Ex post evaluation of major projects supported by the European Regional Development Fund (ERDF) and Cohesion Fund between 2000 and 2013

Construction of a new rail link from Warsaw Służewiec to Chopin Airport and modernisation of the railway line no. 8 between Warsaw Zachodnia (West) and Warsaw Okęcie station

Poland

EUROPEAN COMMISSION

Directorate-General for Regional and Urban Policy
Directorate Directorate-General for Regional and Urban Policy
Unit Evaluation and European Semester

Contact: Jan Marek Ziółkowski

E-mail: REGIO-B2-HEAD-OF-UNIT@ec.europa.eu

European Commission
B-1049 Brussels

Ex post evaluation of major projects supported by the European Regional Development Fund (ERDF) and Cohesion Fund between 2000 and 2013

Construction of a new rail link from Warsaw Służewiec to Chopin Airport and modernisation of the railway line no. 8 between Warsaw Zachodnia (West) and Warsaw Okęcie station

Poland

Directorate-General for Regional and Urban Policy

2020 EN

Europe Direct is a service to help you find answers to your questions about the European Union.

Freephone number (*)**:**

00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Manuscript completed in 2018

Luxembourg: Publications Office of the European Union, 2020

ISBN 978-92-76-17419-6
doi: 10.2776/631494

This report is part of a study carried out by a Team selected by the Evaluation Unit, DG Regional and Urban Policy, European Commission, through a call for tenders by open procedure No 2016CE16BAT077.

The consortium selected comprises CSIL – Centre for Industrial Studies (lead partner, Italy), Ramboll Management Consulting A/S (Denmark), Significance BV (The Netherlands), TPLAN Consulting (Italy).

The Core Team comprises:

- Scientific Director: Massimo Florio (CSIL and University of Milan);
- Project Manager: Silvia Vignetti (CSIL);
- Scientific Committee: Ginés de Rus, John Nellthorp, Emile Quinet;
- Task managers: Silvia Vignetti (CSIL), Gerard de Yong (Significance), Roberto Zani (Tplan), Emanuela Sirtori (CSIL), Xavier Le Den (Ramboll), Julie Pellegrin (CSIL);
- Thematic Experts: Gianni Carbonaro (CSIL), Enrico Bernardis (Tplan), Mario Genco (CSIL), Eric Kroes (Significance), Kim Ruijs (Significance), Barry Zondag (Significance).

A network of National Correspondents provides the geographical coverage for the field analysis.

The authors of this report are Izabela Kaczmarzyk and Roberto Zani. The authors are grateful to all the project managers, stakeholders and beneficiaries who provided data, information and opinions during the field work.

The authors are grateful for the very helpful insights from the EC staff and particularly to Mariana Hristcheva, Daria Gismondi, Jan Marek Ziółkowski, Jerome Glantenay, and other members of the Steering Group. They also express their gratitude to all stakeholders who agreed to respond to the team's questions and contributed to the realisation of the case study. The authors are responsible for any remaining errors or omissions.

Cover picture source: authors.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

B/C	Benefit/Cost ratio
CBA	Cost-benefit analysis
DG REGIO	Directorate-General for Regional and Urban Policy
EC	European Commission
EIA	Environmental Impact Assessment
ENPV	Economic Net Present Value
ERDF	European Regional Development Fund
ESIF	European Structural and Investment Funds
ERR	Economic Rate of Return
EU	European Union
EUR	Euro
FNPV/C	Financial Net Present Value of the investment
FNPV/K	Financial Net Present Value of national capital
FRR/C	Financial Rate of Return on investment
FRR/K	Financial Rate of Return on national capital
FS	Feasibility Study
GDP	Gross Domestic Product
GHG	Greenhouse Gas
JASPERS	Joint Assistance to Support Projects in European Regions
KM	Masovian Regional Railways (Koleje Mazowieckie)
NPV	Net Present Value
NUTS2	Nomenclature of Territorial Units for Statistics
O&M	Operating & Maintenance
PLN	Polish Zloty
PPL	„Polish Airports" State Enterprise (Przedsiębiorstwo Państwowe „Porty Lotnicze")
PPP	Purchase Power Parities
SKM	Metropolitan Railway Service (Szybka Kolej Miejska)
TEN-T	Trans-European transport networks
ToRs	Terms of References
VAT	Value Added Tax
VOC	Vehicle Operating Cost
VOT	Value of Time
ZTM	Public Transport Authority (Zarząd Transportu Miejskiego)

EXECUTIVE SUMMARY

This case study illustrates the story of the modernisation of the railway line no. 8 between Warsaw Służewiec and Warsaw Okęcie station, and construction of a new rail link to the Chopin Airport located at Okęcie, a neighbourhood district of the Polish capital city. This major infrastructure investment was co-financed by the EU over the programming period 2007-2013. More specifically, this is an ex-post evaluation assessing the long-term effects produced by the project and disentangling the mechanisms and determinant factors that have contributed to the production of these effects. The analysis draws from an ex-post Cost-Benefit Analysis (CBA)[1] and from an extensive set of qualitative evidences, both secondary (technical reports, official reports, press articles, books and research papers) and primary (interviews with key stakeholders and experts have been carried out in the period between September 2017 and March 2018[2]).

OVERALL APPROACH AND METHODOLOGY

The overall approach and methodology followed in the evaluation study is briefly recalled hereafter and more extensively in Annex I.

The Conceptual Framework delivered in the First Intermediate Report has been developed to answer the evaluation questions included in the ToR, and further specified and organised in accordance with the study team's understanding. In particular, there are **three relevant dimensions of the analysis**:

- **The 'WHAT'**: this relates to the typologies of long-term contributions that can be observed. The Team classified all the possible effects generated by transport projects (including road, rail, and urban transport projects) under the four following categories: 'Economic growth'; 'Quality of life and well-being' (i.e. factors that affect the social development, the level of social satisfaction, the perceptions of users and the whole population); 'Effects related to environmental sustainability' and 'Distributional impacts'.
- **The 'WHEN'**: this dimension relates to the point in the project's lifetime at which the effects materialise for the first time (short-term dimension) and stabilise (long-term dimension). The proper timing of an evaluation and the role it can have in relation to the project's implementation is also discussed here.
- **The 'HOW'**: this dimension entails reasoning on the elements, both external and internal to the project, which have determined the observed causal chain of effects to take place and influenced the observed project performance. To do this the Team identified six stylised determinants of projects' outcomes (relation with the context; selection process; project design; forecasting capacity; project governance; managerial capacity). The interplay of such determinants and their influence on the project's effects is crucial to understand the project's final performance.

The methodology developed to answer the evaluation questions consists of ex-post Cost Benefit Analysis complemented by qualitative techniques (interviews, surveys, searches of government and newspaper archives, etc.),

[1] Data, hypotheses and results are discussed in Annex II.
[2] See Annex III for a detailed list of interviewees.

combined in such a way as to produce a project history. CBA is an appropriate analytical approach for the ex-post evaluation because it can provide quantification and monetisation of some of the long-term effects produced by the project (at least those also considered in the ex-ante CBA). However, the most important contribution of the CBA exercise is to provide a framework of analysis to identify the most crucial aspects of the projects' ex-post performance and final outcome. It is worth noting that the purpose of this evaluation is not to compare ex-ante and ex post CBAs and that the results of these assessments are not easily comparable, because even if they rely on the same principles and draw from the established CBA methodology, there are often important differences between how the ex-ante and ex-post assessments were scoped and what data were taken into account. Qualitative analysis on the other hand is more focussed on understanding the determinants and causal chains of the delivery process as well as to assess effects that may be difficult to translate in monetary terms.

MAIN PROJECT FEATURES

The major project is located in Warsaw, capital city of the Republic of Poland and of the Masovian Region, and a Core Urban Node of the Baltic - Adriatic and North Sea – Baltic Core Network Corridors.

The investment has been conceived, planned, and implemented by the Polish Authorities with a twofold aim: improving the accessibility to the main international airport of Warsaw by interconnecting it to the national railway network and at the same time improving the performance of the public transport system by railway in the Warsaw metropolitan area and Masovian region as part of the modernisation programme of the national railways in the urban area of Warsaw. The major project **consisted of the development of a railway link to interconnecting the Warsaw Służewiec station with the Chopin Airport** partially in underground alignment. It included the **construction of an access ramp from the existing railway line no. 8 to the terminus station located at the Chopin (Okęcie) Airport for a total length of 1.990 km**. The works also comprised the **reconstruction of the passenger station Warsaw Służewiec**, **provision and instalment of underground railway stations related equipment, modernisation of track no. 1 of railway line no. 8 from km 10.512 to km 11.809**, including catenary and other railway facilities and equipment.

The project involved a total initial investment of EUR 64 million, in nominal prices, **60% of which co-financed by the Cohesion Fund (CF)**. The remaining 40% was covered by national subsidies (22%) and by own resources of the beneficiary, the national railway infrastructure manager PKP PLK S.A. (18%). The preparatory works were undertaken between 2007 and 2009 and the project was implemented between 2009 and May 2012 (2013 thus representing the first full year of operation for the purpose of the elaboration of the ex-post CBA).

At the beginning of 2000s the City of Warsaw was suffering from lack of adequate and fast public transport connections between the airport and the urban, suburban and regional transport systems. Furthermore, the city was experiencing significant economic growth associated with an increase in the total number of airport passengers, and sustained growth of the motorisation index. These resulted in increased traffic congestion and declining of travel conditions expressed in terms of travel times and reliability, including the link between the city

centre and the Chopin Airport. The increase of the capacity of the existing public transport system also adding a sustainable transport mode in alternative to road transport towards the Chopin Airport was perceived as strategically relevant in the wider context of the development and promotion of public transport services by railway in the Warsaw metropolitan area and Masovian region. In addition to this, the hosting by Poland of the EURO 2012 Football Championship is also worth to mention, which offered an important additional element in favour of the timely development and implementation of the major project.

PROJECT PERFORMANCE

Based on the different findings produced by the project analysis, the final assessment of the project performance is presented hereafter, along a set of evaluation criteria.

Project relevance and coherence

The project was relevant in the context where it was implemented, as it was the appropriate initiative to increase the overall capacity of the public transport system by railway in the Warsaw metropolitan area and Masovian region, providing accessibility to the Warsaw Chopin Airport, located at Okęcie. In a context of economic growth and increase in the total number of airport passengers and local motorization index, the major project responded to the need to provide a reliable alternative transport mode to road transport, thus adding capacity in providing accessibility to the airport also promoting at the same time sustainable mobility in the Warsaw metropolitan area and Masovian region. These strategic goals of the project are fully in line with the priorities set in a number of strategic documents at local, regional and national levels, including the 2001 Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw, that first introduced the concept for the interconnection of the Chopin Airport to the national railway network.

The major project is overall coherent with the need to modernise and improve the quality of railway transport in the Warsaw metropolitan area and Masovian region and it is also consistent with the need to develop the accessibility to the Chopin Airport. Actually, under the infrastructure stand point, the major project was both associated with the initiatives for the modernisation of the Polish national railway network in the Warsaw urban area and with the project for the expansion of the airport and specifically with the initiative for the construction of the second terminal. From the functional standpoint, it was furthermore aimed at increasing the offer and usage of public transport by railway in the wider Warsaw metropolitan area and Masovian region. Accordingly, the realisation of the link was considered for implementation as part of the plans, strategies and studies for the modernisation of national railway line no. 8 in the urban area of Warsaw, increasing the speed and safety of railway transport between Warsaw Zachodnia (West) and Warsaw Okęcie, close to the airport. Upon completion of the project two railway lines were put into operation in addition to the existing suburban S2 line already reaching Okęcie station: the suburban railway line S3, and the regional railway line RL. New rolling stock was purchased to be used on the three lines which provided not only accessibility to the airport, but also served passenger and commuter traffic in the agglomeration of Warsaw. Interconnecting with the main railway stations in Warsaw, these lines were not just covering important sectors of the Warsaw metropolitan area and Masovian region, they were also allowing passengers from national railway and long-distance coach services reaching the airport by interchanging at these main

transport hubs. Today a set of historical data is available concerning the total number of passengers served by the S2 and S3 railway lines interconnecting to the Warsaw Chopin Airport. **The implementation of the project and the increase in the operation of the railway services interconnecting to the airport after its completion seem to have contributed to the growth in the usage of public transport by railways in the Warsaw metropolitan area and Masovian region**. Whilst detailed data on the railway trips having the airport as origin or destination are only partially available (between the city centre and the airport and limited to RL services only), the project is reasonably expected to have turned public transport services to the airport more reliable and attractive as also confirmed by the results of the surveys on accessibility patterns to and from the airport, performed by the "Polish Airport" State Enterprise.

Project effectiveness

Overall, the project achieved the expected objectives. The different effects generated by the project are briefly presented in what follows.

The investment was worthwhile because, while costing EUR 134.3 million (in nominal value, including EUR 64 million for the major project and EUR 70.3 million for the rolling stock), the socio-economic NPV of the project is equal to EUR 216.1 million[3], with an ERR of 12.9%. The performance indicators confirm that the project was desirable for society and increased welfare. This is the result of the combination of two main drivers: first, cost savings in the construction phase; and secondly, a considerable reduction in the social costs of the trips served by railway transport, namely time savings, VOC reductions, reduction in accident cost, air pollution, GHG emissions, noise. **Additionally, the risk analysis shows that under the socio-economic perspective the project has a negligible risk level**, i.e. with negative variations from the reference case of the values of critical variables, there is no probability that the ENPV of the project become negative and a probability of nearly 50% that the expected ENPV is less than the reference one.

Based on interviews with the stakeholders it is reasonable to assume that the quality of the service provided increased since the completion of the project and that the services are satisfactory. The rail services on the lines interconnecting to the Chopin Airport are all operated with new modern and comfortable trains. The stations and rolling stock are equipped with real time passenger information displays, and are accessible to persons with reduced mobility. No complains have been recorded about the quality of the public transport services providing accessibility to the airport.

With respect to the time frame of effects, it is reasonable to consider that most of the benefits are likely to have already materialised and stabilised. However an external factor which may affect the project performance in the future should be mentioned, which is related to the planned construction of a new airport located between Warsaw and Łódź (in Baranów), with a capacity up to 100 million passengers per year as indicated by the Resolution of the Council of Ministers dated 7th November 2017 on the "Concept of preparation and implementation of the Solidarity Port – Central Communication Port for the Republic of Poland". Albeit at its inception stage, it is envisaged that this airport may be

[3] With a social discounted rates adopted at the level of 4.83% backward and 4.19% forward.

completed by 2027 and takeover the passengers' operations from Okęcie Airport, which will be used for military purposes only. The concretisation of this possibility would impact on the demand for railway services interconnecting to the airport thus reducing the benefits associated with the implementation of this major project.

