projects implemented under IE OP 2007- 2013. In relation to 2006, there was an increase by 2091.1 km. During the period of over 9 years, 896.3 km of new motorways and 1194.8 km of expressways were constructed. 46% of motorway growth and 80% of expressway growth are those constructed and reconstructed under IE OP.

¹After: W drodze do spójności. Polskie regiony w latach 2007–2013, Główny Urząd Statystyczny (Central Statistical Office).

The aforementioned factual effect undeniably shows that the overall effect of road projects for country cohesion is, of course, very positive. The civilization jump that took place in the field of road infrastructure during the programming period 2007-2013 was possible primarily thanks to IE OP projects.

The intuitively perceptible effects of the development of road infrastructure are:

- shortened travel (transport) time, and thus improved accessibility of regions (including outermost ones), cities and labor markets,
- reduced nuisance of congestion phenomena by eliminating bottlenecks in the transport system,
- increased social satisfaction by improving access to public services (education, health care and culture) and increasing traffic safety.

The socio-economic effects of network expansion can be considered both in terms of demand (usually short-term, occurring during the investment process), i.e.:

- impact on the financial condition of sub-contractors and companies operating in the vicinity of the investment in progress,
- social costs,
- environmental costs;

as well as in terms of supply (usually long-term), i.e.:

- attractive investments in production or services, such as storage facilities,
- development of settlement and intensification of urbanization processes,
- possible occurrence of the so-called corridor effect.

Fig. 2. Fragment of S7 Olsztynek – Nidzica expressway. Source: Łukasz Józwiak photography/ General Directorate for National Roads and Motorways (GDDKiA)



Fig. 3. Fragment of A1 Toruń – Stryków motorway. Source: Łukasz Józwiak photography/GDDKiA



As has been shown by the case analysis, the implemented road construction projects have an impact on the supraregional and national scale. Their implementation has contributed to the achievement of the IE OP indicators for the length of the built sections of national roads, including increasing the length of roads adjusted to the loads of 115 kN / axle.

Thanks to the implementation of the indicated projects, the following has occurred²:

- elevating the road class to category S and adapting the road to the legal regulations for S-class roads, to which the creation of a secure expressway section of the TEN-T trans-European corridor is linked, providing high comfort of high-speed long-distance high-speed road traffic,
- increased level of safety of road users,
- increased capacity and streamlining of transit traffic moving along this road.

Achieved non-measurable effects include:

- increased travel comfort,
- streamlining of travel along the old national road track,
- improved quality of internal communication links of voivodships by appropriate communication of the planned route with the remaining road network,
- increase in the attractiveness of the areas, improved economic competitiveness of the region,
- unemployment reduction, increase in the number of new jobs (development of existing entities and the emergence of new ones), development of the regional labor market,
- increased mobility of persons and goods in interregional exchange.

² Based on surveys conducted among selected SEZ and Technology Park managers, transport and construction companies, marshals and voivods.

It may be pointed out that while the expressway itself does not cause enormous economic growth, it certainly gives the possibility for local self-government units in its immediate vicinity to use this potential and often change growth directions. Construction of the road significantly improves transport accessibility, which automatically increases the value and investment attractiveness of these areas. Some units already experience it. In other areas, investments are at the stage of planning.

2.2. Rail transport

Projects implemented under IE OP 2007-2013 in the form of modernization and rehabilitation of railway infrastructure brought many positive effects. In addition to adaptation to the technical requirements of the modern rail network, completed projects have resulted in many benefits and amenities for the broader environment:

- the implementation of IE OP projects has brought tangible benefits to passengers and other users of rail transport in terms of significantly reduced travel time, construction of modern railway infrastructure such as modern rail traffic control systems, platforms and platform shelters, underground passages using all architectural solutions to facilitate the use of those objects by persons with limited mobility, information systems consisting of information boards, platform displays, clocks and megaphones and much more,
- for the community on a local, agglomeration, regional and interregional level IE OP projects have improved transport accessibility, communication, travel safety and comfort of life through underground passages, access roads, noise absorbing screens and technical solutions significantly reducing acoustic factors,
- for motorized road users - thanks to viaducts built in the place of railway crossings at the rail level, the implementation of IE OP projects completely eliminated the possibility of collision with the train, improving the safety of railway and road traffic, and the emergence of two level crossings significantly improved the flow of traffic,

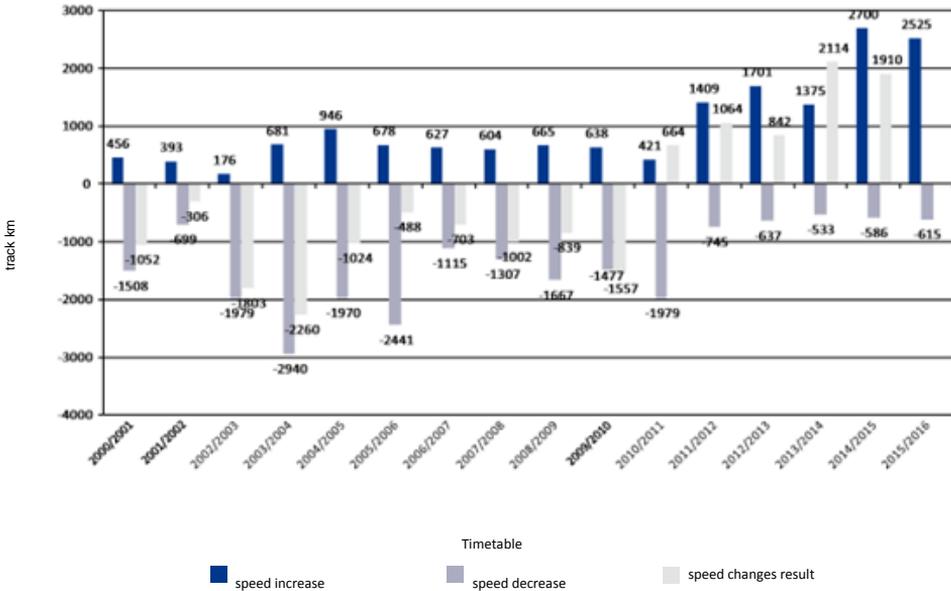
The quality of railway infrastructure, which has a direct impact on the quality of the transport offer, had been gradually improving over the years under review. As a result of the modernization of railway lines, the length of railway lines adjusted to the speed of 160 km / h and more almost doubled in 2006-2014 , from 1.3 thousand km in 2006 to nearly 2.6 thousand km in 2014. The number of regional centers linked by railway lines was also doubled to at least 100 km / h (from 5 in 2006 to 10 in 2014). The length of railway tracks with good technical condition in 2015 accounted for 54.5% of the total track length.

- IE OP projects have brought tangible results to the environment through the use of a number of modern animal migration solutions, the installation of wildlife scare devices warning animals against oncoming trains, and the use of a range of other solutions to protect local waterways and valuable natural sites.

The full positive effects of IE OP will, however, materialize in the long run as projects are underway. However, the positive impact of rail investments implemented under cohesion policy on socio-economic development in Poland can be observed at this stage already.

The real measure of progress in improving the railway network manager's offer is a positive balance of network sections with the speed increase for the years 2011-2016 when the negative trend from 2000-2010 was reversed.

Graph 2. The length of railway tracks operated by PKP PLK S.A., where changes in maximum scheduling speeds were made (as at the date of introduction of train timetable)



It was not until the completion of the renovation and modernization of PKP PLK S.A. network that there could be seen an upward tendency, as the carriers were then able to offer more attractive driving times and a more predictable journey with increased punctuality. There was a clear slow growth trend in transport. Due to the considerable investment effort in the area of modernization of linear infrastructure and passenger and rolling stock handling infrastructure the quality of transport improved considerably. This results in particular from the radical improvement of the carriers' offer and successive transformations in the agglomeration and regional transport segment, but also due to numerous investments in rail infrastructure (shortening of transit time) or terminal-platform-station infrastructure (improvement of the comfort of waiting for the train), including the construction of integrated transfer nodes.

Following a gradual decline in passenger numbers between 2012 and 2014, in 2015 passenger numbers increased by 4.2%. The number of passengers in 2015 amounting to 280.3 million was the best result after 2008, when it reached 292.2 million.

Less positive effects can be observed in the segment of freight transport. With regard to performance, the years 2011-2015 brought confirmation of the trend of returning to the average level of performance from 2005-2008. More pronounced than in previous years had become a disproportion between the dynamics of changes in the weight and performance. This means that the trend is to move lighter loads over longer distances.

2.3. Air transport

Joint implementation of the projects under Measure 6.3 and 8.4 of IE OP had a very positive impact on the airport operations. The implemented projects optimized airport capacity during peak times, shortened passenger check-in times, improved passenger service standards and security of TEN-T airports. The observed effects contribute to achieving the goals set out in the strategic documents of Poland and the EU.

Fig. 4. Airports – key projects implemented under IE OP in the years 2007-2013. Source: own elaboration of the Center for EU Transport Projects



In line with IE OP, expansion of the airports would increase the possibility of using the competitive advantages (such as geographical location, market size) and enable trade with the Community and other neighbors of Poland to be improved. High standard of the services provided

by TEN-T network airports was to be achieved through investments in passengers handling infrastructure (construction, extension or modernization of passenger terminals, taking into account service standard comparable to other EU countries) and through introduction of modern technologies and computerization.

The implementation of IE OP contributed to the optimization and improvement of the quality of the transport system in the country, as well as to the increase of transport accessibility of the regions, which is in line with the objectives adopted in the National Development Strategy 2007-2013. Projects also influence the development of regions and increase in territorial cohesion. As the analyzed projects show, the objective mentioned above was achieved. On the other hand it should be, however, indicated that overall effects of the implemented projects may not yet be known and felt. This is due to the fact that the implementation of some IE OP projects was completed in 2015.

The increase in both passenger and operating capacity stems from the simultaneous expansion of various elements of aviation infrastructure. The expansion and redevelopment of the existing airport infrastructure affects the operational capacity (as measured by the number of operation per unit of time), whilst implementation of the project covering extension of a passenger terminal constitutes a key element of the infrastructure determining the passenger capacity. It should be taken into account that individual components of aviation infrastructure affect directly one type of capacity, which in turn enables the achievement of a synergy effect by combining them with other elements. All these components jointly determine the capacity of a given airport.

The collected data, statistics of the Main Statistical Office and information obtained from the Civil Aviation Authority show that the projects implemented by airports and co-financed by IE OP 2007-2013 have largely contributed to their capacity, located within TEN-T network, as well as the capacity of Polish airspace, and have also contributed to ensuring a high standard of services rendered. Moreover, there has been a significant improvement of safety in air transport. This is the most prominent in the case of three airports - Port Lotniczy Gdańsk im. Lecha Wałęsy Sp. z o.o., Port Lotniczy Wrocław S.A. and Port Lotniczy "Rzeszów – Jasionka" Sp. z o.o., where, thanks to IE OP co-financing, the biggest airport investments were made. The main problems identified with these airports were difficulty with increasing the capacity of airports and the lack of adequate airport infrastructure. Projects implemented under IE OP 2007-2013 enabled efficient handling of the increased number of air operations during EURO 2012 or World Youth Days in 2016.

The increase in capacity occurred among others in Rzeszów, from 6 operations/h to 12 operations/h, and in Gdańsk from 12 operations/h to 30 operations/h. In Gdańsk, owing to IE OP co-financing, the number of parking spaces increased from 19 to 35, and in Wrocław 13 new parking spaces were built, which made it possible to park much more airplanes at one time. Taxi time for planes was shortened - in Wrocław by locating the terminal in a more convenient place (by the center of the runway), and in Gdańsk by building a parallel taxiway. Also service time of aircraft was

reduced accompanied by the increase in its quality, which poses a positive impact on the ability of the carriers to develop air transport network. It should also be noted that within the scope of IE OP co-financing in question, the airport infrastructure was provided with navigation aids for use in low visibility aviation operations. This action has allowed for a significant improvement in the safety of flight operations, as well as the increase in airport capacity. Moreover, tarmacs were modernized, which first and foremost ensures safe taxiing of aircrafts. The construction of new parking spaces dedicated to aircrafts de-icing, equipped with environmentally hazardous waste separators, not only improves airport capacity (previously aircrafts had been de-iced on the apron or taxiway), but also constitutes an important element of environmental protection.

Data obtained from the Civil Aviation Authority show that air traffic - in all Polish airports - has been recording positive results year after year, except during the economic crisis. This is particularly visible in the case of Port Lotniczy Gdańsk im. Lecha Wałęsy Sp. z o.o., Port Lotniczy Wrocław S.A. and Port Lotniczy "Rzeszów – Jasionka", where the largest investments were made under IE OP. It is also worth adding that during the economic crisis, the falls were not so drastic in these cases. With regard to Gdańsk Airport, the drop was less than 60.000 passengers.

At the same time, in 2015 the growth in the number of passengers handled at Polish airports amounted, in comparison to 2104, 13%, i.e. twice that over the world number.

However, from the analysis of the collected data to what extent this increase in the traffic was linked to financing under IE OP cannot be directly concluded. On the one hand, the capacity is related to traffic, but on the other hand, it does not determine traffic. Exceptions can be the situations when the airport reaches the maximum capacity on the airside or landside, and in order to accommodate the increased traffic (e.g. when prognoses indicate so) the extension of infrastructure will be needed. There are numerous other factors having effect on the increase of the traffic itself.

The implementation of projects resulted in, among others, the increase of the national air transport system efficiency by creating airports that keep pace with development aspirations, as well as with the economic and social potential of Poland.



It is worth pointing out that the security and infrastructure developments investments have certainly not only improved the capacity, but also the quality of services (the construction of new terminals, the increase in the number of travelers and luggage control devices, which shortens the time of control, etc.), and consequently affects the competitiveness of such a port.

In the case of airports where new terminals were built, it was necessary to equip them with safety equipment, without which their operation would not be possible. Owing to the airport infrastructure investments described above, collision-free aircraft traffic at the airport has been ensured to the large extent, mainly through the extension of taxiways and the provision of navigation aids, including safeguard against runway incursions. Equipping of airport infrastructure with

navigational aids used for low-visibility aviation operations is also an important element in improving the safety of air operations.

Fig. 5. Navigation lighting systems. Source: Gdańsk Airport



It should be added that within the framework of IE OP, investments were made to increase the level of airport fire protection, which enabled to secure the equipment meeting certain categories of emergency rescue and firefighting protection, shorten the driving time to the farthest runway and adjust the equipment to remove immobilized aircrafts.

The information gathered shows that the sense of security for air transport users has increased, which translates into a propensity to use air transport (on specific routes) and increased mobility, resulting in the growth/maintenance of the level of tourism in the region which cares for its security level.

The investments made also prevent or mitigate losses caused by accidents/incidents in the areas outside and adjacent to airports, resulting in improvements of the economics of insurance companies, medical costs, rescue costs, reputation loss. Nevertheless, it is impossible to be proved until an incident occurs. When it comes to safety, it is better that the efficiency of the installed systems is never to be proved in a real situation. The implementation of the projects also makes it possible to obtain the effects of synergy between the elements of security systems of airports and carriers, which translates into the improvement of economics of airport, insurance companies operations, medical costs, rescue costs and the cost of losing the reputation of the participants. With the acquisition of modern equipment, the scope and efficiency of travelers and luggage control has increased, translating into the sense and awareness of the safety of air transport users and their mobility, contributing to the development of the region.

In the longer term, improvement of security enhances the growth of tourism as a result of increased confidence in air transport, as the safest means of transport (low mortality), both at the time of incident and accidents prevention, as well as the effectiveness of rescue operations, which translates into: tourist expenditure, increase in the number of services related to leisure and broadening the service offer of travel destinations.

2.4. Urban transport

The vast majority (**nearly 80%**) of the **EU urban transport funds** allocated to Poland were allocated to the **investments implemented under IE OP**. These were large and often supra-local investments. The total **value of EU urban transport projects** amounted to more than **PLN 22.5 billion**, whilst the total value of co-financing received amounted to about **PLN 14 billion**. **47 projects closely related to public transport were financed under IE OP**. Their total value amounted to **almost PLN 18 billion**, out of which **nearly PLN 11 billion came from the EU funds**.

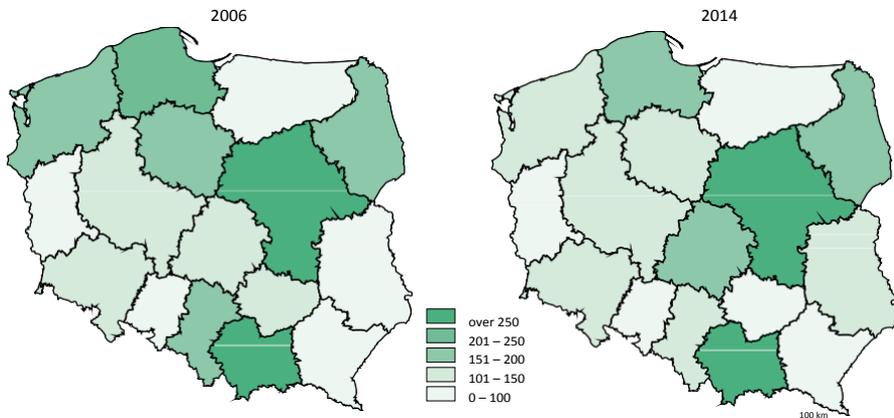
The vast **majority of IE OP funds** in all the supported regions **was allocated to the capitals thereof**. Ecological investments, with a greater impact area and greater integration opportunities for various transport means were promoted, thus mainly large cities with extensive urban transport networks,

especially those with trams and trolleybuses, had the biggest chances for grants.

IE OP investments related to the public transport were complementary to the means of transport at national and regional level.

The development of urban transport has to a great extent led to a decrease in the number of transported passengers, due to the increase in population and the improvement of the economic situation of the rolling stock producers. Domestic and foreign orders contribute to the creation of new workplaces. **IE OP support had a great impact on the increase in the number of passengers in large cities, by about 10% on average.**

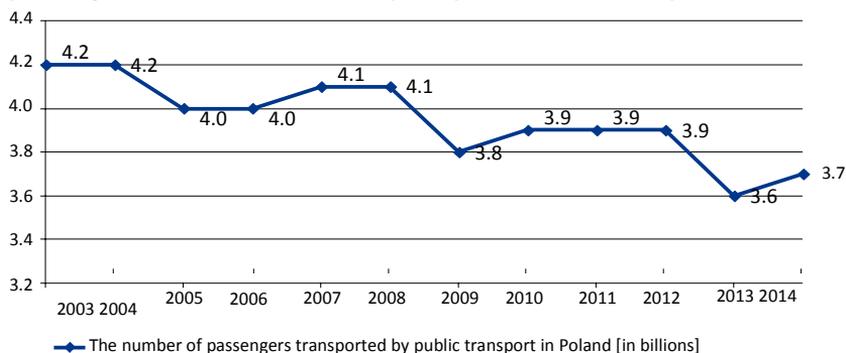
Fig. 6. Transportation of passengers by public transport means per 1 citizen of urban areas, divided into voivodships (NUTS2). Source: GUS – W drodze do spójności. Polskie regiony 2007-2013, November 2016



In Poland, **collective transport** is provided among others by nearly 55 thousand km of urban transport lines. These are mainly: **bus lines (95.1%)**, **tram lines (4.3%)** – in 13 cities and few – **trolleybus lines**, in Gdynia, Sopot, Lublin and Tychy (in total they account for **0.6%** of total public transport lines in Poland).

The number of passenger services per capita in urban areas was the highest in **Małopolskie Voivodship (296)**, **Mazowieckie Voivodship (265)**, **Pomorskie Voivodship (192)** and **Łódź Voivodship (161)**. Among the remaining NUTS2 regions of Poland, the highest value of this rate (however at least twice lower than in Małopolskie Voivodship) is recorded in the following listed voivodships: Podlaskie (151), Zachodniopomorskie (149), Lubelskie (142), Wielkopolskie (136), Kujawsko-Pomorskie (135), Dolnośląskie (129) and Śląskie (123). In the years 2006–2014 the number of passengers transported was steadily declining in most of Poland's NUTS2 regions. **As a result, in 2014 their number was nearly 290 million smaller (i.e. by 7.2%) than in 2006.**

Graph 3. The volume of transport by public transport in Poland. Source: Main Statistical Office: Transport – wyniki działalności 2004–2014 (Transport - the results of operations 2004-2014)



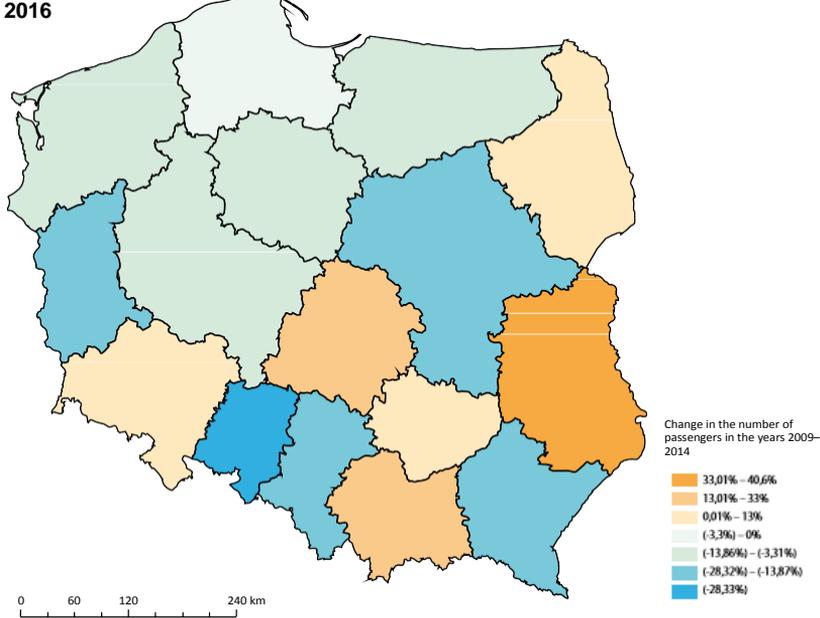
According to the statistics presented by the Main Statistical Office, in the period of 2007-2014 there occurred an initial increase in the number of transported passengers, after which a gradual decline was observed, with the minimum of 3.6 billion passengers in 2013.

Regional trends fitted in the overall picture of urban transport, with long-term declines compared to previous periods. **Between 2009 and 2015 global transports increased by 5.18%.** This increase was mainly related to large cities, which significantly affected the average. In all classes of cities with less than 200 thousand citizens there was a decrease in the number of passengers transported by public transport.

The development of urban transport, thanks to EU investments, led to a significant reduction in the decrease in the number of passengers transported due to the increasing motorization index of the population as well as to the economic situation of rolling stock producers.

Support under IE OP had a great impact on the increase on the number of passengers in large cities, by 10% on average.

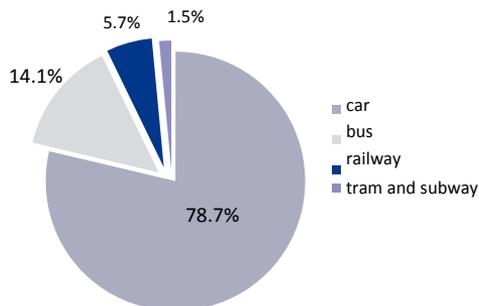
Fig. 7. Change in the number of public transport passengers in 2009-2014 by region. Source: Raport o stanie komunikacji miejskiej w Polsce w latach 2009–2015, eds. dr M. Wolański, IGKM 2016



2.4.1. Modal shift towards more environmentally friendly means of urban transport

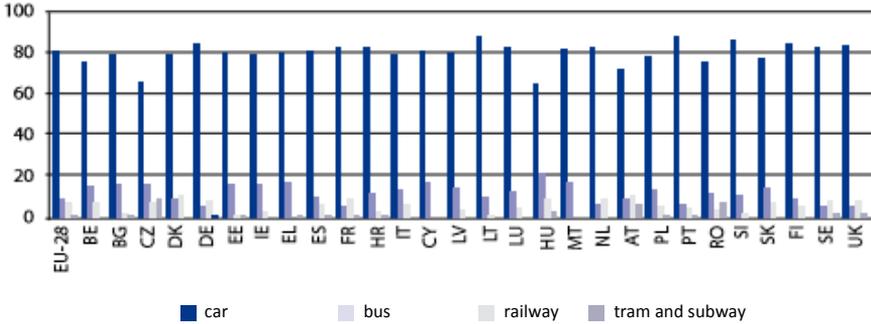
One of the basic statistical summaries is the one concerning the market shape, the so-called modal splits. Basing on the data from various international resources, we can construct a model of Polish transport.