It is worth mentioning that along with an overall positive project assessment an unexpected inconvenience emerged after the completion of the project, at the operational stage, **which is related to the lack of throughput capacity of passengers' outflows from the Warsaw Służewiec railway stop**. The Służewiec business area is one of the largest and busiest in the city of Warsaw attracting and generating significant commuter traffic during the week. In the peak hours, in order to avoid queuing to exit the station using the existing overpass, commuters cross the railway line. This unsafe behaviour by the users has been observed since approximately 2015 and is still continuing today despite the adoption of measures to avoid this practice. The users of the station complained about the design of this railway stop, which is considered not appropriate to provide the required throughput capacity in the peak hours. The Polish Authorities have installed safety barriers and put in place a safety campaign and 'no passage' signs, promoting the usage of the overpass. **Technical solutions are under consideration to expand the capacity of the existing overpass, including the construction of an underpass**.

Project efficiency

Some delays in the implementation of the major project related works and a slight increase in the project costs occurred, associated with some additional unpredicted activities and works. **In any case the services interconnecting to the airport were put in operation in time for the start of the European Football Championship Euro 2012**. Thanks to savings in the tendering process, **the project's construction was ultimately completed with a budget slightly lower** (PLN 271.5 million) **than the one originally assumed** (PLN 300 million).

The financial sustainability has been assessed for the project by adjusting the ex-ante financial projections on the basis of 2009-2016 data, **which is positive**. The project investment was co-financed by the EU (CF) and national resources. The overall level of EU co-funding for this project was 80% of eligible expenditures. The national contribution was partially covered by the direct subsidiary and PKP PLK S.A. own means. The revenues from stations and track access charges cover the operation and maintenance costs.

EU added value

On the basis of the available data and consultation of the concerned stakeholders it is reasonable to conclude that the major project has contributed to an increase in the use of railway transport in the Warsaw metropolitan area and Masovian region also increasing the attractiveness of the accessibility by public transport to the Chopin Airport. Overall **the project is worth generating positive effects and impacts which could not be achieved without the financial support from the EU**.

At the end of 2013, the Regulation EU 1315/2013 was published which set the basic rules for the development of the new TEN-T policy, also identifying 9 core network corridors, including the North Sea-Baltic and Baltic-Adriatic corridors. Warsaw is a core network node of both corridors. According to the Regulation Warsaw Airport shall be connected to the core railway network by 2030. **The major project allowed reaching this target of the TEN-T Regulation well in advance of the 2030**

deadline, an objective which would have not been possible without the EU support.

As a final remark **the role of JASPERS is worth to mention which can be considered an additional element of the EU added value**. As a matter of facts, it helped the project beneficiary streamlining the project design in the preparatory phase, leading to a better definition of the risk associated with the construction works.

MECHANISMS AND DETERMINANTS

In terms of mechanisms and determinants explaining the project outcomes, the first finding is that **the institutional, economic and social context played a relevant role in the project's success**. The plans for the expansion of the Chopin Airport and the ones for the modernisation of the national railway network, including the Warsaw urban area, supported the development and implementation of the project. These development plans were underpinned by the economic growth of Poland and its capital city, which were supporting an increase of the number of passengers at the airport and of the motorisation index of the country and city. Due to the increase in the motorisation index the City of Warsaw started planning initiatives to promote the development of sustainable transport solutions, by investing in public transport. The EU accession created the financial conditions for the expansion of the airport infrastructure and for the definition of a nationwide programme for the modernisation of the railway network. Both the plans for the expansion of the airport and the modernisation of the railway network contemplated the development of the railway link to the airport which had been also included in the 2001 Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw. After and thanks to the completion of the project, public transport services by railway in the Warsaw metropolitan area and Masovian region were put in place and expanded (S2, S3 and RL services) to increase the offer of sustainable transport solutions in the agglomeration of Warsaw. The context was highly positive for the project also considering the expected growth of airport passengers, due to the planned European Football Championship EURO 2012. Within this context, **the project benefited from the commitment by all concerned parties towards its factual and fast implementation**.

The success of the project was also largely due to its accurate planning and selection process. The cooperation among the different stakeholders and concerned authorities in the development and implementation of the project proved to be very effective also thanks to the adoption of formal agreements binding all the parties concerned by the development of the road and rail infrastructure surrounding the new Terminal 2, namely the State Treasury and more specifically the "Polish Airports" State Enterprise, the Warsaw City Hall and PKP PLK S.A.

A public consultation process was undertaken as part of the EIA process, in line with the regulations in place at the time the project was developed and prepared for implementation. No specific critical elements were noted, and the project was welcomed by the involved parties and citizens. After its completion at the very initial stage of operation of the link, contradicting articles appeared on the press, some of them commenting positively the availability of the link. Some others were more negative, and even criticised the lack of users. Nevertheless, **the available traffic data and the results of the survey carried out by the "Polish Airports" State Enterprise seem actually to support the conclusion that the major project has**

contributed to the promotion of public transport by railways in the Warsaw metropolitan area and Masovian region, including the accessibility to the Chopin Airport.

Finally, **another factor which has positively influenced the project's outcome is the well-defined roles and responsibilities within PKP PLK S.A. and the experience of the national railway infrastructure manager in planning, designing and managing tendering processes for the modernisation of the railway network**. The procurement of the works and works supervision services was smooth and effective, which even resulted in cost savings, some of which used for the appropriate and timely solution of some unpredictable problems, related to the repairing of the underground tunnel drainage system; and removal of landmines and petroleum derivatives in the ruins of the Zbarż Fort, a National Heritage site located in-between the national railway line no. 8 and the Chopin Airport.

CONCLUSIONS

In conclusion, **the major project represents a good example of railway transport infrastructure project to promote sustainable transport in a wider metropolitan area, including accessibility to a major transport hub and enhancement of transfer of passengers between transport modes in a core urban node of the TEN-T network.** The project seems generating positive effects both by increasing the capacity and performance of the public transport system in the Warsaw metropolitan area and Masovian region, as well as by providing direct interconnection by railway to the international airport of the capital city of Poland. The project managed to deliver all the foreseen benefits at the expected time and costs. This achievement is due *in primis* to the strategic relevance of the project for all the concerned parties i.e. the "Polish Airports" State Enterprise, the Warsaw City Hall and the national railway infrastructure manager PKP PLK S.A. This ensured commitment in the planning and development of this initiative. This is also the result of good managerial capacity and effective project management and work supervision. The local authorities were in fact able to promptly provide an adequate response to the local needs and secure the financial and technical capacity available for the initiation and implementation of the project. The fact that the service operation is adequately provided by the operators and that the new vehicles are maintained in good conditions is another key factor explaining the positive performance of the project. As a matter of fact, the railway services are reliable and attractive which have reasonably contributed to an overall increase in the usage of public transport services in the Warsaw metropolitan area, as well as to keep high shares of accessibility by public transport to the airport. **The positive performance of the project, although it is expected to be maintained in the long-run, would possibly be affected by the evolving context**. More specifically and albeit at its inception stage, the construction of a new airport located between Warsaw and Łódź (nearby Grodzisk Mazowiecki), with a capacity up to 100 million passengers per year, currently at the planning stage and expected to be completed by 2027, would impact on the demand for railway services interconnecting the city centre with the airport, thus reducing the benefits associated with the operation of this major project.

1. PROJECT DESCRIPTION

The project 'Modernisation of railway line no. 8, construction of new rail link to Chopin Airport (from passenger station Warsaw Służewiec to Chopin Airport)' (CCI2010PL161PR006) **is a stage of a wider investment scheme** aiming at modernising railway line no. 8 connecting Warsaw to Kraków, between Warsaw Zachodnia (West) and Radom, for a total length of about 100 km. According to the modernisation plans of the national infrastructure manager PKP PLK S.A., the modernisation of this line has been divided into several stages. One of these stages is related to the modernisation of the line within the Warsaw urban area, between Warsaw Zachodnia (West) and Warsaw Okęcie stations. Due to the proximity of the latter station to the capital city Chopin Airport – located in the town of Okęcie – the Polish authorities decided to associate the development and construction of a new railway link to the Chopin Airport with the modernisation of railway line no. 8. In accordance with this strategy the implementation of the modernisation of the line between Warsaw Zachodnia (West) and Warsaw Okęcie was divided into three phases, the first one related to the preparatory works; the second one regarding construction works for the modernisation of the Warsaw Zachodnia (West) - Warsaw Okęcie section; and the third one – namely the investment under assessment – primarily consisting of the construction of the link between the Warsaw Służewiec station on railway line no. 8 and the Chopin Airport, but also including some modernisation works between Warsaw Służewiec station and Warsaw Okęcie station on the same line, as well as the modernisation of the Warsaw Służewiec station.

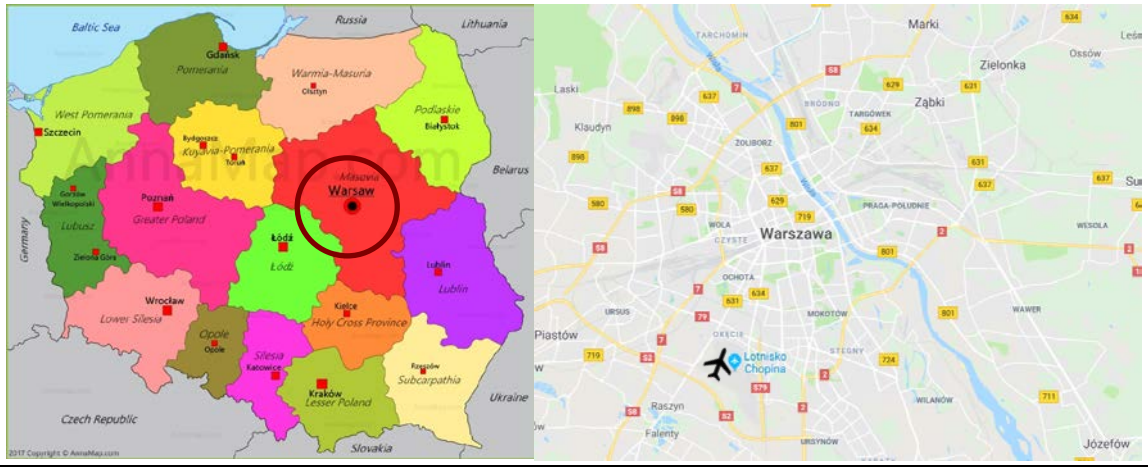
The major project relates to the development of a railway link to the Okęcie airport interconnecting the Warsaw Służewiec station with the Chopin Airport, partially in underground alignment. It included the **construction of an access ramp from the existing railway line no. 8 to the terminus station located at the Chopin Airport for a total length of 1.990 km**. The works also comprised the **reconstruction of the passenger station Warsaw Służewiec**, **provision and instalment of underground railway stations related equipment, modernisation of track no. 1 of railway line no. 8 from km 10.512 to km 11.809**, including catenary and other railway facilities and equipment. The ex-post total investment cost amounts to EUR 64 million in nominal terms.

This section contains a brief description of the project. The socio-economic context, the target population and the key structural features of the infrastructure and service delivered are outlined in order to provide a general description of the project context and objectives.

1.1 CONTEXT

The project is located in the city of Warsaw, capital city of the Republic of Poland (central Poland), and Core Urban Node of the Baltic - Adriatic and North Sea – Baltic Core Network Corridors. The major project represents a last mile connection to the Chopin Airport, which is also a core transport node of the two above mentioned core network corridors.

Figure 1. Polish Regions and transport network in Warsaw

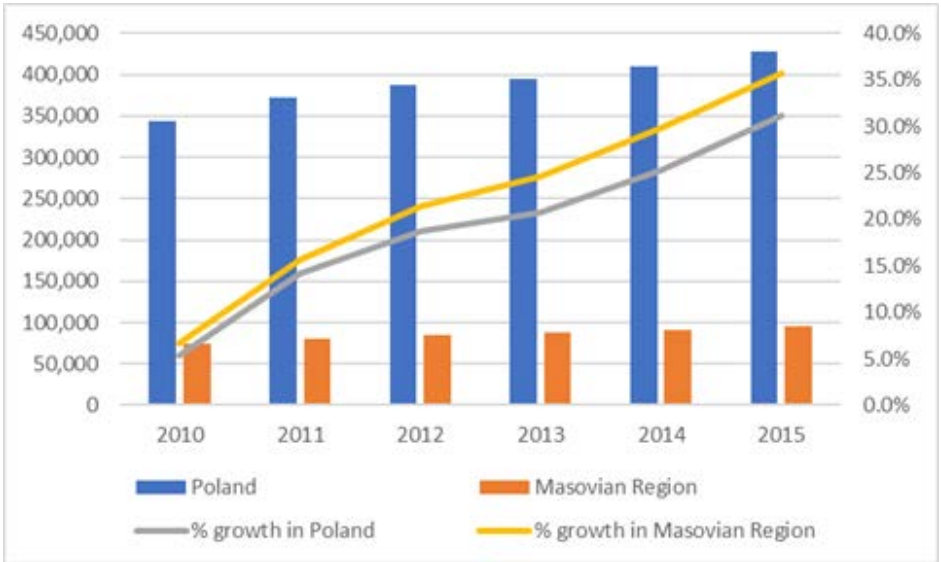


Source: www.AnnaMap.com and http://www.google.maps.pl

The city of Warsaw is part of the Warsaw greater metropolitan area, with over 3 million residents by mid-2017, and it is included in the Masovian region, with a population of about 5.4 million inhabitants in 2017. **The population of the city of Warsaw as of December 2016 amounted to 1,753,977 inhabitants, representing the largest city in the whole country**. Warsaw as the capital city of Poland is the most important economic centre in the country, also registering the highest number of public institutions. The city is also an important science, historical, cultural centre, as well as a popular tourist destination. Its historical *Old Town* was designated by the UNESCO as a World Heritage Site.

As of 2015 the Masovian region produced approximately 22.2% of the national Polish GDP. The figure below shows the trend in the GDP growth between 2010 and 2015. In line with the national trend the region has registered a constant increase of the GDP value since 2010. Considering the GDP (PPP), Warsaw is the wealthiest capital city in Central and Eastern Europe alongside Berlin.

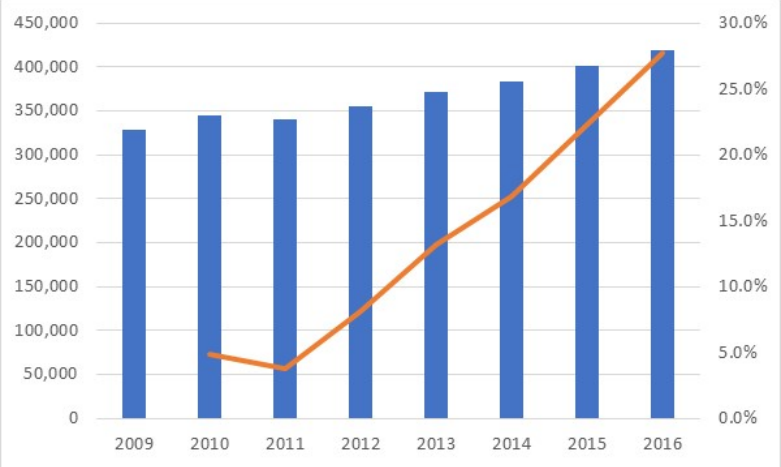
Figure 2. GDP in Poland and Masovian Region (in EUR million)



Source: Authors, based on data from GUS (Central Office of Statistics)

The increasing number of registered economic entities shows that Warsaw is a dynamically growing economic centre in Poland.

Figure 3. Economic activity in Warsaw (number of registered economic entities in the city of Warsaw)



Source: Authors based on data from GUS (Central Office of Statistics)

The city is also home to major universities, high-end malls, government seats, churches and some of Europe's tallest buildings. Many global companies have building branches, offices and headquarters in Warsaw. The industry of the city is particularly strong in the following sectors: electronics, high-tech mechanics and food-processing. Large steel mill and car factories for the production of components and subassemblies are also still present in the city. Warsaw Stock Exchange proves to be one of the most promising trading sectors in Europe, with nearly 480 companies listed. As the capital city of Poland and hub of the national Polish airline Polskie Linie Lotnicze LOT S.A (LOT), Warsaw attracts numerous civil aviation passengers for administrative and business purposes. **Tourism is also a relevant economic activity** in the city, that offers an attractive Old Town, rebuilt in its original shape, after the Second World War, along with modern facilities.

The following figure shows the annual number of overnight stays in Warsaw from 2009 to 2016. The dynamic growth recorded over the past years is noticeable. It is worth to mention that the increase observed in 2012 is also related to the Euro 2012 European Football Championship.

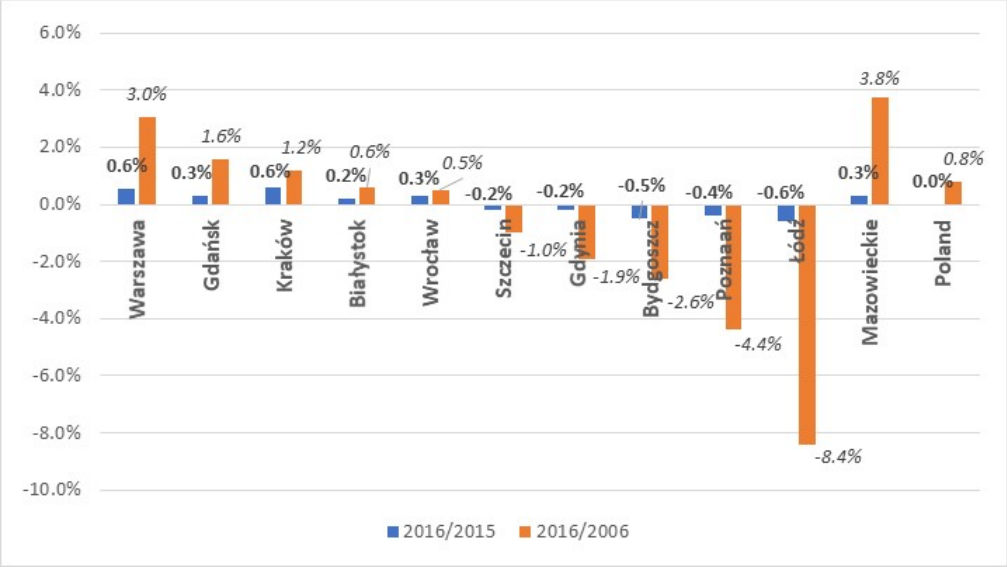
Figure 4. Overnight stays in Warsaw

Source: Authors, based on data from GUS (Central Office of Statistics)

The overall positive economic conditions are also reflected in the monthly average salary of the city employees, which has also constantly increased between 2005 and 2015. This was equal to PLN 5,314/EUR 1,265 (in 2015) representing by far the highest in Poland.

All these elements make Warsaw an attractive place to live, which is proved by the statistic indicators relating to population and migration.

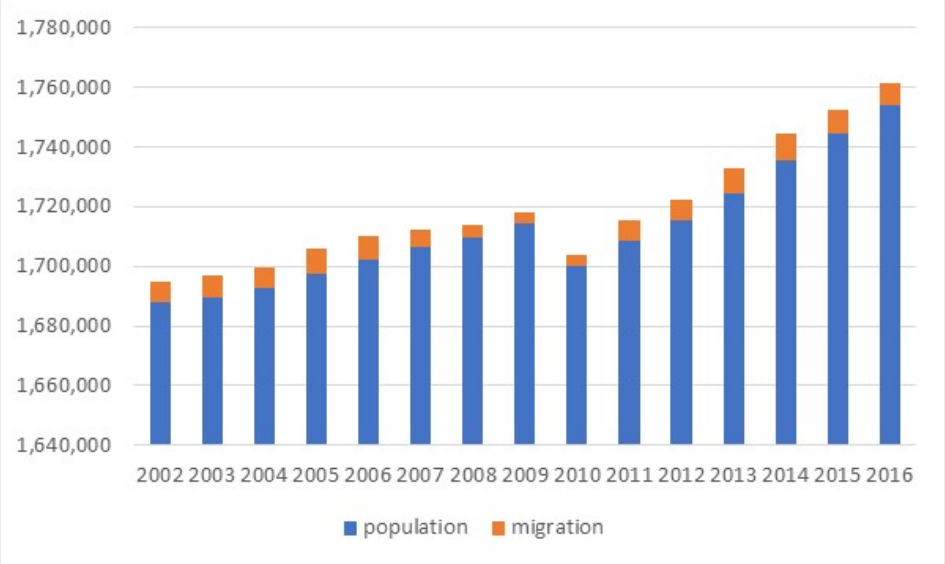
Figure 5. Percentage change in population of Warsaw in the context of other selected Polish cities, Masovian Region and the whole country



Source: Authors, based on data from GUS (Central Office of Statistics)

Actually, Warsaw is experiencing a population growth, with both a natural increase and a net migration from Poland and other countries, yielding a positive value in the region, **especially in the last 6 years**.

Figure 6. Natural demographic and migration growth in Warsaw between 2002-2016

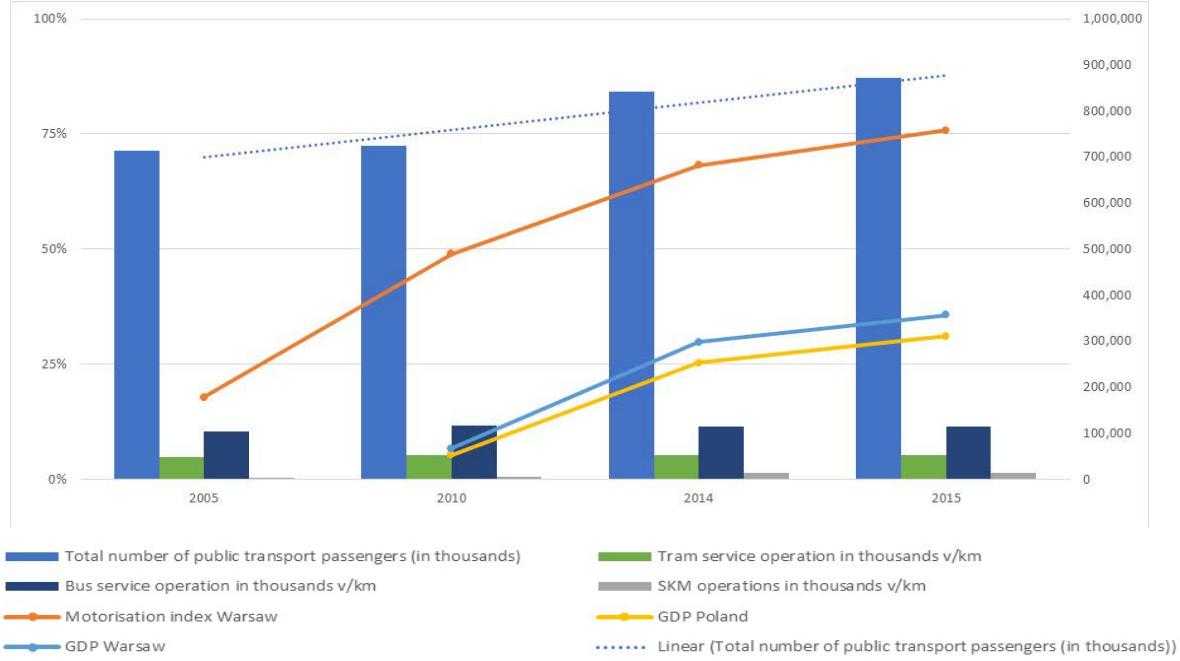


Source: Authors, based on the data from GUS (Central Office of Statistics)

The age structure of Warsaw population is characterised by a decreasing share of people in working age and growing share of elderly people, observed in the last 15 years; whereas the population in the pre-working age is relatively stable.

At the time the feasibility study for the railway link to the Chopin Airport was prepared in 2005, **the city of Warsaw was experiencing significant economic growth** (in line with the overall development of the whole Polish economy). **This was also associated with a sustained increase in the motorisation index**. In parallel, the public transport system operations were growing together with the number of public transport passengers (see figure below).

Figure 7. Socio-economic and operational context of the Warsaw public transport system (2005-2015)

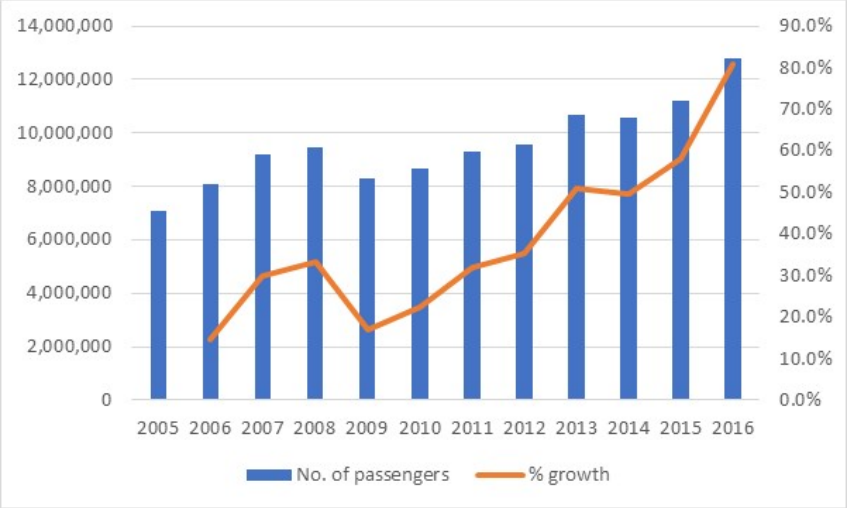


Source: authors based on data from GUS (Central Office of Statistics) and ZTM.
*Notes: * lines refer to the scale on the left; columns refer to the scale on the right*

In 2005 the annual number of public transport passengers in Warsaw was about 713 million, including users of the bus, metro, train and trams systems. This number systematically grew over the past decade and reached 872 million in 2015.

Warsaw and its surrounding territories are served by two airports, the largest Polish airport located within the city boundaries – Warsaw Chopin Airport, and a smaller one, Warsaw Modlin airport – located about 40 km far from the city centre. The Chopin Airport totalled nearly 12.8 million passengers in 2016, equivalent to 37% of the passengers registered at all Polish airports in the same year. Modlin airport, dedicated to the low-cost market segment, registered approximately 2.8 million passengers in 2016.

Figure 8. Number of passengers at Warsaw Chopin Airport (2005-2016)



Source: ulc.gov.pl

Warsaw Chopin Airport is located within a distance of 8 kilometres from the city centre of Warsaw. The airport is currently accessible by private cars, taxies, intercity coaches, urban buses, as well as by suburban and regional trains. Specifically regarding the accessibility to the airport by public transport services in the urban area, urban bus services are operated by the municipal company Zarząd Transportu Miejskiego (ZTM)[4]. **Urban bus services are operated every 10-20 minutes depending on the time of the day and every 30 minutes at night**. **The frequency of the train services is about 15-minutes[5]. These are operated by two railway undertakings: SKM (Szybka Kolej Miejska w Warszawie – Metropolitan Railway Service) and KM (Koleje Mazowieckie – Masovian Regional Railway)**. The train services currently operated from/to the Chopin Airport by these operators are two suburban (SKM S2, SKM S3) and one regional (RL) railway lines.[6] The bus line 175 and the S2, S3 and RL rail services allow interconnecting the airport with the Warsaw central railway station, respectively in 22-27 minutes and 22-24 minutes. The S2, S3 and RL railway lines also ensure interconnection to the airport by railway from the wider Warsaw metropolitan area and Masovian region.

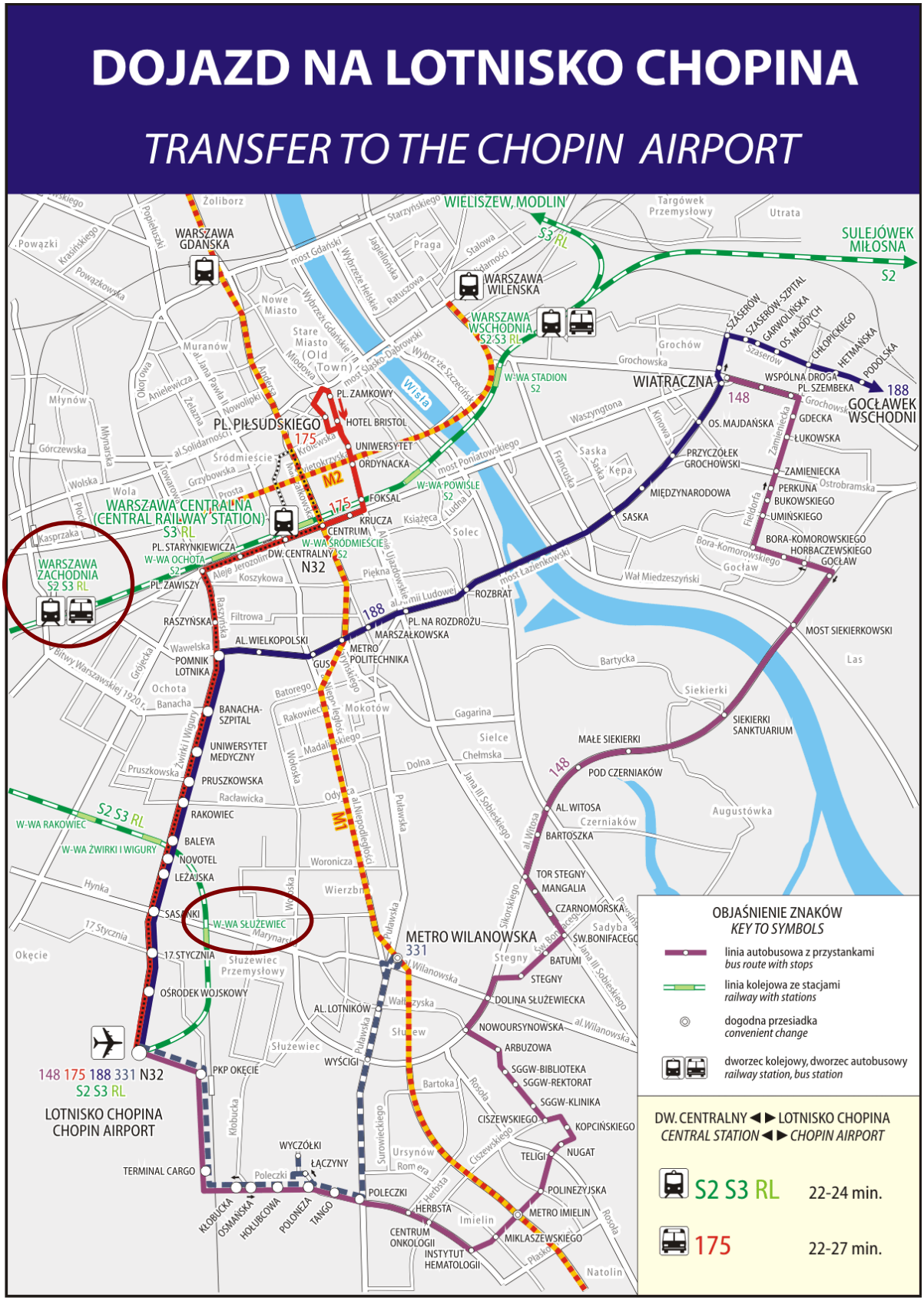
The scheme of the accessibility to the Chopin Airport by public transport services (suburban and regional trains, and urban bus services) is illustrated in the map below.