Graph 4. Passenger transport in Poland in 2014. Modal Split expressed in passenger-kilometers [%] – Poland. Source: own elaboration based on Eurostat data for the year 2014³



³http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2016_en.

Graph 5. EU-28 passenger transport – modal split. Source: own elaboration based on Eurostat data for the year 2014⁴



Modal split in urban transport towards the means alternative to car journeys in large cities that received support from IE OP⁵ should be considered as a success when taking into account the increase in the vehicle motorization index. Over the period of 10 years (from 2005 to 2015) the said index had almost doubled (from 323 cars to almost 600 cars per 1000 citizens). Nevertheless, the share of car journeys remained virtually unchanged.

The increase in the number of passengers in urban transport is the result of a combination of many actions, including organizational ones (fares, integration of services of different carriers). This does not change the fact that projects involving the construction/modernization of a line or purchase of rolling stock are a prerequisite for the increased share of public transport in cities and agglomerations.

2.4.2. The impact of IE OP on changes in urban and agglomeration transport

One of the objectives of IE OP in the field of urban transport, which are consistent, among others, with the provisions of *The Green Paper. Towards a new culture for urban mobility*⁶ was to increase the availability, quality and safety of urban public transport in relation to car transport.

In the years 2007–2015 the largest investments in public transport, per kilometer of the network, took place in large cities: Warsaw, Kraków, Gdańsk and Łódź⁷. The analysis of the value of EU co-financing for transport projects indicates that the biggest project of this type is the second metro line in Warsaw.

⁴http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2016_en.

⁵What is confirmed by CUPT surveys and expert panel conclusions.

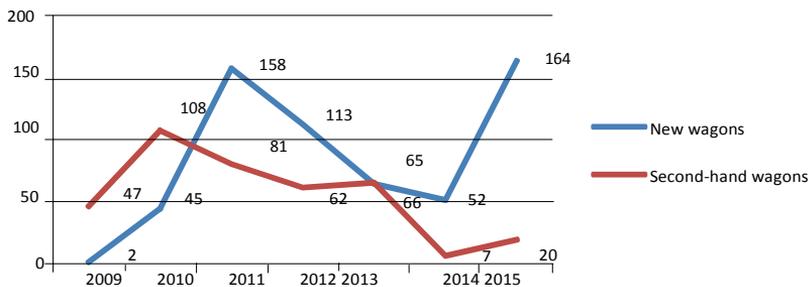
⁶The Green Book. Towards a new culture for urban mobility, COM (2007) 551, European Commission, Brussels 2007.

⁷Ex-post evaluation of National Development Plan 2004-2006, Ministry of National Development, Warsaw 2010.

Projects implemented in metropolitan cities under IE OP covered the construction of new tram lines, modernization of numerous existing sections (including the reconstruction of stops and other necessary infrastructure) and the implementation of extensive traffic control and dynamic passenger information systems (ITS). Under IE OP **237 km of railway and trolleybus transport networks were built or modernized**. Also under IE OP the investment in rolling stock was made - 573 new trams were purchased (partially or fully low-floor ones). IE OP did not provide for co-financing the bus fleet, therefore metropolitan cities had to use ROP funds for this purpose (M. Wolański, 2016).

The replacement of tram rolling stock observed in the period 2009–2015 covered both the purchase of new and second-hand wagons.

Graph 6. Purchase of tram rolling stock in the period of 2009–2015 [in pcs.].
Source: Raport o stanie komunikacji miejskiej w Polsce w latach 2009–2015,
eds. M. Wolański, IGKM 2016



Over 500 trams were purchased and more than 200 km of tram lines were constructed or modernized under IE OP.

The purchased vehicles were meeting the latest ecological standards and contributed to the elimination of barriers for people with disabilities (increase in the share of low-floor rolling stock in the total number of tram wagons from 6.5% in 2009 to 27.7% in 2015).

2.4.3. Public transport with agglomeration coverage

IE OP projects had a significant impact on the creation of conditions conducive to commuting to work, greater mobility of the citizens and investment attractiveness, as well as, through the improved accessibility of schools and thus the opportunity to gain education, better suited to the needs of the labor market and predispositions of a given person.

The largest projects in the field of metropolitan railways are the Pomeranian Metropolitan Railway and the Łódź Agglomeration Railway, as well as the Warsaw S-train (SKM). Plans of agglomeration railways allow also dozens of other self-governments to develop. One of the precursors of this direction was also the Lower Silesian Voivodship, which took over and renovated Wrocław-Trzebnica line.

The development of road infrastructure increases the attractiveness of individual transport. Bearing in mind the postulate of sustainable development, a more balanced distribution of transport tasks, including the development of low carbon technologies, should be sought.

Rail transport in metropolitan areas can play a much more important role, but this requires the active involvement of the transport operator and the provision of the necessary level of funding as public service transport.

Due to often pilot nature of implemented ITS projects under IE OP, the potential of ITS systems is insufficiently exploited. Solutions are in many cases not optimal in relation to the needs. ITS systems need to be expanded and modernized in order to achieve the effect of scale, and it is also advisable to disseminate the guidelines, standards and good practices related to the implementation of ITS projects.

2.5. Sea transport

Polish ports, compared to the port sector in the Baltic region, not only improved their market position, but in several cases they became regional leaders (increase in Poland's share in total transshipment turnover realized by Baltic ports from 7.3% in 2005 to 12.7% in 2015). At that time, the total turnover of Polish ports, taking into account both the three basic port centers (Gdańsk, Gdynia, Szczecin and Świnoujście), as well as smaller ports, increased from 58.54 million tonnes in 2005 to 80.9 million tonnes in 2015. Most of the transshipments (94-97%) were carried out in large seaports.

The share of seaports in handling load weight of Polish foreign trade is steadily growing. In 2015 seaports handled 21.5% of exported loads weight and 18.7% of load weight imported to the country, compared to 19.1% for export and 11.1% for import respectively in 2007. Against this background, it is worth pointing out that sea port regions play an increasingly important role in the creation of national trade. It is confirmed by high - 17.8% share in the value of export stream and 19.1% – of export one, being handled in coastal regions.

The key development factor for the ports was full access to EU aid funds, including those covered by IE OP 2007-2013. Simultaneously implemented comprehensive investment program was at the same a time a prerequisite for positive changes in seaports. This applies both to their infrastructure and the port superstructure (including transshipment facilities and equipment). In addition, investment activities on facility infrastructure including mainly road and rail connections to/from ports were implemented.



Polish seaports are playing an increasingly important role both in the Baltic Sea Region and in Central and Eastern Europe and contribute to the creation or functioning within the national economy (analysis for the year 2015) of: 42.000 enterprises, 227.000 workplaces, PLN 30.5 billion of gross value added, 19.2 billion of budget revenue.

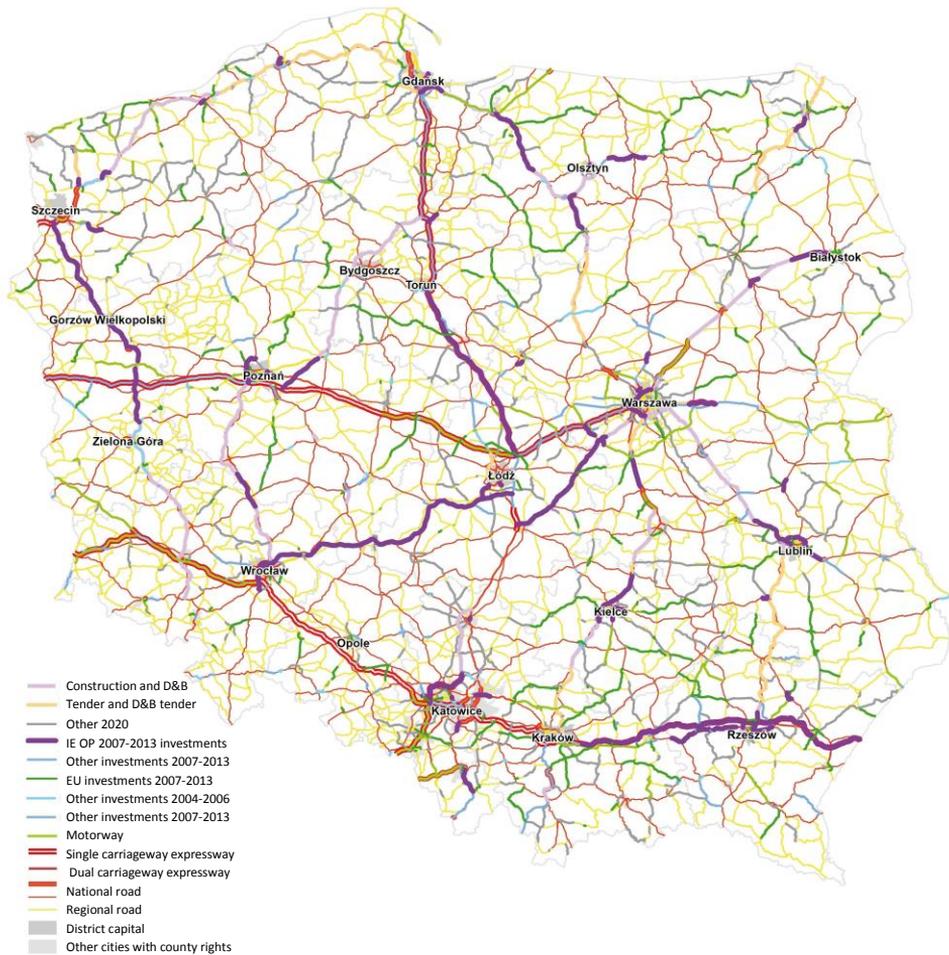
3. Spatial analysis of transport network development in terms of coherence and complementarity of investments implemented under IE OP 2007-2013

Investments implemented under IE OP 2007-2013 were key fragments of the motorway and expressway network, railway lines, as well as important arteries and elements of nodal infrastructure in cities. In terms of reducing bottlenecks, improving accessibility and reducing travel times and other network effects, for obvious reasons large projects are of the greatest importance. They were implemented on longer sections of inter-city routes. In some relations, **reduction of time of travel by car exceeded 30%**, whereas IE OP investments with such large effects in terms of time reduction included, among others, **A1 motorway between Toruń and Łódź (Stryków), A4 motorway between Kraków and Rzeszów and S8 expressway between Wrocław and Łódź.**

Among rail investments, the improvement in technical speeds gave also, with the participation of IE OP 2007-2013 funds, potential reduction of passenger train travel times by more than 30% on the following routes: Warsaw–Łódź (the effect of modernization of line no. 1) and Toruń–Bydgoszcz (the effect of modernization of line no. 18). In rail transport, greater investment resulted in the improvement of the functional connection between Warsaw and Gdańsk, as well as Kraków and Rzeszów. On some inter-city routes, the effect of railway investments was postponed in time. The effects of a significant reduction in inter-agglomeration travel times are also apparent for other reasons, independent of IE OP investments, e.g. in the case of investments implemented with the use of budget or concession funds (road transport) or as a result of ROP investment, national funds or as a result of putting into service a new line segment (railway transport). **The complementarity of IE OP road projects** in relation to analogous large projects implemented with the use of IE OP or CEF funds in 2014-2020 programming period, e.g. of S5 – Poznań–Wrocław and Poznań–Bydgoszcz–Grudziądz or S3 – Szczecin–Bolków is also important.

In the rail transport, the complementarity with 2014-2020 programming period can be seen within the following rail routes: no. 271 – Poznań–Wrocław, no. 8 – Warsaw–Kielce–Kraków, no. 6 – Warsaw–Białystok–Grodno. In **agglomeration nodes** and on exit sections from large cities, usually shorter projects, but significantly more expensive per kilometer, were implemented under IE OP. A number of by-pass road investments under IE OP should be recognized as a positive phenomenon. In part, however, these projects were implemented too late in relation to the remaining sections located between cities and characterized by lower traffic, and some of these key investments were transferred to the programming period 2014-2020.