[4] Namely lines 148, 175, 188, 331 during the day, and N32 during the night.

[5] Capacity constraints on the network limit the possibility to operate one train every 15 minutes over the day especially in the direction from the Chopin Airport. The modernisation of the section Warsaw Zachodnia (West) – Warsaw Wschodnia (East) is expected to allow a 15 minutes operating schedule in both directions.

[6] The SKM S2 suburban railway service, with heading station in Sulejówek Miłosna and going through station Warsaw Śródmieście; the S3 SKM suburban railway service from Legionowo Piaski / Wieliszew through Warsaw Centralna (Central) and through Warsaw Zachodnia (West) station; and the regional line operated by Koleje Mazowieckie (marked as RL) from the station in Modlin through Nowy Dwór Mazowiecki, Legionowo, Warsaw Wschodnia (East), Warsaw Centralna (Central) /Warsaw Central Station/ and Warsaw Zachodnia (West).

Figure 9. Connection to the Chopin Airport in Warsaw



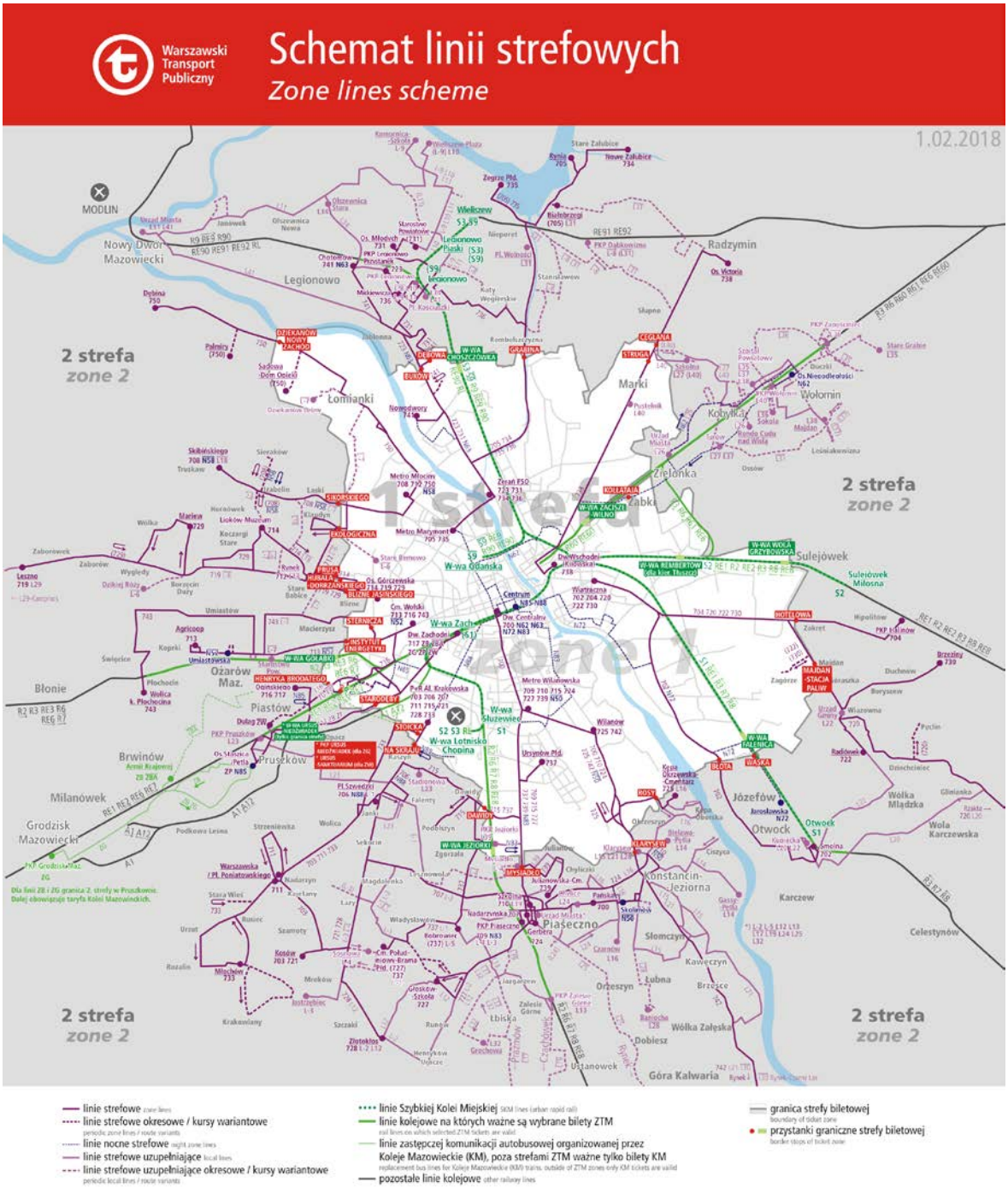
Source: ZTM.waw.pl

All the rail services interconnecting to the Chopin Airport use line no. 8 between Warsaw Zachodnia (West) and Warsaw Służewiec (see red circles in the above figure). This same section is also used by many regional trains as well as national and international trains with origin or destination in Warsaw and proceeding towards or coming from Kraków.

The S2, S3 and RL services are all calling at the main Warsaw City stations, namely Warsaw Zachodnia (West) – Warsaw Centralna (Central)/ Warsaw Śródmieście and Warsaw Wschodnia (East). As such the S2, S3 and RL services are strategically relevant to provide transfer solutions to the Chopin Airport for the passengers using the suburban, regional, national and international railway lines. Considering that Warsaw Zachodnia (West) – and Warsaw Centralna (Central) stations are also the largest coach hubs in the city, the S2, S3 and RL services are also providing transfer solutions between intercity bus services and the airport (although some intercity lines are also calling at the Chopin Airport directly).

Conceived since its development and entry into operation as part of the wider metropolitan and regional public transport system, the price of the tickets for the use of the bus services and train services between the Chopin Airport and the city centre are the same and can be purchased at the same ticket machines located in the proximity of the stops. The cost of a single ticket is about EUR 1. The ticket is valid for 75 minutes and can be used on all public transport services in the Warsaw metropolitan area (Zone 1), including (buses, trams, metro and trains).

Figure 10. Zoning system of the Warsaw Metropolitan Area



Source: ZTM.waw.pl

1.2 PROJECT OBJECTIVES

As further detailed at Chapter 2 below, **the original idea for the development of a rail link to the Chopin Airport was originally included in the 2001 Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw**. Following the economic development of Poland and of its capital city, traffic at the airport was also growing and the Polish authorities opted to expand the Chopin Airport by constructing a second passenger terminal. This resulted in an **increase in road traffic flows to and from the airport and a decline of travelling conditions in terms of travel time and reliability**. The growing congestion of the network, particularly in the peak-hours also negatively contributed to an increase of the externalities generated by road transport.

At the same time Poland was implementing a nation-wide programme for the modernisation of the railway network, also including railway line no.8 between Kraków, Kielce, Skarżysko Kamienna, Radom, and Warsaw. The line crosses the Polish capital city and it also passes close to the Chopin Airport. **The modernisation of this line represented an opportunity to interconnect by railway the Chopin Airport with the city centre and wider national network and enhance the use of public transport system in the Warsaw metropolitan area and Masovian region**.

As already described above, the major project under assessment relates to the third phase of the modernisation of railway line no. 8 in the agglomeration of Warsaw. **Further to establishing a rail connection to the Chopin Airport, additional rehabilitation works were required for the improvement of existing line between Warsaw Służewiec and Warsaw Okęcie**. The track substructure between Warsaw Służewiec and Warsaw Okęcie was indeed in poor conditions (from km 10.512 to km 11.809), representing a speed limitation bottleneck for both passenger and freight trains. The catenary system needed to be replaced to avoid system failures. The passenger railway station at Warsaw Służewiec also required modernisation works; the station was also not accessible to people with reduced mobility.

In line with the above needs and implementation strategy, **the project responds to different functional elements, ranging from modernisation of a section of an existing railway line and station to the construction of the new section of the railway line linking the existing network with the Chopin Airport**. The different project components are further discussed in the following section.

With respect to the project objective of providing a railway link to the airport, it shall be underlined that **the project was expected to improve the overall accessibility of the passengers as well as of the employees working at the airport**. At the time the project was implemented, the flow of tourists was also expected to boost in view of the 2012 European Football Championship.

Strictly referring to the coherence of the project with the EU urban transport policy it is noticed that the project provides the basic infrastructure elements to enhance the use of public transport system and allow the interconnection of the Chopin Airport of the capital city of Poland with the European railway network. This represents a basic condition to improve the accessibility by sustainable transport to a major transport node, located within the administrative boundaries of the territory of Warsaw at 8 km of distance from the city centre.

Considering that the implementation of the major project was conceived to be associated with the increase in the offer of public transport services by railway in the Warsaw metropolitan area and Masovian region (S2 extended and S3/RL, newly established), the investment was also expected to contribute to the development and promotion of sustainable mobility in the agglomeration of Warsaw. As a sustainable transport solution, the project did not only represent a mean to reduce congestion and travel times in the city, it also constituted an element for the improvement of the image of Warsaw and the main Polish international airport.

At the time the project was conceived and the application for funding submitted to the EU, it was thus in line with the Goteborg Strategy, *A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development* supporting the development of environmental friendly means of transport and solutions towards solving negative effects resulting from increasing traffic, especially in the urban areas. It was also in line with the National Strategic Reference Framework 2007-2013, supporting expansion and improvement of effective, safe and clean transport infrastructure solutions, also representing a mean for economic development. By enhancing the share of sustainable transport, the investment was furthermore responding to the priorities and targets of the National Development Plan 2007-2013; the National Transport Strategy 2006-2025; the Railway Transport Strategy up to 2013; the Master Plan for Railway Transport in Poland up to 2030; and the 2007-2013 Programme for Infrastructure and Environment.

Finally, the project was also aimed at achieving the targets and objectives set in the regional and local strategic documents[7]. All these documents emphasised the importance of developing a sustainable transport solution for the interconnection between the Chopin Airport and the city centre of Warsaw in the wider context of the greater Warsaw metropolitan area and Masovian region. Before the project was implemented **the City of Warsaw was suffering from lack of adequate and fast public transport connections between the Airport and the urban and suburban transport system**. The only existing public transport connection to the airport was by bus. Other than buses the airport was accessible by private cars or taxis. Also due to the growing economic conditions, accompanied by an increasing motorisation rate, Warsaw roads were gradually becoming more congested. In the peak-hours traffic flows to the airport overlapped with the local and extra-urban traffic, impacting on travel times and journey reliability. The travel time from the city centre to the airport varied from 90 minutes in the peak-hour to 15 minutes only in normal traffic conditions – without congestion.

Albeit representing a phase of a wider, multi-annual investment scheme, the major project was deemed an independent functional, technical and financial unit of analysis by the entities involved in its preparation, including the PKP PLK S.A., and JASPERS (the role JASPERS is further discussed in the sections below). At the time the application for funding for this major project was submitted to the EU, the preparatory works and works for the modernisation of line no. 8 between Warsaw Zachodnia (West) station and Warsaw Służewiec station had already been completed as part of phases 1 and 2 of the project "Modernisation of railway line no. 8: section Warsaw Zachodnia (West) – Warsaw Okęcie". The modernisation of line no. 8 outside

[7] Including the Development Strategy of the Masovian region up to 2020; the Sustainable Development Strategy of the Public Transport System in Warsaw up to 2015 and beyond; and the 2001 Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw

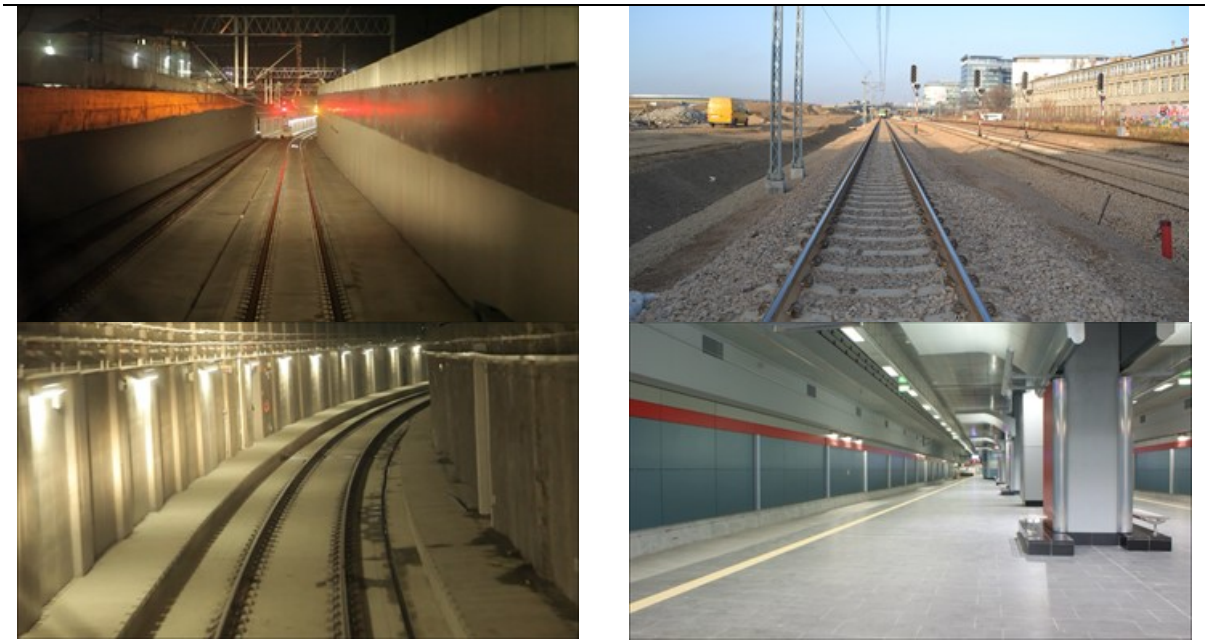
the Warsaw urban area, between Warsaw Okęcie and Kraków is still to be implemented. The above assumption concerning the consideration of the major project as an independent unit of analysis for the CBA is deemed acceptable also for the ex-post assessment, specified that the cost for the procurement and supply of the rolling stock have been also included in the ex-post CBA (see Annex II to this report). The cost for the construction of the civil works where the underground station is located at the Chopin Airport, and implemented as part of the construction of the Terminal 2 have not been included in the CBA analysis, as these have not been quantified by the concerned stakeholders. Considering the very positive results of the CBA and the conservative assumption to limit the consideration of the effects to the section between the city centre and the Chopin Airport, the non-inclusion of these costs in the analysis is deemed negligible.