Fig. 8. Complementarity of road and rail projects of IE OP 2007-2013 across the country.
Source: IGIpZ PAN



The **spatial layout** of road and rail projects of IE OP 2007-2013 is characterized by a **lack of clear concentration of funds in one part of the country**, which should be considered positive due to polycentric character of the network of urban centers in Poland. Moreover, road and rail projects were implemented generally on various intercity routes. Functional routes on which simultaneous road and rail transport works were carried out are Kraków– Rzeszów, Warsaw–Gdańsk and Warsaw–Łódź routes. In the programming period 2007-2013, a number of important investments significantly improving Polish **airport capacity** was undertaken, partially under IE OP 2007-2013.

In principle, each of the airports was also, to a greater or lesser extent, a beneficiary of the development of road infrastructure. The biggest changes in population number in the isochrone 60 minutes from the airport took place in airports in Rzeszów (among others, the effect of construction of A4 motorway) and in Wrocław (among others, the effect of construction of S8 expressway towards Łódź).

IE OP 2007-2013 road and rail investments contributed to the improvement in the transport situation of the Eastern Poland Macroregion. First and foremost, there was a concentration of funds on routes connecting Eastern voivodships (especially capitals thereof) with the rest of the country, including the metropolises of Warsaw, Kraków and Gdańsk. Road and rail investments in other regions (especially in Central Poland) have also contributed to the improvement of transport in Eastern Poland. The complementarity with EP OP road investments was preserved. Also a large part of measures taken in the Eastern regions under their Regional Operational Programs was aimed at increasing the effects of IE OP measures (node handling, traffic distribution).

At the level of individual voivodships, it can be concluded that IE OP projects were generally aimed to a larger extent at improving the internal cohesion of the country, i.e. **the coherence of inter-city links** rather than **intra-voivodship cohesion**. Nevertheless, a number of projects were, at the intra-voivodship level, of **concentric-radial** nature, with the capitals of the regions as centers (e.g. Kujawsko-Pomorskie, Dolnośląskie, Wielkopolskie and Śląskie voivodships). In some voivodships, extensive areas were lacking major IE OP investments. Partially these areas were supported with the use of other funds, e.g. ROP 2007-2013.

On some inter-city routes, the effect of railway investments was postponed in time. The effects of a significant reduction in inter-agglomeration travel are also apparent for other reasons, independent of IE OP investments, e.g. in the case of investments implemented with the use of budget or concession funds (road transport) or as a result of ROP investment, national funds or as a result of putting into service a new line segment (railway transport). The complementarity of IE OP road projects in relation to analogous large projects implemented with the use of IE OP or CEF funds in 2014-2020 programming period, e.g. of S5 – Poznań–Wrocław and Poznań–Bydgoszcz–Grudziądz or S3 – Szczecin–Bolków is also important. In the rail transport, the complementarity with 2014-2020 programming period can be seen within the following rail routes: no. 271 – Poznań–Wrocław, no. 8 – Warsaw–Kielce–Kraków, no. 6 – Warsaw–Białystok–Grodno. In agglomeration nodes and on exit sections from large cities, usually shorter projects, but significantly more expensive per kilometer, were implemented under IE OP. A number of by-pass road investments under IE OP should be recognized as a positive phenomenon. In part, however, these projects were implemented too late in relation to the remaining sections located between cities and characterized by lower traffic, and some of these key investments were transferred to the programming period 2014-2020.

3.1. The evaluation of coherence and complementarity of IE OP projects in the Eastern Poland Macroregion

The main objective of large transport investments in the specific Eastern Poland Macroregion was, in the 2007-2013 financial perspective, better integration thereof with the rest of the country, including linking capitals of 5 voivodships with major national and European metropolises, removal of bottlenecks and overcoming spatial barriers, including the hydro ones (Vistula line). The implementation of these objectives was based on two complementary operational programs: a) IE OP and IE ROP (only road transport). The actions taken under individual ROPs were of complementary nature. As a result, a large part of the investments implemented in the Eastern Poland Macroregion under IE OP concerned the main routes referring to the basic functional routes defined as the target links in the National Spatial Development Concept 2030. These were the routes for which parallel operation of the motorway or expressway and the railway with a minimum speed of 160 km/h were considered necessary. These include routes linking Lublin, Białystok, Kielce and Olsztyn with Warsaw, and in addition Rzeszów with Lublin (and further with Warsaw), Rzeszów with Kraków, Kielce with Kraków and Olsztyn with Gdańsk. Out of the eight mentioned above, road investments under IE OP were started on six, and completed only at one route (Rzeszów-Kraków; A4 motorway). In the case of Kielce-Warsaw route, almost all the section of S7 expressway within Świętokrzyskie voivodship were completed, leaving considerable unfinished parts in Mazowieckie voivodship. On Warsaw-Lublin and Warsaw-Białystok routes, sections in the vicinity of the capitals of these two regions were completed (Białystok-Jeżewo fragment on S8 and Lublin-Kurów on S17/S12). In the case of Olsztyn, the improvement of travel routes to both Warsaw and Gdańsk was achieved through the implementation of the fragments of S7 expressway within Warmińsko-Mazurskie voivodship (despite the fact that the investments were located far from Olsztyn and were not extended in Pomorskie and Mazowieckie voivodships). Nearly no road investments were implemented between Lublin and Rzeszów (except for a small part of S19 route at the exit from Rzeszów and the Kraśnik bypass) and between Kielce and Kraków. As a result, car travel time has been clearly reduced between Rzeszów and Kraków (42%) and significantly between Kielce and Białystok and Warsaw, as well as between Olsztyn and Gdańsk (approximately 14-15% each). On other basic routes, the travel time has been slightly reduced (about 5%) or has not been reduced at all (Kielce-Kraków section).

Rail investments on the mentioned basic routes were limited to four pairs of centers, with only two cases involving real construction work on long sections, whilst in the other two they were focused on preparatory work. The work was completed almost on the whole route of line no. 91 (E-30) Kraków-Rzeszów (although due to the fact that their completion was prolonged in several sections, the effect in the form of shortening travel time had not been visible until the end of 2015). Furthermore, line no. 9 (E-65) from Warsaw to the Tri-City was fully modernized, which significantly improved rail access from Olsztyn to the capital city (19%) and to a lesser extent to Gdańsk (14%). On the Warsaw - Białystok line, only a fragment within the Warsaw Metropolitan Area was actually modernized (Warsaw Rembertów-Zielonka-Tłuszcz-Sadowne) section.

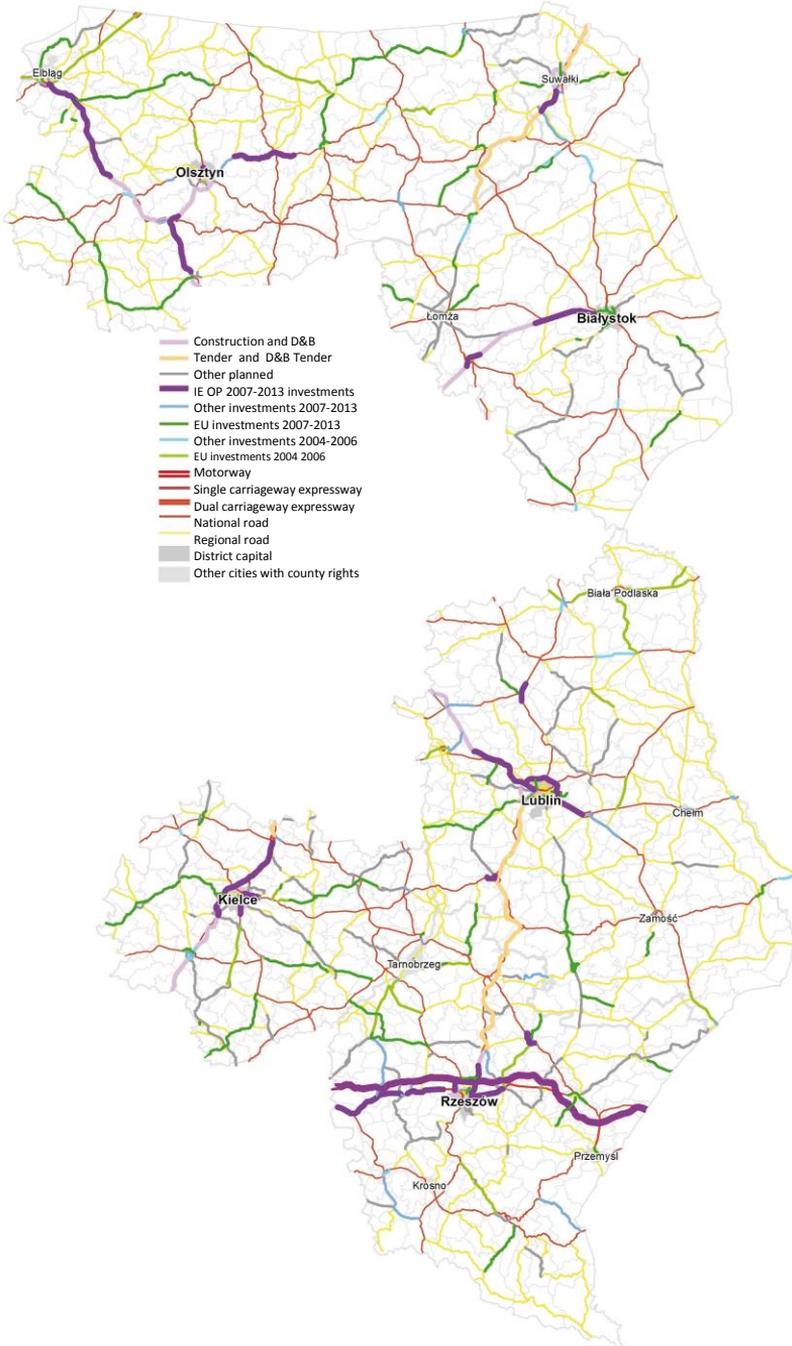
Further parts, as well as the entire Warszawa–Lublin route were covered by preparatory elaborations. On line no. 8 Warsaw–Radom–Kielce–Kraków, implemented was only modernization within the capital city agglomeration (Warszawa Zachodnia–Warszawa Okęcie). No actions were undertaken on routes Lublin–Rzeszów and Kielce–Kraków under IE OP. However, there was shortening of travel times being the result of PKP PLK S.A. own investments. (line no. 71 Ociec–Rzeszów and line no. 8 on section Kozłów–Tunel–Kraków Batowice).

Taking into consideration the role of the above mentioned corridors, the conduct of parallel works on the construction of road and modernization of railway lines (on routes: Warsaw–Olsztyn, Warsaw–Białystok and Kraków–Rzeszów) should be considered justified. Apart from the routes connecting the voivodship centers, several large investments were implemented under IE OP on the routes towards border crossings (A4 motorway from Rzeszów to the Ukrainian border, railway line from Warsaw and Siedlce to Terespol on the Belarusian border and fragments of S61 expressway towards the Lithuanian border). They had a significant international dimension but at the same time served to enhance the functional cohesion of the peripheral territories of Eastern Poland with the capitals of the voivodships, or directly with Warsaw. The investments in the routes leading along the border and the routes of the intra-voivodship nature (among others, few fragments on DK16 and DK19) had a significantly smaller scale. The decision to concentrate funds on routes connecting Eastern Poland with the rest of the country was certainly right. They constituted the obvious first stage of transport activities in the macroregion. Certain doubts may be raised by the modernization of the current DK94 road (parallel to A4 motorway), as well as failure to take actions on some other important routes.

Investments from IE OP certainly helped to increase the functional cohesion of Eastern Poland with the rest of the country. They were the basis for potential socio-economic development, including the intensification of supra-regional (metropolitan) functions in the five capitals of voivodships. These investments were generally complementary to actions taken in the same corridors, but in neighboring regions (Mazowieckie, Małopolskie and Pomeranian voivodships). However, significant delays in construction of S7 road in the Mazowieckie and Małopolskie regions were problematic. Also the scope of the railway investments was relatively small (despite a reasonable level of concentration on selected routes).

Regions of Eastern Poland have clearly gained a lot (improved their accessibility) as a result of IE OP investments implemented in other parts of the country. For example, the travel time from Białystok to Wrocław was shortened by 24% (thanks to investments between Łódź and Wrocław), and between Kielce and Gdańsk by 29% (thanks to investments along A1 motorway). The same effect was also attributed to some railway investments. Modernization of E-65 line between Warsaw and Gdańsk significantly improved the mutual accessibility of Tri-City with Lublin (19%), Białystok and Kielce.

Fig. 9. Complementarity of road and rail projects of IE OP 2007-2013 in the area of Macroregion of Eastern Poland. Source: IGIPZ PAN



4. Analysis of net effectiveness of transport investments under IE OP 2007-2013 on reduction of travel time between voivodship cities.

4.1. Impact on reduction of travel time

Effects of improvement of road and railway infrastructure in relations between the capitals of voivodships (January 1, 2007– December 31, 2015) were calculated with the use of the Car Travel Time Shortening Index ($WSCP_{sc}$) and Passenger Train Travel Time Shortening Index ($WSCP_{pp}$). The ($WSCP_{sc}$) index refers to percentage reduction of time of travel by car in any relation between a pair of capitals of poviats as a result of implementation of infrastructure investments on the national and regional roads network, and the ($WSCP_{pp}$) index refers to the percentage reduction of time of travel by passenger train in any relation between a pair of capitals of voivodships as a result of implementation of infrastructure investments on the network of railway lines (also, as a result of network degradation and speed reduction) during the analyzed period. In road transport, effects of improvement of road infrastructure are directly associated with investments (shortening of travel time associated with commissioning of further sections of motorways and expressways). Whereas in case of rail transport, effects of improvement of infrastructure condition depend directly on the existing railway network offered to rail network carriers, and indirectly on the timetable. In the rail transport, the positive effect of investment on one section of a inter-city relation can be offset by a drop in technical speed on another section.

In the road transport, travel time was shortened by more than 30% on the following relations:

- Łódź–Gdańsk (42%) – the effect of construction of a section of A1 motorway (partial effect of investment under IE OP 2007-2013 between Toruń and Stryków),
- Rzeszów–Kraków (42%) – the effect of construction of A4 motorway (investment implemented under IE OP 2007-2013),
- Toruń–Gdańsk (40%) – the effect of construction of A1 motorway (concession measures),
- Toruń–Łódź (33%) – the effect of construction of A1 motorway (IE OP 2007-2013),
- Łódź–Wrocław (32%) – the effect of construction of S8 expressway (IE OP 2007-2013),
- Łódź–Warszawa (31%) – mainly, the effect of construction of A2 motorway (budgetary resources).

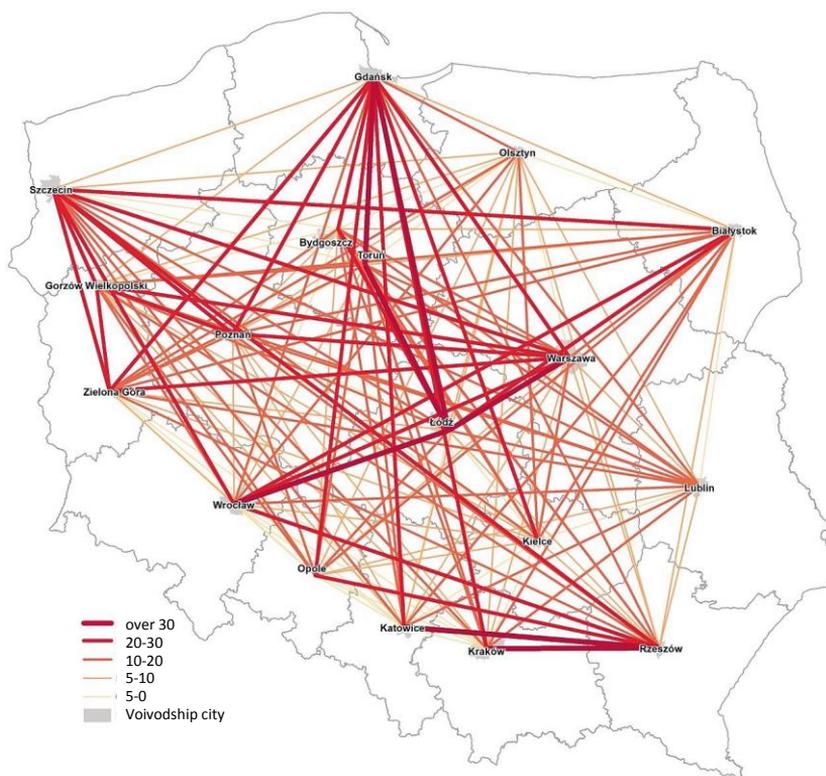
Spatial distribution of shortening of travel time by individual transport shows the greatest improvement in the Northern and Central Poland (overlap of the positive effects of the newly commissioned northern sections of S3 and A1 as well as A2 motorway between Łódź and Warsaw as well as S8 expressway between Wrocław and Warsaw) and in relations of Rzeszów with Kraków and Katowice (A4 motorway). Among the regional centers, the “winners” of IE OP investments were certainly Łódź, and secondly Warsaw, Wrocław and Toruń. The smallest changes concerned capitals of three voivodships of Eastern Poland, i.e. Olsztyn, Lublin and Kielce (the situation for these three cities within this scope will improve significantly only during the programming period 2014–2020).

A clear impact of the three major IE OP 2007-2013 investments, i.e. A1 motorway between Toruń and Stryków, A4 motorway between Kraków and Rzeszów and S8 expressway between Wrocław and Łódź is thus noticeable. The effect of construction of S3 expressway between Szczecin and Sulechów is also noticeable (shortening of travel time on this section in relations of Szczecin with Gorzów Wielkopolski, Zielona Góra and Poznań by approx. 25-29%). The investments financed from other funds, which also significantly shortened the travel time in inter-voivodship relations are mainly: license investment A1 Gdańsk–Toruń as well as A2 motorway Warszawa–Łódź financed by the state budget. Moreover, in certain relations, despite the fact that the effect of improvement was not very large, it was an important complement to the investments commenced in the previous programming period. Such a situation took place in relations between Warsaw–Kielce, where significant sections of S7 expressway were constructed during the programming period 2004-2006. In other relations, operations under IE OP 2007-2013 were the first stage for future investments, and at the same time – removed the basic bottlenecks of the road system. Such a situation can be seen in the case of S12/S17 expressway's section Piaski-Kurów (along with the Lublin-Lublin by-pass), as well as S5 expressway's section Poznań-Gniezno (in relation Poznań–Bydgoszcz) and the southern by-pass of Gdańsk (S7 expressway, sections: Gdańsk-Olsztyn and Gdańsk-Warsaw).

In the **railway transport**, the technical speed was significantly improved, which resulted in the shortening of travel time by:

- Łódź–Warsaw (39-40%) – the effect of modernization of line no. 1 (on section Warszawa Zachodnia–Skierniewice–Koluszki) and line no. 17 (on section Koluszki–Łódź Widzew) – investment financed from IE OP 2007-2013 funds),
- Gorzów Wlkp.–Zielona Góra (40%) – the effect of investment of ROP 2007-2013 (lines no. 367 Gorzów–Zbąszynek, 358 on section Zbąszynek–Czerwieńsk, as well as construction of a new slipway Pomorsko–Przylep, allowing the passage from Zbąszynek to Zielona Góra without the need to change direction in Czerwieńsk),
- Szczecin–Zielona Góra (40%) – mainly, the effect of investments from national funds, on the so-called Nadorzanka (some sections of the line were in a very poor condition, therefore partial restoration of the parameters without modernization had visible effects),
- Lublin–Rzeszów (34%) – the effect of reactivation of railway line no. 71 connecting Tarnobrzeg (Ocice) with Rzeszów (the investment financed from national funds)
- Toruń–Bydgoszcz (33%) – the effect of revitalization of line no. 18 (the investment financed from IE OP 2007-2013 resources),
- Poznań–Bydgoszcz (30%) – the effect of a number of reconstruction investments financed from national funds within the frameworks of preparation for Euro 2012,
- Poznań–Zielona Góra (30%) – the effect of investment of ROP 2007-2013 (modernization of line no. 358 on section Zbąszynek – Czerwieńsk and construction of slipway Pomorsko–Przylep),
- Zielona Góra–Bydgoszcz (30%) – combined effect of investment under ROP 2007-2013 and actions financed from national funds.

Fig. 10. Percentage changes of car travel times (January 1, 2007– December 31, 2015) in relations between the capitals of voivodships. Source: IGiPZ PAN

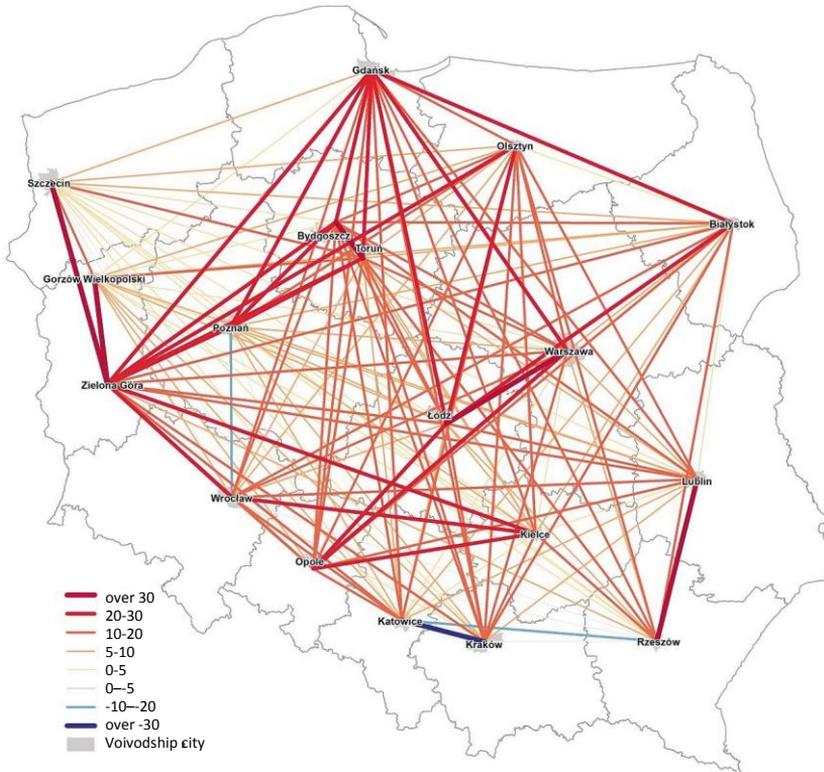


Impact of network decapitalisation and worsening of technical speeds in the analyzed period was particularly visible in two relations:

- Rzeszów–Katowice (-15%) – the effect of network decapitalisation and the lack of major investments on section Katowice–Kraków as well as delays of clear effects of IE OP 2007-2013 investments for the entire section Rzeszów–Kraków (as a matter of fact, by the end of 2015, the traffic-hindering modernization works were still in progress, therefore the effects in the form of increased speed and shortened travel time are barely noticeable; only in 2016 there was a radical improvement).
- Kraków–Katowice (-32%) – the effect of network decapitalisation and multi-year delays in the planned modernization of the section within E-30 corridor.

Decrease of the speed throughout the whole section is also visible in Poznań–Wrocław relation, which results from the fact that, despite the actions carried out on two parts of the route funded by IE OP 2007-2013 and a significant increase in technical speed (Wrocław-border of the voivodship and Czempin–Poznań), the conditions were simultaneously deteriorated on the middle section of the route in the Wielkopolskie voivodship, which in consequence led to a slight decrease of the average technical speeds for the whole relation. The situation within this scope will improve in the next programming period 2014-2020.

Fig. 11. Percentage changes of rail travel time (January 1, 2007 - December 31, 2015) in relations between capitals of voivodships (according to the maximum utilization of infrastructure, according to the technical speeds). Source: IGiPZ PAN



In spatial terms, Zielona Góra was particularly successful, which results primarily from the effect of the so-called low base and the improvement of very low technical speeds on regional routes in Lubuskie voivodship (ROP investments) and the so-called Nadodrzancka (investment from national funds). Improved situation of Bydgoszcz i Toruń is also noticeable as a result of improvement of technical speeds in a diagonal system for relations between Tricity, Poznań and Zielona Góra. The effect was also generated by the IE OP investments implemented in the Warsaw–Łódź and Warsaw–Gdańsk relations. In the latter case, because of the relatively high “base” in percentage terms, this effect was “only” 25%. The situation in Szczecin and Rzeszów centers is surprising, where the improvement of travel conditions in the meridian relations (respectively to Zielona Góra and Lublin) was accompanied by a lack of a clear improvement in relations with the hexagonal system and the network metropolis, i.e. respectively to Poznań and Kraków (in the latter case despite large IE OP 2007-2013 investment).