1.3 STRUCTURAL FEATURES

The total scope of the project includes the following components:

- Construction of a dual track railway link – partially in underground alignment – together with a tunnel access ramp of 420 meters length, from the existing railway line no. 8 at Warsaw Służewiec station (km 10.800) to the terminus station located within the Chopin Airport. The length of the newly constructed section equals 1.990 km; the total length of the 15m wide tunnel is 1,183m;

Figure 11. Construction of railway link to Chopin Airport



Source: PKP PLK S.A.:

- Reconstruction of the passenger station Warsaw Służewiec;
- Provision and instalment of underground railway stations related equipment;

Figure 12. Passenger railway station Warsaw Służewiec

Source: http://warszawa.wikia.com/wiki/Warszawa_Służewiec

- Modernisation of railway track no. 1 of the line no. 8 on the section from km 10.512 to km 11.809, including replacement of the catenary and instalment of other railway infrastructure facilities and equipment. The length of the reconstructed railway line equals 1.243 km.

Figure 13. Modernisation of the railway track of the line no. 8

Source: PKP PLK S.A.

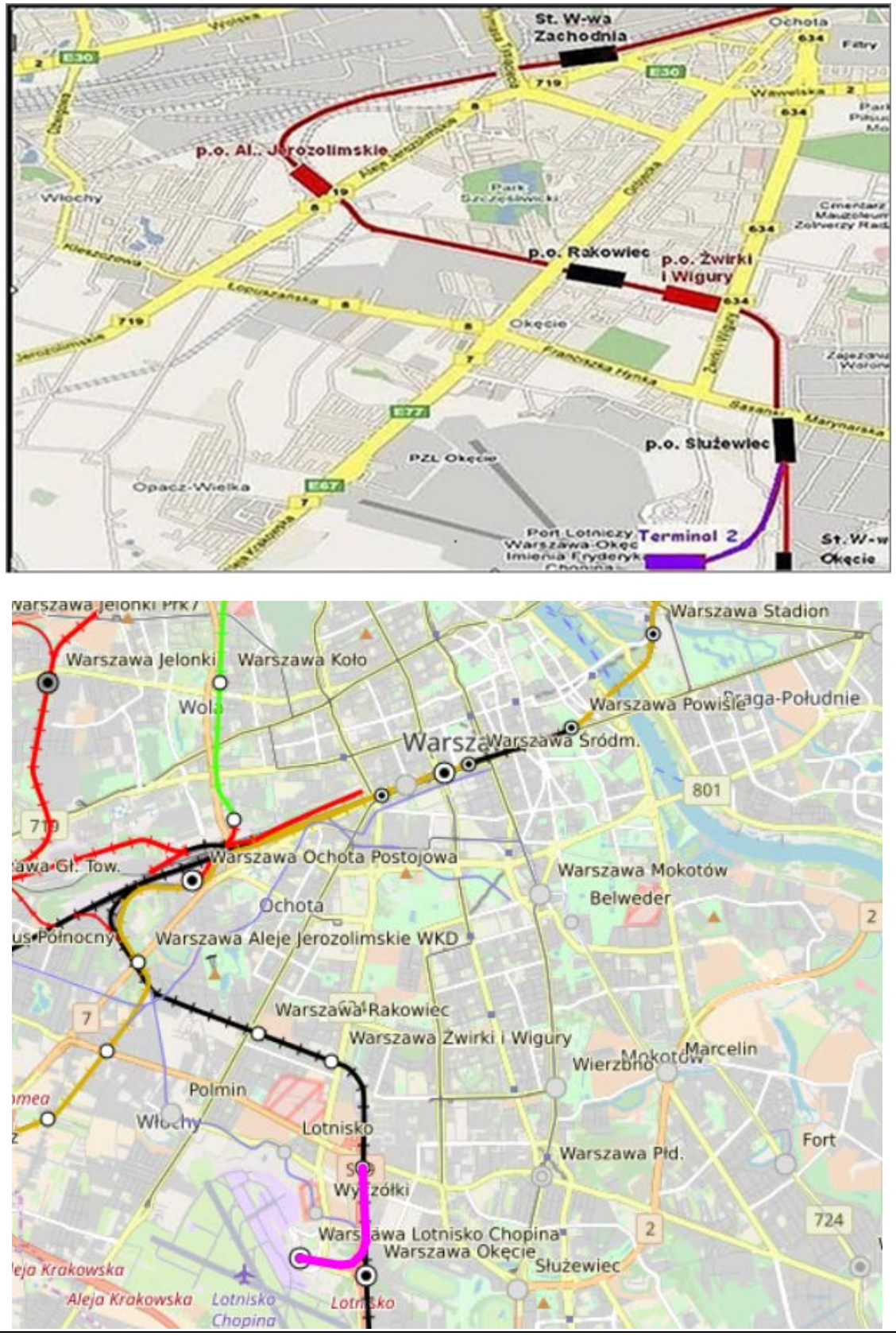
The investment costs associated with the above listed works and materials are summarised in the table below: **the most relevant share of the budget is allocated to construction works,** absorbing 85% of the total project costs, out of which the most expensive component is related to the tunnel (approximately EUR 34 million) and track construction and modernisation (approximately EUR 9 million). The remaining project components, including project preparatory works, site preparation, supply of the equipment, project supervision and promotion correspond to 15% of the entire investment value.

Table 1. Investment cost breakdown by project component net

PROJECT ITEM	NOMINAL VALUE		% ON TOTAL
	PLN	EUR	
Preparatory phase (design, documentation, FS)	817,400	192,783	0.3%
Land access	649,857	153,268	0.2%
Construction works	230,861,738	54,448,523	85.0%
Supply of the equipment	2,672,884	630,397	1.0%
Supervision and management	7,051,065	1,662,987	2.6%
Promotion and other costs	29,429,506	6,940,921	10.8%
Total	**271,482,451**	**64,028,880**	**100.0%**

Source: Authors based on information provided by the PKP PLK S.A.

Figure 14. Location of the railway lines in the Warsaw Railway Node



Source: Application dossier https://www.bazakolejowa.pl/index.php?dzial=d29&id=650

2 ORIGIN AND HISTORY

2.1 BACKGROUND

The Chopin Airport serves passengers' operations since 1934, when a wide, dual carriageway street (Żwirki i Wigury) was constructed and opened for traffic, interconnecting the airport with the city centre. For decades the access to the airport was only possible by road, the Żwirki i Wigury street representing the shortest way from the centre of Warsaw. **In 2001 a Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw was elaborated and approved by the City Council, which proposed the development of a railway link between railway line no. 8 (Warsaw - Radom) and the Chopin Airport.** In 2004 the State Treasury, the Warsaw City Hall and the "Polish Airports" State Enterprise entered into agreement for the development and implementation of the road and rail infrastructures surrounding the new second terminal, also under development. In 2006 this agreement was modified involving the national railway infrastructure manager PKP PLK S.A. An annex to the agreement of 2004 was formulated including the rules for the cooperation and financing responsibilities between the involved stakeholders. In the meantime, the modernisation works of railway line no. 8 between Warsaw Zachodnia (West) and Warsaw Okęcie had received approval in 2005, from the Sectoral Operation Programme 2004-2006.

On the basis of the above agreement and subsequent modification, appropriate administrative decisions, processes and permits have been issued and completed between 2006 and 2009 by the concerned authorities, land owners and infrastructure managers. These included issuing of location permits covering both public and private areas, land use agreements allowing development of construction works for the railway link and tunnel, environmental decision, construction permit as well as financing grants.

The following table provides details on the main milestones and events characterising the development and implementation of the major project. Among these, the accession of Poland to the European Union in 2004 is worth mentioning. **The possibility to use funds from the European Union facilitated the implementation of the modernisation works of railway line no. 8, and in particular the implementation of the major project under assessment**.

Table 2. Milestones of the major project

YEARS	MILESTONES
2001	Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw, proposing the development of a railway link to Chopin Airport interconnecting to the railway line no. 8 (relation Warsaw - Radom)
2004	Agreement between the State Treasury, the City of Warsaw and the "Polish Airports" State Enterprise (PPL) on the development of the road and rail infrastructure surrounding the second terminal under development at the Chopin Airport
2004	Accession of the Republic of Poland to the European Union
2006	Annex 1 to the Agreement of 2004 involving PKP PLK S.A. as stakeholder for the development and construction of the railway link to provide a railway interconnection between the airport and the city centre
2006	Adoption by PKP PLK S.A. of the spatial and development concept for the

YEARS	MILESTONES
	construction of a railway link between the Warsaw city centre and the Terminal 2
2007	Environmental decision issued by the Masovian Region
2008	Construction permit issued by the Masovian Region
2009	Finance granted by the Ministry of Finance
2009	Completion of the tendering process for the selection of the contractor for the construction of the link and start of the works
2012	Completion of the works and start of the operation of the services just in time for the start of the 2012 European Football Championship

Source: Authors

Additionally, the construction of the railway link to the Chopin Airport, together with the construction of Terminal 2 represented relevant infrastructure improvements in view of the 2012 European Football Championship[8].

Figure 15. Żwirki i Wigury street towards the Chopin Airport before EURO 2012

Source: https://inzynieria.com/fotogalerie/branzy/fotogaleria/10/386,warszawskie-inwestycje-przed-euro-2012

The following box lists the main components of the major project subject of this ex-post assessment, together with additional complementary initiatives of local and regional relevance.

[8] On 27 November 2003 the Polish Football Association and the Ukrainian Football Association signed an agreement on joint efforts to organise the 2012 European Football Championship. In April 2007, twelve UEFA members voted for Poland and Ukraine as the organiser of the 2012 European Football Championship.

Box 1. Complementary projects

- Stage 1: Preparation of design and tender documentation for the project "Modernisation of railway line no. 8 Phase I: section Warsaw Zachodnia (West) – Warsaw Okęcie and construction of the railway link to Chopin Airport" for stage 2 and stage 3; (project financed from ERDF under the Sectoral Operational Programme Transport, 2004-2006);
- Stage 2: Implementation of the project "Modernisation of railway line no. 8 Phase I: section Warsaw Zachodnia (West) – Warsaw Okęcie and construction of the railway link to Chopin Airport". Construction works on section Warsaw Zachodnia (West) – Warsaw Okęcie; (project financed from ERDF under the Sectoral Operational Programme Transport, 2004-2006);
- Stage 3: Implementation of the project "Modernisation of railway line no. 8 Phase I: section Warsaw Zachodnia (West) – Warsaw Okęcie and construction of the railway link to Chopin Airport". Completion of modernisation works between Warsaw Służewiec and Okęcie stations and construction of the link to Chopin Airport)"; (project financed from CF under the Operational Programme Infrastructure and Environment, 2007 - 2013) – **project in subject**;
- "Construction of the express road S2 in Warsaw, section from "Konotopa" junction – "Puławska" junction together with the link "Lotnisko" junction – Marynarska (S79)", (project financed from CF under the Operational Programme Infrastructure and Environment, 2007 - 2013);
- "Modernisation of the airport infrastructure", relating to the construction of terminal 2 of the Chopin Airport, also including the civil works for the construction of the basic infrastructure for the location of the future underground railway station (project financed by PPL and PKP PLK S.A.);
- "Modernisation of the airport infrastructure", relating to the expansion of the terminal 1 of the Chopin Airport (project financed from ERDF under the Operational Programme Infrastructure and Environment, 2007 - 2013);
- "Lunching the railway service of the Chopin Airport by SKM", concerning the procurement and supply to SKM of the rolling stock to operate the S2 and S3 services (project financed from ERDF under the Operational Programme Infrastructure and Environment, 2007 - 2013);
- "Modernisation of the railway siding from the railway station Modlin to the Modlin Airport and construction of railway stop at the Modlin Airport" (project financed from ERDF under the Operational Programme Infrastructure and Environment, 2007 - 2013);
- "Purchase of the rolling stock serving the airports and agglomeration traffic within the E65 railway corridor and Warsaw agglomeration", concerning procurement and supply of rolling stock to KM, for the operation of services on the RL line interconnecting to the Chopin Airport (project financed from ERDF under the Operational Programme Infrastructure and Environment, 2007 - 2013).