4.2. Improved access to airports

In the programming period 2007-2013, a number of important investments significantly improving Polish airport capacity was undertaken. The dynamics of the aviation market in Poland and a total number of passengers serviced in 2015 amounting to more than 30 million persons allow to conclude that the implemented investments have outstripped the dynamically growing demand in this branch of transport.

Access to airports by car in 2007 was hindered due to the lack of motorways and expressways on most access routes. Due to the numerous infrastructure investments, both in airports as well as in access to ports, the accessibility of airports has increased significantly. In principle, each of the airports was, to a greater or lesser extent, a beneficiary of the development of road infrastructure.

The biggest changes (more than 50% increase) in population number in the isochrone 60 minutes away from the airport took place in airports in Rzeszów (among others, the effect of construction of A4 motorway) and in Wrocław (among others, the effect of construction of S8 expressway towards Łódź).

By 2015, the railway accessibility of selected airports was also improved. Within the IE OP 2007-2013, an underground Warsaw-Chopin Airport station was built along with a tunnel linking it to railway line no. 8, enabling the regular SKM train traffic and Mazowieckie Railway traffic from the airport to the center of Warsaw, Sulejówek, Legionowo and Modlin Airport. Opening of Pomeranian Metropolitan Railway in September 2015 provided a connection of Gdańsk, Gdynia and the Kaszuby area with Gdańsk Lech Walesa Airport. Regional airports in Szczecin, Szymany and Lublin have obtained direct rail connections thanks to investments financed by funds of ROP 2007-2013.

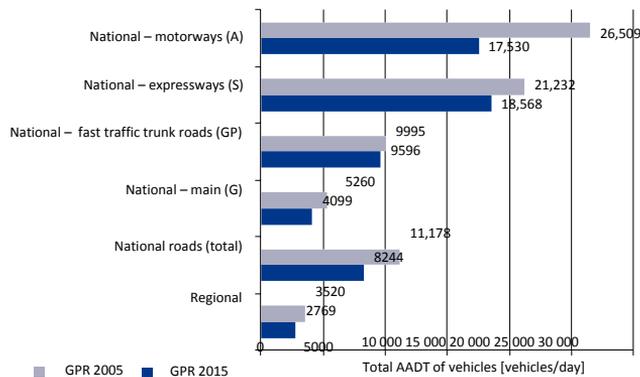
5. Assessment of traffic flow for the entire road network in Poland in terms of reducing the number of sections constituting transport bottlenecks

The concept of a *transport bottleneck* in this study refers to sections of national roads (including motorways - A and expressways - S) and regional roads managed by GDDKiA and the regional road administrations in Poland. In general, the road network covered by the analysis are roads on which General Traffic Measurement (GPR) was conducted, i.e. on rural and urban roads, administered by GDDKiA (A and S). Transport bottleneck should be understood as a road section (on the network of roads described above) on which the stated traffic conditions (PSR) are worse than recommended by the relevant instructions.

Assessment of changes within transport bottlenecks was conducted by comparison of their number and location in years 2005 and 2015. It was assumed that 2005 refers to the condition before implementation of road investments in EU 2007-2013 perspective, while 2015 refers to the condition after implementation of road investments.

General traffic measurements provide information, among others, about the traffic volume on the road network in Poland. Graph 7 shows comparison of the Annual Average Daily Traffic (AADT) calculated for years 2005 and 2015, broken down into categories (national - Dk and regional - DW) and technical classes of roads (only national roads according to GPR results).

Graph 7. Comparison of AADT 2005 and 2015 – total vehicle traffic (vehicle/ day).
Source: AECOM Polska Sp. z o.o. based on GPR 2005 and GPR 2015



Annual Average Daily Traffic (AADT) of motor vehicles on national road network is approx. 3 times higher than in case of the regional roads both for year 2005 and for year 2015. When comparing AADT on regional roads to motorways and expressways, proportions grow to 1:6,3–7,5.

When it comes to comparison of AADT on particular categories of roads in years 2005 and 2015, on national roads recorded was increase of approx. 36%, whereas on regional roads of –27%. Among the national roads distinguished are motorways - increase of above 50%.

National roads

In 2005, the national roads most loaded with traffic included:

- motorway A4, passage through Katowice (AADT = 59,564 vehicles/day);
- road no. 7, section Raszyn–Janki (AADT = 58,574 vehicles/day);
- road no. 8, section Warszawa–Marki (AADT = 54,378 vehicles/day);
- road no. 7, passage through Raszyn (AADT = 52,821 vehicles/day);
- expressway S86, section Sosnowiec–Katowice (AADT = 51,426 vehicles/day);
- road no. 79, section Warszawa–Mysiadło (AADT = 50,330 vehicles/day).

The above sections are located in the area of two voivodships: Mazovian (dual carriageway national roads DK7, DK8 and DK79 in the vicinity of Warsaw) and Silesian (motorway A4 and expressway S86 in the vicinity of Katowice). The Annual Average Daily Traffic on them is above 50 thousand vehicles/ day.

In 2015, the list of national roads with the highest traffic volumes is as follows:

- expressway S8, section of AK Route in Warsaw from Prymasa Tysiąclecia junction to Łabiszyńska junction (AADT = 110,395 – 142,269 vehicles/day);
- expressway S86, section Sosnowiec–Katowice (AADT = 112,212 vehicles/day);
- motorway A4, passage through Katowice (AADT = 100,983 vehicles/day).

In comparison to the year 2015, the most traffic-loaded roads still include: A4 in Katowice and S86 Sosnowiec–Katowice, although the AADT value significantly increased to more than 100 thousand vehicles/day. In case of other sections of roads from 2005, the following may be stated:

- DK7, section Raszyn–Janki and passage through Raszyn – alternative expressway S7/S8 Salomea–Wolica was created in 2015;
- DK8, section Warszawa–Marki – the road continues to function in the present shape; construction of the Marki bypass is in progress (scheduled completion date – 2017);
- DK79, Warszawa–Mysiadło – the road continues to function in the present shape; planned is construction of expressway S7 on section Warszawa–Grójec which will unload existing DK79; scheduled completion date – 2019.

As a confirmation of the above thesis, the length of single carriageway sections of national roads with traffic volume of above 15 thousand vehicles/day may be specified. Such traffic level on a road of this type causes a severe deterioration in traffic conditions and driving comfort (which may, but doesn't have to, meet the definition of a transport bottleneck). In 2005, there were a total of 861 km of sections of single carriageway national roads with AADT > 15 thousand vehicles/day, whereas in year 2015 - 433 km. This constitutes a 2-fold reduction due to the expansion of the expressway network in Poland.

Noticeable is a positive impact of the development of the expressway network and other national roads on the regional roads. The expanded national road network takes over part of the traffic from the most loaded regional roads. On the other hand, however, it is worth noting that the length of sections of the regional roads most heavily loaded with traffic (AADT > 15 thousand vehicles/day) increased from 111 km in year 2005 to 179 km in year 2015 (increase by 61%). These sections are located in the vicinity of large urban agglomerations, pass through towns or constitute access roads to junctions on motorways and expressways. Thus, in the latter case, an increase in the traffic load of regional roads can be observed as a result of development of the expressway network.

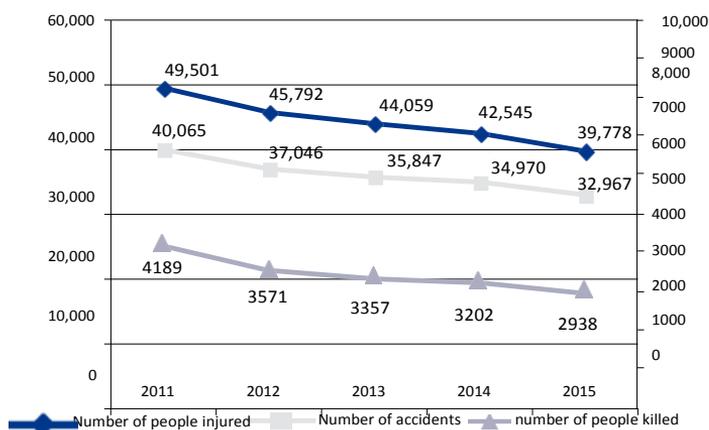
To sum up, **it can be noticed that, while in 2005 dominating were transport bottlenecks covering whole routes of the main roads in the country, in 2015, as a result of the development of the road network, bottlenecks generally are present on the "missing" sections. "Missing" sections should be understood as the ones that have not yet been rebuilt / replaced by motorways or expressways.**

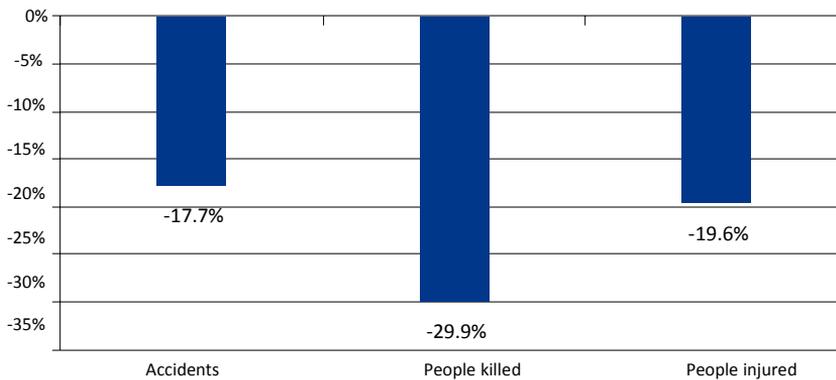
6. Assessment of impact of transport investments of IE OP 2007-2013 on the improvement of road safety and railway safety

6.1. Assessment of tasks aiming to improve road safety

Pursuant to the objectives adopted in IE OP within the 2007-2013 perspective, efforts should be made to reduce the number of casualties. Actions within the scope of road safety improvement have been of multidirectional and scattered nature, requiring appropriate coordination and supervision of the undertakings being responsibility of public administration, governance, and public and social activities at all levels of the state organization. It is difficult to indicate that purchasing projects had an impact on the improvement of road safety. Certainly, however, the protection of the regions against the effects of negative communication events had, and still has, a positive impact on improving transit and tourism traffic flow. According to the beneficiaries, the effects are perceptible but not measurable. Increased external accessibility of voivodships and internal communication cohesion is visible and positively assessed by residents. The purchased equipment increased the efficiency of Fire Brigade and Police actions on the roads. By increasing the number and quality of roadside rescue equipment, possible is a more effective and faster help which minimizes the impact of accidents for the victims.

Graph 8. Number of accidents and number of people killed and injured in the accidents. Source: National Police Headquarters



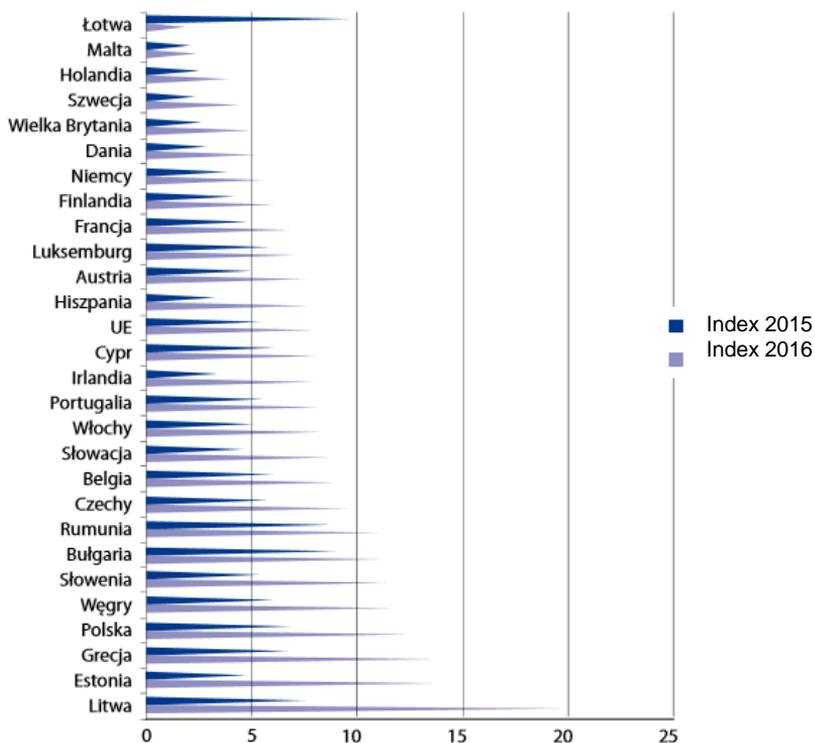
Graph 9. Change in road safety in years 2011 and 2015. Source: National Police Headquarters

Unfortunately, despite the undertaken actions, data of the European Transport Safety Council (ETSC) shows that Poland continues to be one of the countries where residents face the highest risk of serious injury or death as a result of a road accidents. Comparison of the currently observed state of threat to year 2006 shows that the dynamics of positive changes oscillates around the average reached by the EU countries. This means that a quick catching up with Europe's top safe countries will be an extremely difficult task, requiring reaching or even exceeding the targets set in the National Programme for Road Traffic Safety.