2.2 FINANCING DECISION AND PROJECT IMPLEMENTATION

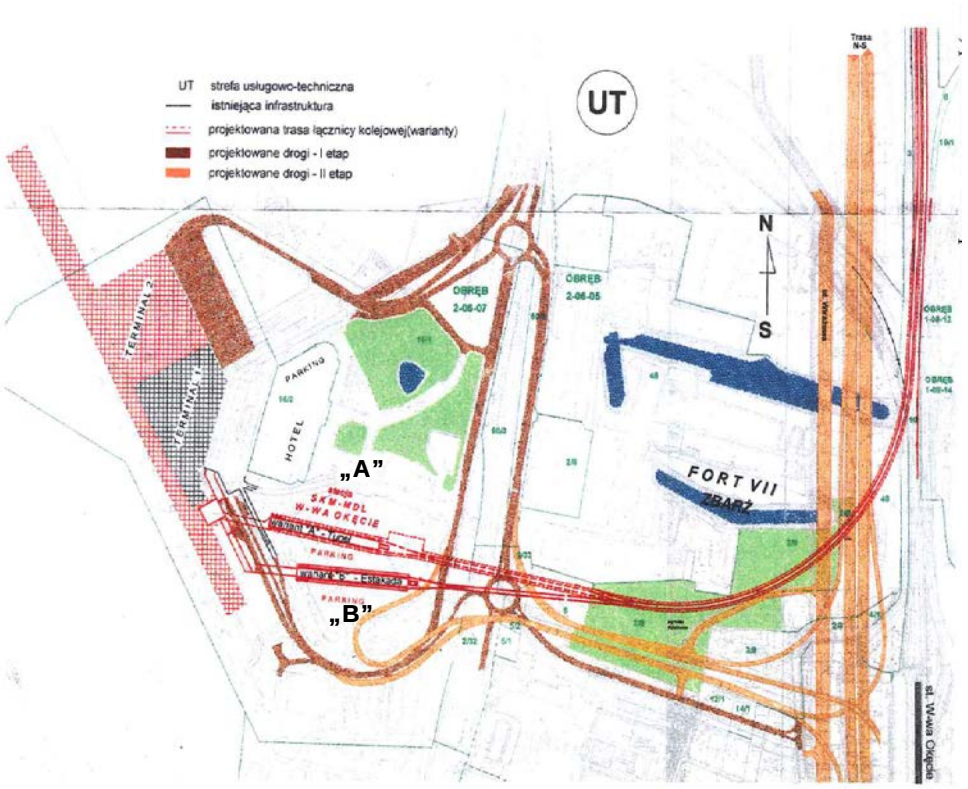
The project was prepared by PKP PLK S.A., the national railway infrastructure manager which is 100% owned by the Polish State (through the PKP Group). **PKP PLK S.A. is the owner of the infrastructure who is also in charge of its development, operation and maintenance. JASPERS was also involved in the project at its tendering stage**, in 2009, assessing all the investment' aspects, in particular the engineering solutions, layout options and project alternatives, the demand, financial and economic analysis as well as the EIA related aspects. As further explained in section 4.2 the project was overall positively evaluated by JASPERS. Comments were made relating to the location of the station at the Chopin Airport; some recommendations were also provided to be considered at the construction stage, to mitigate the potential negative effects of the project on the moat surrounding Fort Zbarż, a National Heritage site located in-between the national railway line no. 8 and the airport (see also the figures overleaf).

On the basis of the above mentioned agreement of 2004 between the State Treasury, the "Polish Airports" State Enterprise and the Warsaw City Hall, a feasibility study was implemented by a private engineering company on behalf of the Warsaw City Hall, relating to the construction of the new railway link. The study was completed by December 2004 and considered two different layouts: underground and viaduct solutions. These were required to underpass or overpass the road infrastructure located nearby the railway line (see figure overleaf). No final decision was taken concerning the railway link, as it was assumed to be taken by the Ministry of Infrastructure.

According to the 2004 agreement the construction of the station building was to be implemented by the "Polish Airport" State Enterprise as part of the works for the construction of the second terminal. The works for this building progressed as part of the works for the construction of this terminal and were completed by 2006. In this same year PKP PLK S.A. also formally entered into the agreement for the development and implementation of the road and rail infrastructure surrounding the second terminal. A new feasibility study was elaborated by PKP PLK S.A. On the basis of the already existing station building at the second terminal, the study considered the development of the first option identified in the 2004 study, which was preferred to the viaduct due to high gradients required to develop the latter solution.

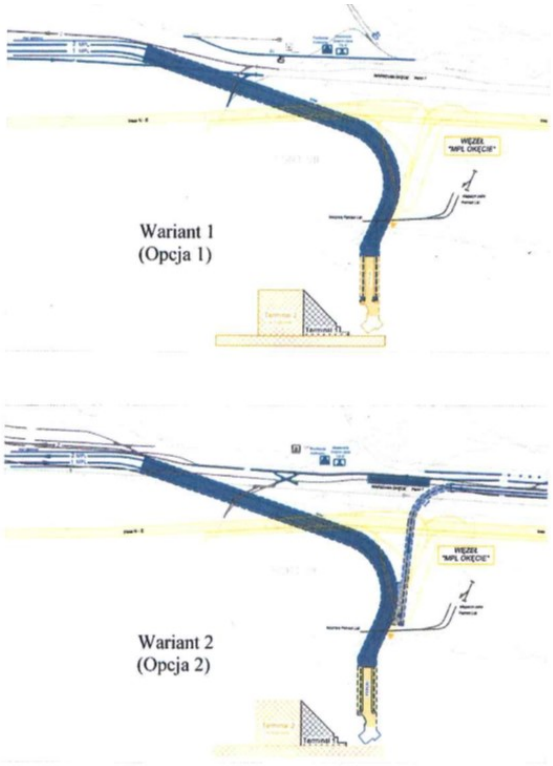
As part of this second feasibility study dated February 2006, two underground options were assessed – with and without an additional link allowing trains going directly not only towards Warsaw, but also in the direction of Radom. Both options were examined under the technical and environmental perspectives. The latter option was rejected as the benefits did not justify the additional construction costs.

Figure 16. Alternative alignments ("A" and "B") of the new rail connection



Source: Results of the Feasibility Study

Figure 17. Alternative alignments of the new rail connection: option 1 - connection with the city centre and option 2 – connection with the city centre and towards Radom



Source: Results of the Feasibility Study

Regarding the feasibility studies, JASPERS commented the location of the station at the Terminal 2 building as not optimal in terms of proximity to both airport terminals. As a matter of fact, the construction of the station building in 2005 as part of the works for the implementation of the Terminal 2, before the formal involvement of PKP PLK S.A. in the development of the link in 2006, did not make it practical anymore the further analysis of alternative options for the different location of the station.

Concerning the project financing and more specifically the support from the EU, a first Commission decision was taken in 2011[9] which has been subsequently modified in 2015[10] increasing the co-financing rate up to 80% of the eligible costs. Overall the EU support amounted to 60% of the total project cost. The national subsidies and PKP PLK S.A. own contribution equalled respectively 22% and 18% of the investment cost. **From the financial stand point, the ex-post profitability of the project is negative.** The Financial Net Present Value (NPV) on the investment is equal to nearly EUR -85 million (at a discount rate of 4%, in real terms), with an internal rate of return of -14.6%. The Financial Net Present Value on national capital is also negative, EUR -37 million as well as the capital related internal rate of return, -14.9%. These negative values confirm that the project required the EU financial support.

The project implementation and the service operation of the newly constructed and modernised railway network was, and currently still is, entrusted to PKP PLK S.A.

Due to additional unpredicted activities and works some delays in the implementation of the major project and a slight increase in the project costs occurred. Compared to the originally assumed project implementation deadline of August 2011, 9 months of delay occurred, which resulted from some unexpected technical problems associated with 1) the failure of the underground tunnel drainage system; 2) some unpredicted additional activities and works related to the removal of landmines and petroleum derivatives from the Second World War, identified at the construction stage, in the ruins of Fort Zbarż. The repairing of the failure of the underground tunnel drainage system, and the removal of landmines and hazardous wastes from the Fort's also resulted in an additional project expenditure of EUR 3 million. **In any case the services interconnecting to the airport were put in operation** on the 1st of June 2012, just **in time for the start of the European Football Championship Euro 2012** – held between 8 June and 1 July 2012 (2013 is thus the first full year of operation of the link). **Project costs savings also occurred at the works tendering stage, the final investment cost resulting in EUR 64 million, nearly 10% less than the planned investment cost of EUR 70.8 million.**

[9] K(2011) 3932 dated 07.06.2011.
[10] C(2015) 8573 final dated 30.11.2015.

2.3 CURRENT PERFORMANCE AND OTHER INVESTMENT NEEDS

Thanks to the implementation of the project, since 2012 the Chopin Airport is accessible by rail in addition and in alternative to road transport. Since this time public transport services by railway in the Warsaw metropolitan area and Masovian region were also significantly increased and improved, all this resulting in a more attractive and competitive public transport system in these areas, in favour of sustainable mobility. Before the project was completed SKM was operating the S2 line between Sulejówek Miłosna and Okęcie on national ralway line no. 8. Thanks to the implementation fo the project the S2 was extended up to the Chopin Airport station. In addition the S3 and RL were put in operation (the latter also replacing bus services between the city centre and the Modlin station); the S3, between Chopin Airport and Legionowo Piaski; and the RL between the Chopin Airport and Modlin station. Subsequently the services were extended on the S3 up to Wieliszew; and the frequency of the services on the RL increased. The entry into operation of these lines and the extension of these services thanks to the realisation of the major project were strategically relevant to improve the offer of public transport services by railway in the Warsaw metropolitan area and Masovian Region. **The inclusion of the project in this wider context of the development of the public transport services by railway in the area, is fully in line with the targets and needs of the main stakeholders formally involved in its development and implementation of the major project,** namely the "Polish Airports" State Enterprise, the Warsaw City Hall and PKP PLK S.A., all of them interested in having a link to the airport integrated in the wider metropolitan, regional and national modern railway system. As such the price of the ticket is also in line with the one applied in the wider area. Whilst the CBA analysis developed as part of this ex-post assessment only focusses on the effects of the project between the city centre and the airport (in line with the conservative approach adopted in the ex-ante CBA), the impact of the project may be significantly larger both in terms of territorial scale and magnitude. This is however only commented qualitatively.

The major project allows for a regular and reliable sustainable transport connection to the Chopin Airport at the different territorial scales in which the S2, S3 and RL services are in operation, including the link between the city centre and the airport. The journey time from the city centre to the Chopin Airport from Warsaw Centralna (Central) or Warsaw Śródmieście lasts 22-24 minutes. According to the timetable, the train frequency varies from 8 to 30 minutes, depending on the time of the day (combining the S2, S3 and RL services). For comparison, the journey by bus takes 22-27 minutes according to the time schedule, however this travel time becomes less reliable in the peak hours. Concerning the organisation of the services, it is indeed worth to notice that despite the entry into operation of the railway services to the Chopin Airport, urban bus services to the airport remained in operation. In line with the strategic vision by the Polish Authorities to plan and operate the connection to the airport as part of the urban, metropolitan and regional public transport system, the cost of the ticket to the Chopin Airport is the same for both buses and rail services. All public transport services are thus contributing together to the increase in the offer of sustainable transport alternatives to the private road means of transport.

Regarding travel comfort, both public transport solutions by bus and train, seem to be comparable. Both train operators serving the Chopin Airport connection, namely SKM and KM, are using new rolling stock. Regarding the buses, the vehicle fleet in

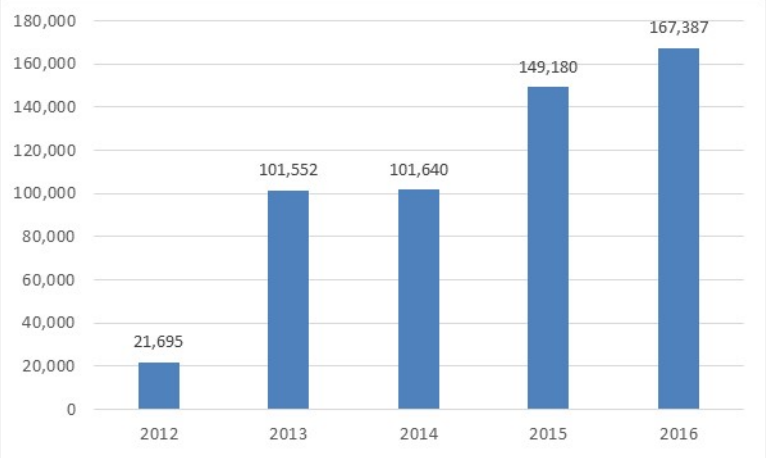
operation is relatively new, it has been fully renewed and all buses since 2013/2014 are low floor. The SKM and KM rolling stock is also accessible by passengers with reduced mobility and elderly people.

Figure 18. Example of low floor bus and trains (SKM and KM) serving Chopin Airport direction

Source: https://pl.wikipedia.org/wiki/Autobusy_miejskie_w_Warszawie; http://www.ztm.waw.pl/download/img/lot_skm.jpg

Detailed data on the number of passengers travelling directly to/from the airport are not available for the bus route 175 and the three railway lines in their entire extension (S2, S3 and RL). Only data of passengers travelling between the city centre and the Chopin Airport on the RL line are available. The trend for the first five years of operation of the RL line operated by KM shows a significant growth over the period (considering that the major project was completed in May 2012, data for 2012 relate to the period between June and December only).

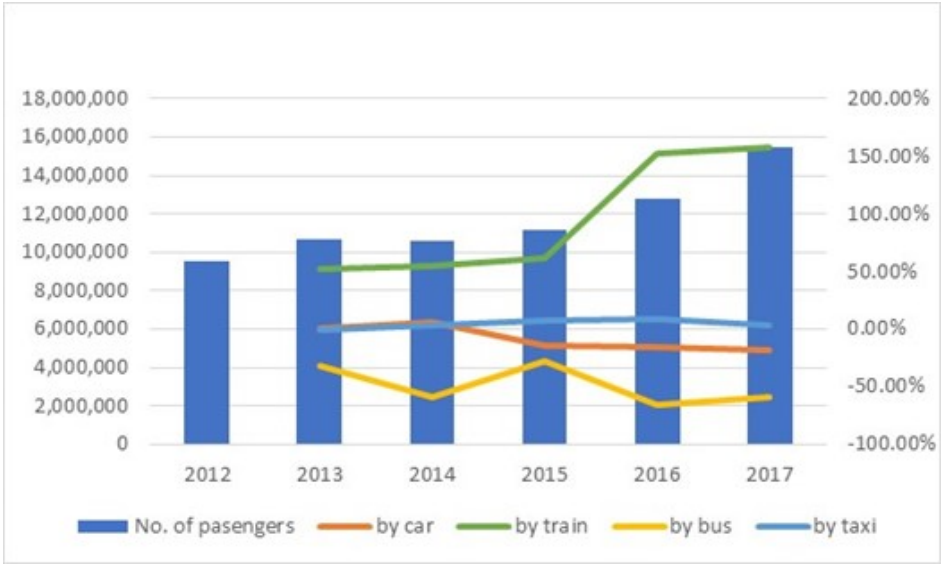
Figure 19. Number of passengers travelling to Okęcie Airport station by KM between 2012 and 2016



Source: Authors on the basis of KM data

Further to the above data, a survey by the "Polish Airports" State Enterprise is worth to be considered, which is performed on the accessibility to the airport by the Chopin passengers on an annual basis.