Analyses of the available data show that all the actions co-financed from the IE OP were necessary. Such a statement is justified by the demographic ratio: number of people killed/ 100 thousand of residents in EU countries in year 2015 (source: Secretariat of the National Road Safety Council on the basis of information obtained from representatives of particular countries) which has been improved.

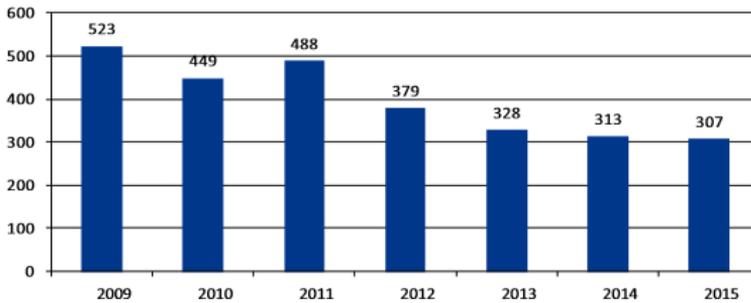
Analyses of all available data from the previous years show that there has been a significant improvement in the safety situation in Poland, as the number of accidents has decreased by almost 18%, the number of people injured by almost 20%, and the number of people killed, which should be particularly emphasized, has decreased by 30%. It is difficult to unequivocally specify the impact of the implementation of IE OP projects on the above. There is no doubt that achieving such results was possible, among others, thanks to more dynamic actions of the Police and the Fire Brigade using the equipment purchased under the IE OP.

Graph 10. Number of people killed/100 thousand residents in EU countries in years 2006 and 2015. Source: own study based on data of EUROSTAT

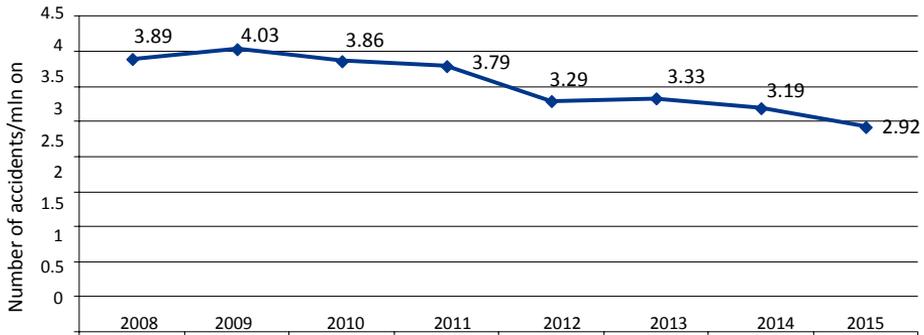


6.2 Railway safety

Actions within the scope of improvement of railway safety were carried out both within the frameworks of modernization and revitalization of railway lines (modern railway control systems were built, including partial implementation of the European Train Control System, railways were modernized, new turnouts were installed and road-rail crossings were modernized, two-level intersections were built), as well as within the frameworks of separate investment projects dedicated to this purpose assuming replacement of turnouts or including modernization of road-rail crossings. Another solution implemented within the frameworks of modernization of the railway lines was the wildlife scare system whose task is to counteract migration of large mammals through rails straight before the passage of a train, thus minimizing the risk of collisions with the oncoming train. As a result, the number of significant accidents on the Polish railway network has decreased over the studied period and the reference ratios within the scope of railway traffic safety have improved.

Graph 11. Number of significant accidents in years 2009–2015

For universal description of relation between the number of accidents and the operating work used is the accident meter referring the number of accidents on the railway lines in a given year to the operating work performed. There is a significant improvement in railway safety throughout the studied period.

Graph 12. Accident meter in years 2008–2015

Social perception of expenditures incurred for the railway safety clearly indicates positive effects of implementation of IE OP. Passengers' satisfaction with safety in trains and passenger facilities has gradually increased over the studied period.

7. Assessment of impact of transport investments of IE OP 2007-2013 on transport accessibility, social and economic development of the regions

Polish regions were initially one of the least accessible regions in terms of communication in European Union, especially in the areas of North-Eastern Poland. A number of investments increasing the transport accessibility was implemented under IE OP 2007-2013 in Poland. Despite significant investments improving the state of infrastructure in all regions of Poland, the largest values of the Interfacial Transport Availability Indicator (WMDT) are characteristic of the largest urban centers (capital city of Warsaw, Silesian conurbation) and of the routes connecting these centers.

Authors of report entitled *Oszacowanie i ocena zmian wartości WMDT i wskaźników gałęziowych na potrzeby ewaluacji ex-post NSRO 2007-2013* (IGiPZ PAN, 2015) (*Estimation and assessment of WMDT values and branch indicators for ex-post evaluation of NSRF 2007-2013*) indicate that the overall effect of improvement of road passenger accessibility for all investments financed by the European Union is similar to the effect of IE OP. The balance of the analyzed period indicates a complete improvement in the road passenger accessibility as a result of investments supported by the European Union in operational programs

2007-2013 by approx. 9.4% in comparison to 15% impact of all factors. **The impact of the road investments under IE OP is estimated at the level of 6.63%**, and they had the largest net effect on road freight transport in the Podkarpackie, Lodzkie and Lubuskie voivodships.

The effect of impact of rail investments implemented under IE OP on railway accessibility in Poland increases by 4.85% (net effect). Particularly visible are the effects in voivodships: Opolskie (increase of accessibility by 13.8%) and Warmińsko-Mazurskie (increase by 11.7%). Whereas, a slight impact is seen in Podkarpackie voivodship (increase by mere 0.4%). Investments implemented under IE OP 2007-2013 create long routes and are focused on three areas of the country. Railway accessibility significantly increases between Warsaw, Gdynia and Bydgoszcz and between Lodz, Katowice and Zielona Góra. The increase in accessibility is also significant in the area east of Warsaw towards Terespol.

Study analyses indicate that the improvement of accessibility in air transport can be achieved either through the construction or modernization of airport infrastructure (new facilities, increased capacity) and through the development of land transport (road and rail). **Impact of IE OP investments on the change of accessibility of inland transport is estimated at 2.74%.** Such a state of affairs results primarily from the improvement of road infrastructure and, albeit to a much lesser extent, from point investments on Odrzańska Droga Wodna.

Fig. 12. Percentage change of the synthetic Road Transport Accessibility Indicator (WDDT) as a result of investments co-financed by IE OP during the programming period 2007-2013 (net effect of investments co-financed by IE OP; relative change between accessibility at the end of 2015, taking into account investments of IE OP, and accessibility in 2015 without investments of IE OP). Source: IGIPZ PAN

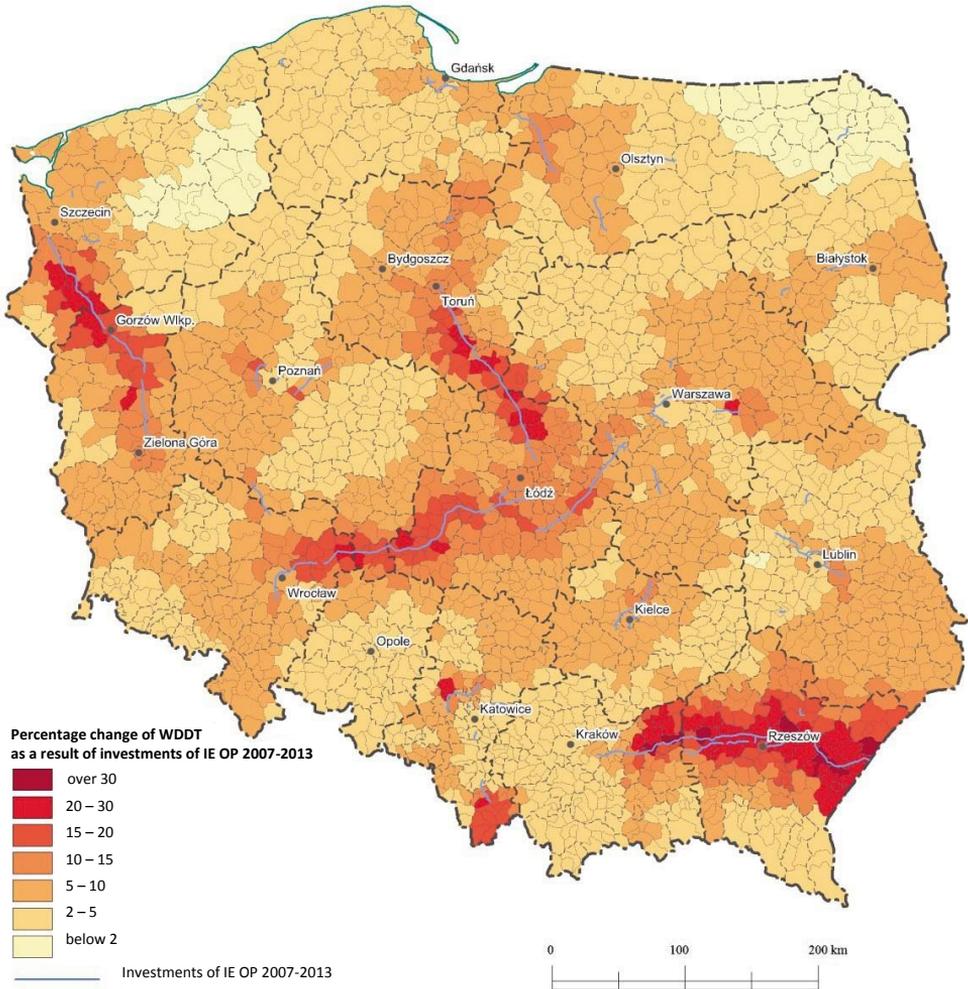
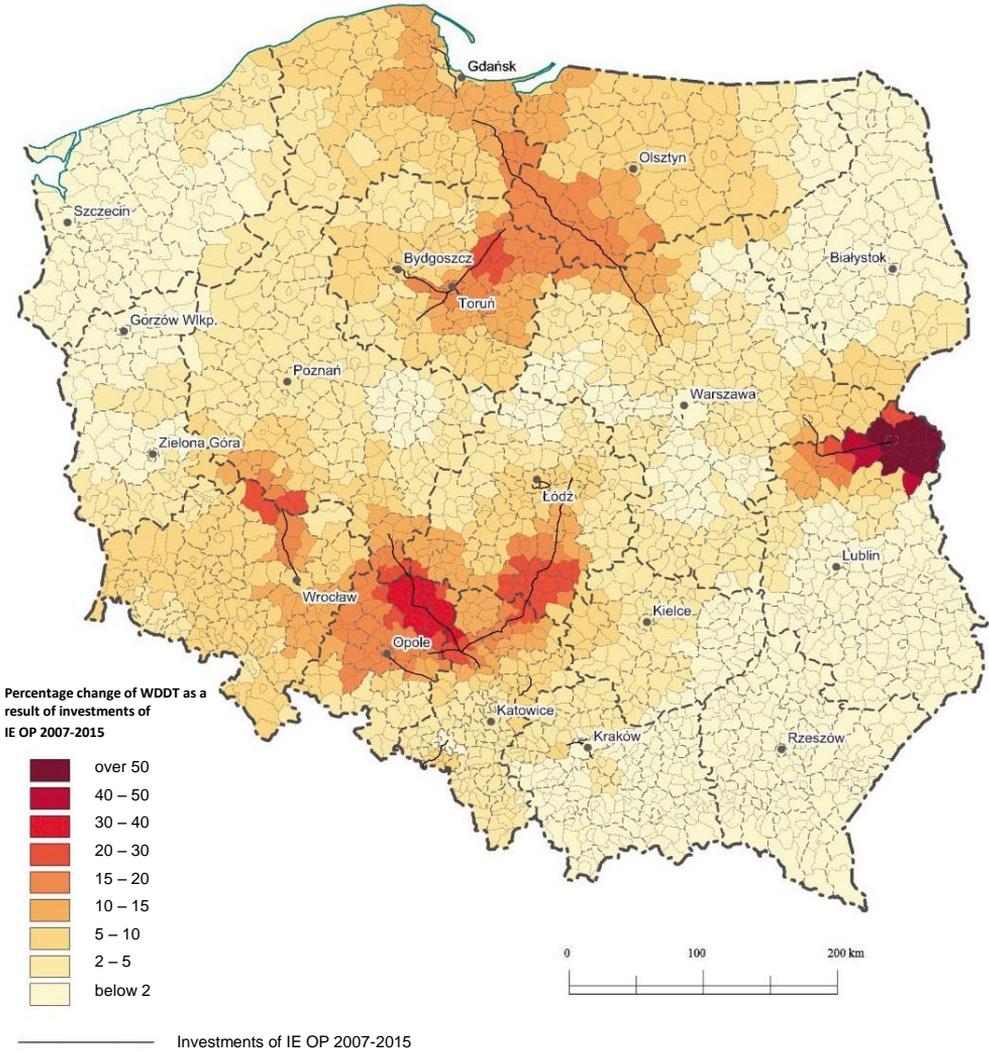


Fig. 13. Percentage change of the synthetic Railway Transport Accessibility Indicator (WKDT) as a result of investments co-financed by IE OP during the programming period 2007-2013 (net effect of investments co-financed by IE OP; relative change between accessibility at the end of 2015, taking into account investments of IE OP, and accessibility in 2015 without investments of IE OP). Source: IGIPZ PAN



The most important thing for changes in the period 2007-2015 were road investments, which indirectly also affected the improvement of aviation and inland water accessibility and locally even railway accessibility (access to nearest stations).