Figure 20. Number of passengers at the Chopin Airport and accessibility to the airport by means of transport



Source: Authors on the basis of "Polish Airports" State Enterprise and ULC data

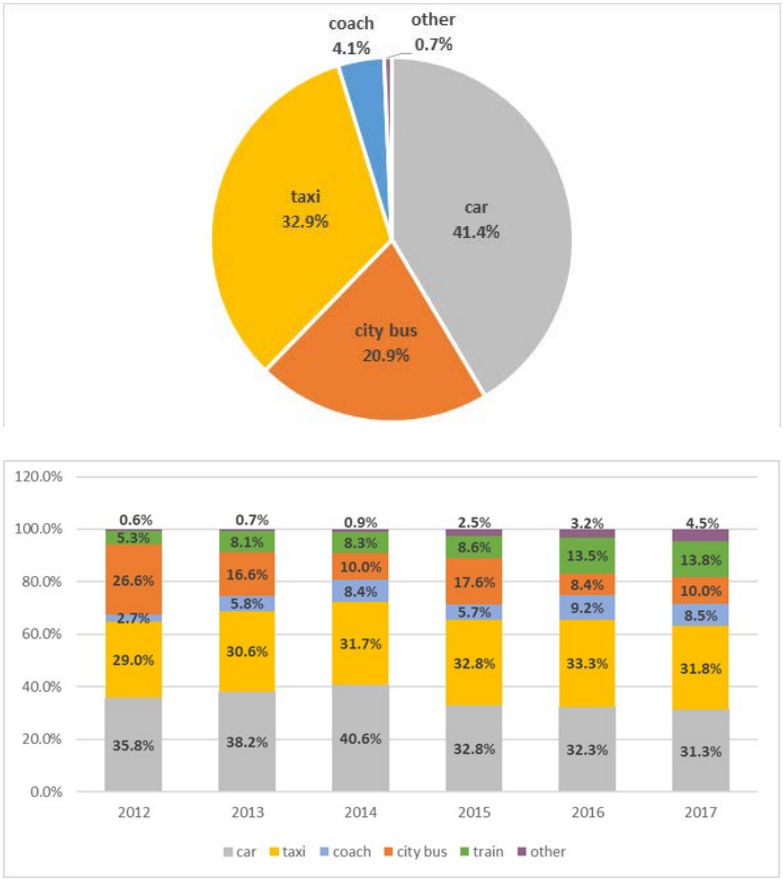
These data, albeit related to a survey and thus possibly not reflecting the real accessibility pattern[11], seem overall confirming the positiveness of the project in improving the attractiveness of public transport services in accessing the airport. **The share of passengers using the train connections to go to the airport is increasing. Although the rail services seem to compete with road transport including bus services, which appear to show a declining trend, the overall share of public transport is remaining constant and even slightly increasing over the years**, with a benefit for society in terms of development of sustainable

[11] The sample measured each year varies and ranges from 4,190 persons interviewed in 2014 to 16,760 in 2013.

mobility in the Warsaw metropolitan area and Masovian region. The percentage share of taxis used as the connection to the airport appears to be relatively stable.

The figures overleaf present the detailed results of the above mentioned airport accessibility survey, measuring the share of the different means of transport used by the passengers to go to the airport between 2012 and 2017 (till November 2017). Counting the last seven months of 2012, the percentage share of passengers using the train as the last mean of transport to get to the airport equalled 5.3%. This value increased up to 8.1% already in 2013 and its further growth was noticeable in the subsequent years, up to 13.8% in 2017. Over the same period the number of passengers accessing the airport by car decreased and the one of the taxi users remained almost constant. The share of city buses declined from 16.6% in 2013 to 8.4% in 2016 towards the airport and from 15.0% to 9.8% in the opposite direction, also in favour of railway services which are more reliable, especially during peak hours. At the same time the share of city buses and railway services together, passed from 24.7% in 2013 to 21.9% in 2016 towards the airport and from 20.7% to 22.9% in the opposite direction.

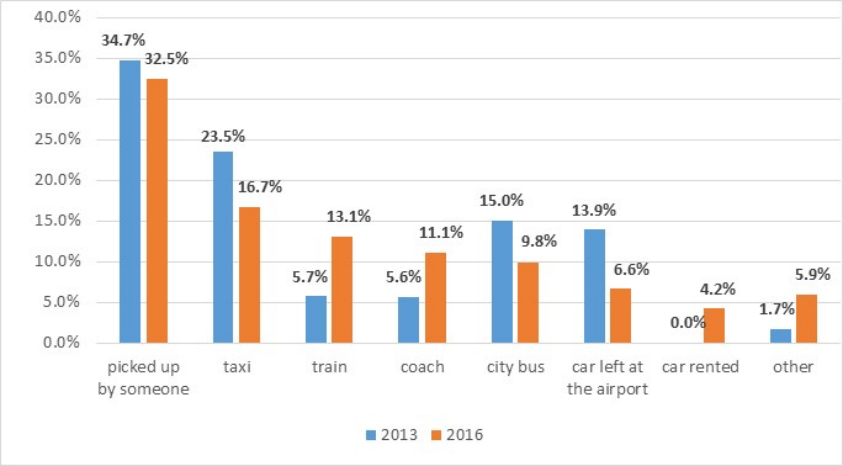
Figure 21. The last transport mean used by passengers to go to the Chopin Airport before project completion (between January and May 2012)- pie chart and between 2012 (since June) and 2017 – histogram chart



Source: Authors on the basis of the "Polish Airports" State Enterprise data; for 2012 average from seven months is calculated (June-December)

A similar analysis has been undertaken by the "Polish Airports" State Enterprise to analyse the transport means used by passengers leaving the airport. The results are presented in the figure below.

Figure 22. The transport means used by passengers in 2013 and 2016 to leave Chopin Airport



Source: Authors on the basis of the "Polish Airports" State Enterprise data

Not differently from the analysis of the accessibility pattern to go to the airport, the results of the surveys for the reverse direction "from the airport" seem indicating that the usage of the private car to leave the airport reduced in favour of the rail services.

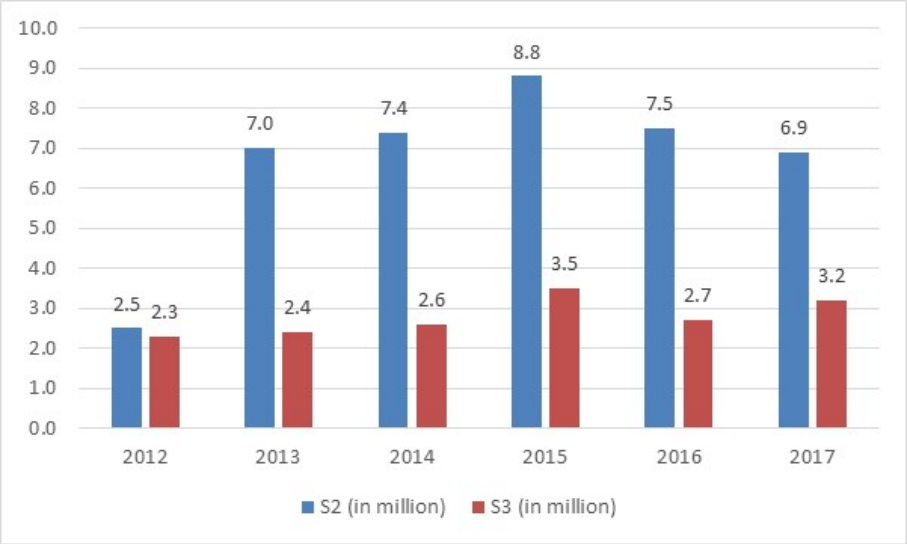
Although the available data do not allow a detailed calculation of the benefits associated to the traffic originated an directed to the Chopin Airport, **the positive effects of the project in terms of accessibility to the airport, can be reasonably assumed to represent only a part of the benefits overall attributable to the project thanks to the increase of railway services in the Warsaw metropolitan area and Masovian region following its completion**.

> ***It shall be noted that most of the passengers using the railway services are the ones travelling to Służewiec business district, and exiting at Służewiec station, one before the terminus stop*** *(Source: interviewed service operator)*

The entry into operation of the S3 and RL line operated by KM, in concomitance with the entry into operation of the railway link, are likely to have contributed to the increase of the public transport patronage in Warsaw and surrounding territory. The passengers of the public transport system in Warsaw passed from 725 million in 2010 to 872 million in 2015. This is the result of a constant investment in the improvement of the public transport system in the city also including the development of the railway and bus services serving the Chopin Airport.

Data on the annual patronage on the S2 and S3 lines operated by SKM is presented in the figure below. Data for the RL line are not available.

Figure 23. Total number of railway lines S2 and S3 passengers in 2012-2017



Source: Authors on the basis of SKM data

The total number of passengers using the S2 and S3 lines is overall increasing since the completion of the major project. The share of passengers using more environmental friendly transport solutions has grown over the past years. The decline observed in 2016 (as well as 2017 for S2), are most likely the result of the increased frequency of services provided by KM towards Rembertów station, as well as modernisation works on the Warsaw railway node. **The analysis of the available real observed and survey data seems overall confirming the effectiveness of the major project in promoting environmental friendly transport by railway in the Warsaw urban area and surrounding territories, including accessibility to the Chopin Airport**.

Notwithstanding the general positive impact of the major project, some **functional shortages are worth mentioning**. **First, the fact that in the city centre the rail services are operated from two different stations slightly affects the overall ease of the use of the service**. As a matter of fact, in the very city centre, the S2 operated by SKM calls at the Warsaw Śródmieście station, which is located on railway line no. 448, whereas the S3 and RL services, operated by SKM and KM respectively, stop at Warsaw Centralna (Central), which is located on railway lines no. 1 and 2. Whilst the two stations are located at a 500 meters walking distance from each other, the frequency of the services in the very centre of Warsaw is either reduced compared to the other two stations of Wschodnia (East) and Warsaw Zachodnia (West), or depends in any case on the combined use of Warsaw Centralna (Central) and Warsaw Śródmieście.

Figure 24. Scheme of the lines in the Warsaw City Centre

Source: http://siskom.waw.pl/planistyka-aglomeracja-wwk.htm

The other shortage reported by the stakeholders relates to the ticketing system. Within the Warsaw metropolitan area, an integrated transport ticketing system is available, which is managed by ZTM (Zarząd Transportu Miejskiego – Warsaw Metropolitan Public Transport Authority) and covers all available public transport modes and services (buses, trams, metro and SKM trains). Between the Chopin Airport and Warsaw Wschodnia (East), namely within Zone 1 of ZTM ticketing system, the ZTM tickets can be used for any of the three lines S2, S3 and RL, except the single ticket (valid for 20 or 75 minutes)[12]. On the same alignment, the tickets sold by KM can be also used on the three lines S2, S3 and RL. Outside Zone 1, the use of the S2 and S3 is possible with a ZTM ticket for Zone 2; the use of the RL line is allowed with a KM ticket. **All tickets must be validated before the use of the services. S2 and S3 trains are equipped with validating machines. RL trains are not equipped with such devices and the ticket must be validated by the train operators. Passengers are requested to access the train from the first door and look for the train manager to validate their tickets. Whilst both automatic and manual validating procedures are clearly communicated in the**

[12] Currently due to the construction works on the 447 line between Warszawa Włochy and Grodzisk Mazowiecki there are some temporary regulations expected to be in place until September 2018, including validation of all the ZTM tickets, but only to Warsaw Służewiec station.

Websites and ticket selling machines in different languages, some users may find this procedure not easy to follow.

Since the completion of the project and entry into operation of the services along the S2, S3 and RL railway lines, the S2 express road section between the Konotopa node and the Chopin Airport was also opened for traffic in 2013. As demonstrated by the passengers traffic data for SKM and modal share data from the Airport surveys, this does not seem to have affected negatively the performance of the railway services interconnecting to the Chopin Airport, which in any case only started in June 2012.

Regarding future investments, it is worth to notice about RL that the Modlin station is interconnected by bus to the Modlin Airport. An investment is planned for the interconnection of the Modlin Airport with the Modlin railway station, which will allow in the future a Airport to Airport interconnection by railway. Based on the available data it is not possible to attribute any effect on the passenger traffic to the extension of the S3 line and the increase in the services operated by KM.

Albeit still at an inception stage of development, an external factor which may affect the project performance in the future should be mentioned, which is related to the construction of a new airport located between Warsaw and Łódź, with a capacity up to 100 million passengers per year. It is envisaged that this airport will be completed by 2027 and takeover the operations from Okęcie Airport, which will be used for military purposes only. The materialisation of this possibility would impact on the demand for railway services interconnecting the city centre with the airport thus reducing the benefits associated to the implementation of this major project.

3 DESCRIPTION OF LONG-TERM EFFECTS

In this chapter the main long-term effects produced by the project are presented and discussed. First, a summary of the effects produced along the four categories identified in Volume I of the First Interim Report is briefly described. Then, the most significant ones are discussed and supported by available evidence.

3.1 KEY FINDINGS

The long-term contribution of this project shall be considered under the following four main categories: economic development, quality of life and well-being, environmental sustainability and distributional effects.

The **economic growth** aspect includes the quantifiable benefits derived from faster and more reliable connection from the city centre of Warsaw to the Chopin Airport. These effects are incorporated in the CBA in the form of travel time savings as well as vehicle operating cost savings.

Under the heading of **social well-being and quality of life** positive impacts were identified in terms of increased journey comfort, safety and security for passengers diverted to the new railway services from other modes together with the positive effect resulting from reduction of noise. The increase in travel safety and the reduction of noise are reflected in the ex-post CBA, whereas the effect on security and comfort was proved to be positively perceived in a qualitative way. With regard to safety however, another effect has also been observed, resulting from un-safe behaviour of passengers ending the trip at the Warsaw Służewiec station, interconnecting to the largest business centre in Warsaw.

Among the **environmental sustainability effects**, reduction of air pollution and greenhouse gas emissions can be observed, due to the reduction in private car traffic. Conservatively no impact has been calculated for the shift from buses to trains, considering that the bus services have not been modified after the entry into operation of the rail services, notwithstanding the observed decline in the modal share of buses in terms of accessibility to the airport. Both effects quantitatively measured as part of the CBA are positive.

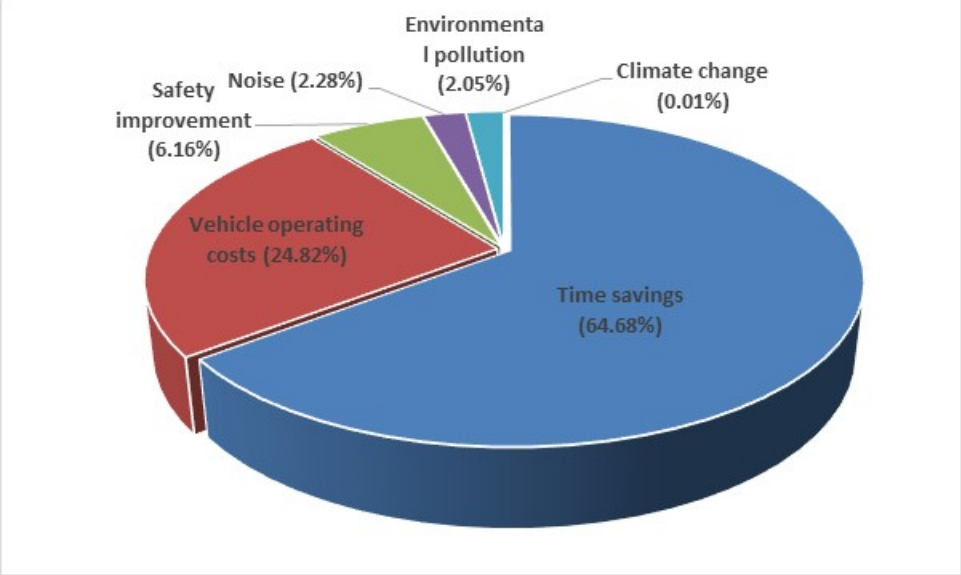
As for the **distributional effects**, a positive effect on territorial cohesion is visible due to the extension of the operated services in the Warsaw metropolitan area and Masovian region. Thanks to the purchase of new rolling stock the project allows elderly and disable people accessing public transport services.