The results of the HERMIN macroeconomic modeling show that the implementation of the IE OP in years 2008-2015 on annual average increased the current level of GDP at current prices in Poland by PLN 55 billion (3.4%). In the Macroregion of Eastern Poland, the impact of IE OP is relatively less visible in relation to the one observed for the whole country. According to the results obtained for the Eastern Poland, as a result of implementation of IE OP, the GDP level of the Macroregion was increasing on average by 3% in the years 2008-2015, while the unemployment rate was being reduced by 1.2 percentage points in relation to alternative scenarios assuming that this Program has never been implemented.

EU funds, through the generation of additional jobs, have contributed to the increase of employment and the limitation of unemployment. The results of the simulation conducted using the HERMIN model indicate that **in 2015 the number of people working in Poland in the scenario taking into account the IE OP funds was higher by 460.6 thousand persons** in relation to the assumed hypothetical situation not taking into account the funds from the IE OP, **and in the territory of Eastern Poland this figure was higher by 71.3 thousand persons**. Magnitude of impact at the level of individual regions was quite varied, ranging from 5.9 thousand people in Podlaskie Voivodship up to 65.7 thousand people in the Śląskie Voivodship.

Results of a survey conducted among 16 voivodes and 16 marshals of voivodships indicate that **the investments implemented under IE OP 2007-2013 had and still have a positive impact on the development of regions and comfort of living of local community**. They are mostly positively assessed by the public. In general, they allow for **better communication, take into account the improvement of transport capabilities in the context of improving access to national borders**. The transport improvements indicated in the surveys concern, inter alia: road parameters, safety (including provision of the necessary fire protection equipment), improvements on railway networks. As a result of implementation of part of the investment, transit traffic has been led out of the cities and the population security has improved. As indicated by the voivodships' authorities, the effect of changes (particularly appreciated by business environments) also include **improvement of parameters of road sections and shortened travel time in a road connection**. Railway investments included preparatory measures towards the centralization and automation of rail traffic control equipment, the purchase of the necessary infrastructure for the maintenance of passenger rolling stock, the purchase of locomotives for passenger traffic. Transport improvements in the field of road rescue (purchase of rescue and fire fighting vehicles) turned out to be socially important. It should be pointed out that a vast majority of the described projects was carried out in cooperation with partners - often several local governments, which proves farsightedness in the approach to investing.

8. Conclusions

8.1. Main conclusions from the study

To sum up, the **overall effect of IE OP 2007-2013 on cohesion of the country is obviously very positive**. The civilization jump that took place in the field of road infrastructure during the programming period 2007-2013 was possible primarily thanks to IE OP projects. In the field of railway infrastructure the effects were not so spectacular, partly due to the projects' phasing process and partly as a result of a generally smaller scale of expenditures. Investment plans for the programming period 2014-2020 indicate that there is a high complementarity in time (2007-2013 and 2014-2020), in program (IE OP vs. ROP and OP EP) and in space (projects implemented mainly in corridors as well as closure of intercity road and railway sections in important functional connections).

Conclusions:

- Thanks to the previous investment activities, including, first of all, thanks to the IE OP, in the years 2007-2013 a very fast development of road network took place. Activities were undertaken on most of the major routes referring to the basic functional linkage system of NSDC 2030 and in TEN-T (basic and complex) network. Their progression is so great that the missing fragments have become natural investment priorities of the current financial perspective. Failure to close the intercity road network would be at the current stage tantamount to wasting the previous investment effort.
- In the programming period 2014-2020 under IE OP, it is necessary to place more emphasis on the reduction of system bottlenecks, both in certain agglomerations (e.g. Warsaw road junction).
- Road safety – among others as a result of implementation of IE OP 2007-2013 projects – the number of accidents has decreased (although this trend changed in 2016) but their costs are increasing. Investments in road infrastructure generally improve the situation in this regard. The traffic safety is threatened by the behavior of car drivers (exceeding speed limits, failure to keep a safe distance, overtaking by trucks). On the other hand, the progressive concentration of traffic on the network of expressways and motorways causes fast depletion of route capacity - especially on sections in the vicinity of large agglomerations. Drivers' expectations concerning significant reduction of driving time after commissioning of the new road is confronted with the problem of congestion increasing the risk of accidents.

- Today's airport network in Poland is a reflection of the previously implemented state policy by implementation of: the Transport Development Strategy for the years 2007-2013 and the Program of the Development of Airport Networks and Aerial Ground Devices. This Program was the basis for the European Commission's approval of support under the Cohesion Fund and the European Regional Development Fund, mainly through the implementation of IE OP 2007-2013. Airports and the broadly understood air transport play a key role in connecting local markets with world markets, which is a prerequisite for the development of both markets and local communities as well as the entire country. The effect of IE OP implementation is, among others, an increase in economic activity associated with or induced by the provision of air transport services. It is necessary to take further actions complying with the principle of sustainable development. It should be emphasized that significant and costly challenges are emerging in Poland in the future within the scope of safety, therefore it is necessary to create conditions and opportunities for obtaining external funds, including the EU, within the scope of IE OP 2014-2020 concerning execution of tasks associated with safety.
- In spite of support from IE OP, the infrastructure of Polish seaports is still largely depreciated, and its technical parameters and equipment (e.g. depths, quay lengths, square loads) do not meet most requirements of today's global maritime transport market. Continuation of support of investment needs' implementation under IE OP 2014-2020 is necessary.
- Further growth potential of ports lies in the possibilities of handling transit relations and favorable economic situation of the Polish and global dimension and in expansion of logistics services area by creation of favorable conditions encouraging the logistics operators to locate their activity in ports in order to expand the range of logistics services (e.g. preparation of investment areas in ports and their neighborhood). It is advisable to develop mechanisms strengthening the inter-sectoral complementarity of investments allowing for maximization of the competitive capacity of ports in the context going beyond the Baltic area by coordinating investment activities executed by responsible actors, i.e. maritime administration (Maritime Offices), port managers and infrastructure managers (PKP PLK S.A., GDDKiA, cities, etc.).
- The effect of scale of the impact of investments implemented under the IE OP in the context of stopping the inland shipping recession has not been fully achieved due to the small resources allocated for this purpose in the Program. The study results show that the inland transport has been under-invested for many years, also in the aspect of infrastructure maintenance, institutional weakness, lack of professional competence and practical experience of the employees in this sector as well as in the aspect of low range of these issues in the transport system.

- Despite substantial resources allocated to railway investments under IE OP 2007-2013, it is advisable to continue investment support including railway infrastructure and passenger infrastructure (e.g. railway stations) in an adequate shape and scope including a change of investment philosophy towards optimization of interventions and re-prioritization of IE OP 2007-2013 objectives towards benefits for final beneficiaries (e.g. total transport time) and rail accessibility to other areas of the country). It is necessary to ensure greater effectiveness of the investment portfolio of PKP PLK S.A. based on the rational premises of the implementation of transport policy, to use the existing investment resources and to include the investment priorities in the implementation of the current programming documents within the scope of socio-economic development.
- In order to make the best use of the resources from IE OP 2014-2020 and CEF, it is necessary to optimize the implementation of the rail investment process at all stages and to ensure a stable medium- and long-term financial frameworks for the maintenance of railway infrastructure. It is also advisable to increase the role of strategic planning, based on the analytical tools related to traffic modeling and multimodal transport planning at the strategic level, independent of infrastructure management units.
- Despite significant investments in the rolling stock and the development of tram networks under IE OP 2007-2013, there are still significant arrears within the scope of the state of the tram network and rolling stock standard. The development of road infrastructure increases the attractiveness of individual transport and the increase in the number of passengers in urban transport is the result of a combination of many activities, including organizational ones. Implementation of the narrowly-specialized rolling stock or infrastructure projects without a broader context may lead to further fragmentation of the system. Therefore, the key to the development of urban transport is expansion of the systems with areas adjacent to the city as well as fully functional and tariff integration of various means of transport.
- Investments in urban transport should include more elements that take into account the actual transport needs of citizens based on the methodically standardized study of needs and forecasts. At the same time it is important to develop consistent transport planning standards at country/ region/ agglomeration level to facilitate the needs analysis process as well as to assess the impact of the investment. At the present stage of urban transport development, projects consisting in the construction/ modernization of lines or the purchase of rolling stock should be implemented, as infrastructure and rolling stock projects are a prerequisite for increasing the share of public transport in transportation in cities and agglomerations.

- Support under IE OP had a great impact on the increase on the number of passengers in large cities, by 10% on average. Modal split in urban transport towards the means alternative to car journeys in large cities that received support from IE OP should be considered as a success when taking into account the increase in the vehicle motorization index.
- Conclusions from the IE OP ex-post evaluation indicate that there are no uniform standards for measuring the division of transport tasks in cities. This is due, among others, the lack of standards for studies on communication behavior which prevents aggregation of data to a higher level and its comparison between individual urban and agglomeration areas. In order to carry out comparative analyses at NUTS2 and NUTS3 levels, it is advisable to create top-down provisions on standardization of studies in the form of guidelines or a manual.
- Due to often pilot nature of implemented ITS projects under IE OP, the potential of ITS systems is insufficiently exploited. Solutions are in many cases not optimal in relation to the needs. Therefore, it is necessary to expand and modernize ITS systems to achieve the effect of scale and to further promote open systems and publicly provide non-sensitive data for the needs of the application and citizen-friendly solutions (traffic volume and structure, travel planning, timetables-changes, fares–tariffs, etc.).
- The imbalance of investments from previous perspective between road and rail transport and the weakened importance of public transport associated, among others, with consumer preferences for individual car transport constitute an important challenge of IE OP 2014-2020. Despite the improvement recorded in recent years, the safety of road and rail transport continues to be unfavorable in international comparisons.
- The impact of the IE OP mainly concerned metropolises, voivodship centers and in spatial arrangements - Western Poland to a greater extent than Eastern Poland. Therefore, necessary is a consequent support of infrastructure development and its integration in all spatial scales, in order to avoid the sustained backwardness of certain areas of the country, which would make it impossible to use their territorial potentials.
- Within the frameworks of IE OP 2014-2020, ensuring the allocation of investment resources and funds for the maintenance of already existing transport infrastructure will require, among others, improvement in the quality of investment process management in the field of road and rail infrastructure, as well as strengthening of public transport management mechanisms in cities. Priority should be given to the integration of different transport modes, the development of passenger and freight intermodal transport.

We encourage you to familiarize yourself with the Final Report on the Ex-post Study of support to the transport sector in IE OP 2007-2013 available in electronic version at: www.cupt.gov.pl (Research and Evaluations tab)



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