The results of the Cost-Benefit Analysis, as included in Annex II to this report indicate that the project adds value to society under the social and economic points of view. **In the baseline case, the Socio-Economic Net Present Value (ENPV) equals EUR 216.1 million** (with applied discount rates of 4.19% backward and 4.83% forward)**, whereas the Economic Internal Rate of Return is at the level of 12.9%**. Also, the risk analysis indicates that there is a nil probability for the ENPV to be less than zero and a probability of nearly 48% that the expected ENPV is less than the reference one. **These results show that the project yields positive socio-economic net benefits and it has a low level of risk**. The distribution of benefits in the CBA is presented in the figure below.

Before introducing the results of the ex-post CBA it is worth underlining that the costs and the benefits have been estimated in relation to the evolution of passengers on the section interconnecting the city centre of Warsaw with the Chopin Airport. As such

these were estimated based on an incremental approach considering the implementation of the project. It shall be noticed that the main effect associated with the implementation of the investment is the modal shift of passengers from road to railway traffic. The passengers' traffic not using the services between the city centre and the airport has not been taken into account both in ex-ante and in ex-post analysis, which is a conservative approach, also positively commented by JASPERS at the stage of the ex-ante feasibility analysis in 2009. Induced traffic has also been not considered in line with practices on studies concerning services directed to major hubs, which determine their demand in terms of origin and/or destination. A recent ex-post assessment including demand modelling analysis has been also performed by the national railway infrastructure manager PKP PLK S.A. which is showing the estimates in the ex-ante analysis were quite conservative in terms of modal share. The analysis shall also be deemed conservative in view of data related to the number of passengers using the services, as proved by the historical data.

Figure 25. Main socioeconomic benefits (% on the total benefits)



Source: Authors

In addition to these measurable impacts, there are also other effects difficult to be captured in monetary terms, but relevant for the comprehensive assessment of the project, which are discussed in the following sub-chapters.

The table below summarises the nature and strength of the project's effects classified under the above referred four categories (economic growth, quality of life and well-being, environmental sustainability and distributional issues), as well as the territorial levels where these are visible, and the time-horizon of their materialisation.

Table 3. Summary of nature and strength of effects (the effects highlighted in green are those included in the ex-post CBA)

CATEGORY	EFFECT	STRENGTH*	LEVEL
Economic growth	Travel time	+4	Local – regional
	Vehicle operating cost	+3	Local – regional
	Reliability of journey time	+5	Local - regional
	Wider economic impacts (improved connection to the business centre)	+1	Local - regional
	Income for the service provider	N.R.	
	Institutional learning	N.R.	
Quality of life and well-being	Safety	+1	Local
	Service quality	+2	Local
	Security	+2	Local
	Crowding	N.R.	
	Noise	+1	Local
	Aesthetic Value	N.R.	
	Urban renewal	N.R.	
Environmental sustainability	Local air pollution	+2	Local – regional
	Climate change	+1	Local – regional – global
	Water pollution	N.R.	
	Biodiversity	0	
Distributional issues	Social cohesion	+1	Local
	Territorial cohesion	+1	Local – regional

*Note: * the strength score reflects the weight that each effect has with respect to the final judgment of the project. In particular:*
-5 = the effect is responsible of the negative performance of the project;
-4 = the effect has provided a negative contribution to the overall performance of the project;
-3 = the effect has contributed in a negative way to the performance but it was outweighed by other positive effects;
-2 = the effect has a slightly negative contribution to the project performance;
-1 = the effect is negative but almost negligible within the overall project performance;
0 = the effect has no impact on the project performance;
+1= the effect is positive but almost negligible within the overall project performance;
+2 = the effect has a slightly positive contribution to the project performance;
+3 = the effect has contributed in a positive way to the performance but it was outweighed by other positive effects;
+4 = the effect has provided a positive contribution to the overall performance of the project;
+5 = the effect is responsible of the positive performance of the project;
N.R. = The effect is not relevant for the specific project;
No data = The effect is potentially relevant, but no evidence on impacts is available. This shall be used only for relatively low significant effects whose inclusion would in no case dramatically affect the overall assessment.
*Note: ** Learning effect here has been distinguished by 'institutional learning' identified in the First Intermediate Report since it refers to the learning-by-doing process related to the implementation of new technical solutions.*

The following sub-chapters include some more detailed description of the effects incorporated in the ex-post CBA and/or supported by available qualitative evidence either from documental sources or interviews.

3.2 EFFECTS RELATED TO ECONOMIC GROWTH

3.2.1 Measurable effects

With regard to the socio-economic consequences of the investment, **the most significant effects are the reduction of travel time** for bus, taxi and private car users **and to a more limited extent savings in operating costs for passengers diverted from cars**, i.e. the users of the connection to and from the airport, mainly airport passengers but also persons accompanying them as well as airport employees. These two effects are incorporated in the Cost-Benefit Analysis (see Annex II) in which, respectively, 64.7% of total benefits arise from savings in travel time and 24.8% arise from savings in operating costs (fuel consumption, car usage) for diverted passengers. To obtain the value of benefits in time savings, it has been assumed that 17% of the total traffic using railway services is represented by business travellers, 36% are commuters and 47% are other passengers.

3.2.2 Non measurable effects

Among the non-measurable effects the one related to an increased transport offer in terms of mode and services interconnecting to the airport shall be underlined, which positively impacts on the reliability of travel times. Indeed, the operation of the railway services is constant over the day, taking about 20 minutes by train to travel between the city centre and the Airport, whereas by road (either by bus, car or taxi), the trip may also last up to 90 minutes in the peak hours. Depending on the line/direction the trains leave every 30 minutes on average from the Central station as well as every 30 minutes on average from the Śródmieście station[13]. Overall, there are 6 trains every hour from the city centre towards the airport (although from Warsaw Centralna (Central) and Warsaw Śródmieście stations, the frequency is higher thanks to the possibility of combining the services at both stops).

3.3 EFFECTS ON QUALITY OF LIFE AND WELL-BEING

3.3.1 Measurable effects

Under the heading of quality of life and well-being, some measurable effects including safety improvement and noise have been considered together with effects on attitudes and perceptions of the project impacts not expressed in monetary terms.

The realisation of the project has marginally increased safety, thanks to the construction of the railway link to the airport, and modernisation of the railway line no. 8, both contributing to the shift from road to railway transport. This has brought about some benefits not only related to reductions in vehicle operating costs but also in the decrease of accidents due to modal shift from private car to rail, including injuries and fatalities.

The table below provides recent statistics on the decrease of accidents in the City of Warsaw. Overall the number of accidents is decreasing and in particular the reduction in the number of injuries and most of all mortalities is noticeable.

[13] With unequal intervals occurring during the day, as already explained on page 17.

Table 4. Accidents in the city of Warsaw 2013-2016

YEAR	NO. OF ACCIDENTS	% CHANGE	NO. OF INJURIES	% CHANGE	NO. OF MORTALITIES	% CHANGE
2013	1210		1368		74	
2014	1109	-8.3%	1242	-9.2%	65	-12.2%
2015	962	-13.3%	1086	-12.6%	61	-6.2%
2016	914	-5.0%	1037	-4.5%	54	-11.5%

Source: Authors on the basis on data from the City of Warsaw

Although the data are not only associated with the implementation of the major project, it is reasonable to assume that in qualitative terms, the realisation of the project has contributed to sustain the positive trend presented in the table above. Specifically regarding the quantitative estimation of the benefits related to safety, the assumptions in the ex-ante CBA have been reviewed and confirmed based on the analysis of the incremental effect of the project and consideration of the accident rates of the different transport modes in the city (see Annex II). On this basis **the safety benefit which is incorporated in the Cost-Benefit Analysis is valued at maximum nearly EUR 6 million per year**. Overall, it constitutes 6.2% of total project socio-economic effects.

Another effect included in the ex-post Cost-Benefit Analysis (see Annex II) is the **noise reduction effect, equalling EUR 9 million at present level**. This minor effect is driven by the reduced level of congestion on the road thanks to the effect on modal shift generated by the project.

3.3.2 Non measurable effects

A relevant effect of the investment occurred, which was not foreseen at the stage of project planning and implementation, which is related to the **intensive use of the train stop at Warsaw Służewiec**. This stop provides accessibility to the second largest office area in Warsaw (after the city centre), called Warsaw Służewiec. As such the railway services represent an alternative transport mode to the road and tramway system. **This part of Warsaw was dynamically developing over the past 20 years and reached approximately 100 thousand - employees. The dynamic growth of this part of Warsaw was however not appropriately followed by the development of transport accessibility solutions**, thus causing problems in terms of congestion and difficulties in finding available parking. **The improvement and extension of the railway interconnection towards the Chopin Airport represented an opportunity for Służewiec' employees to abandon private transport and congested roads and shift to the rail**. The feasibility studies for the modernisation of the Warsaw Służewiec railway stop did not most probably take into consideration such a high level of passenger flow and apparently the design of the stop did not answer the accessibility need of the real demand at this station and surrounding area, this leading to some unsafe behaviour of passengers, especially in the peak hours. **In order to avoid queuing at the overpass passengers prefer to pass through the tracks instead of using the safe overpass, stairs and/or elevator**.

Figure 26. Warsaw Służewiec railway stop (2014-2016)

Source: Courtesy of the author: Witold Urbanowicz

> ***Służewiec station is interconnected with the surrounding area in a non-satisfactory way, a better road connection with the station would be desirable as well as an additional underpass together with better interconnection with Cybernetyki street. At present the southern part of the station platform is located 200 m away from Cybernetyki street, whereas passengers need to use the overpass at Marynarska street, which extends their way substantially, also causing some users to illegal and unsafe passing through the railway tracks*** *(Source: interviewed passenger).*

Different technical solutions are under consideration to solve this issue, also including the construction of an underpass. In the meantime, safety barriers have been installed accompanied by a safety campaign and 'no passage' signs, to promote the usage of the overpass. However these latter measures do not seem to have helped solving the problem so far.

3.4 EFFECTS ON THE ENVIRONMENTAL SUSTAINABILITY

3.4.1 Measurable effects

The project is contributing to the reduction of road traffic. By offering passengers an alternative to private vehicles and taxis, **the project contributes to a reduction of air pollution and GHG emissions**. These effects are incorporated in the Cost-Benefit Analysis (see Annex II) representing respectively 2% and 0.01% (EUR 8.1 million and EUR 35 thousand each) of the total socio-economic benefits generated by the project.

3.4.2 Non measurable effects

The project in subject has no effect on biodiversity, as there are no environmental or protected areas which fall under the environmental protection law. Also, the NATURA 2000 areas are located away from the project location (6.7 km – Middle Vistula River Valley and 14.3 km Kampinos Forest), therefore no relevant impacts are expected. Nil impact of this project on biodiversity has also been confirmed by the Strategic Impact Assessment undertaken for the Operational Programme Infrastructure and Environment 2007-2013, which included the major project under ex-post assessment.

3.5 EFFECTS RELATED TO DISTRIBUTIONAL ISSUES

Social cohesion is understood here as the capacity to minimise disparities among social groups in terms of railway transport access. Thanks to the fact that the terminus station was designed in a way to allow easier access to people with reduced mobility and due to the purchase of a modern rolling stock as part of complementary investments, **the project has positively contributed to social cohesion**.

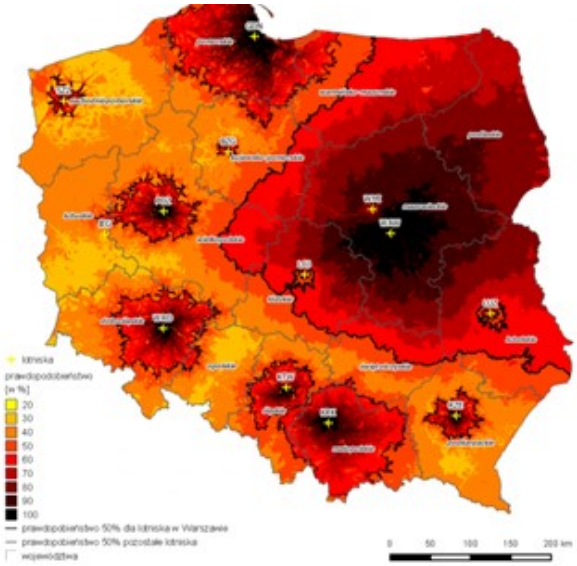
One of the implicit objectives of the above mentioned Sustainable Development Strategy of the Public Transport System in Warsaw up to 2015 and beyond, was certainly to improve the territorial cohesion in the project area, encompassing the allocation of main benefits over the central (core) and peripheral areas. In this regard **the major project can be also reasonably considered a relevant contribution towards the development of more accessible and coherent urban, metropolitan and regional territory**.

3.6 TIME-SCALE AND NATURE OF THE EFFECTS

The project was put in operation in June 2012, therefore **the discussed observed effects materialised in the short-run, although they are expected to continue to be generated also in the long-run**. With reference to the spatial scale of the effects, the ones quantitatively estimated in the CBA, are of local nature. However due to the operation of the railway services interconnecting to the airport in the wider Warsaw metropolitan area and Masovian region and considering the interchanges between the S2, S3 and RL services with other local, metropolitan, regional and national services by railway and coach, the effects are likely to have materialised also at the regional and wider territorial scale. According to the Polish aviation market survey undertaken in 2015[14] the Chopin Airport would most likely be chosen by passengers coming from Masovian, Podlaskie, Warmian-Masurian regions – and partially from Lublin, Holy Cross and Łódź regions. The analysis showed the dominance of the Chopin Airport in the North-East, East and central part of Poland, although at that time the Modlin airport was still at the initial phase of its development.

[14] WB Data Mining Polish aviation market survey, 2015.

Figure 27. Chopin Airport (and other airports) area of influence as of 2013



Source: http://www.pasazer.com/news/26250/skad,ma,pasazerow,lotnisko,chopina.html

Some of the effects related to economic growth, like time savings may also have wider impacts, even at the national level, especially when combined with the complementary investments described in Chapter 2. Furthermore, the environmental sustainability effect resulting from GHG emission reduction, contributes to a very small extent, but in a positive way to the global effect.

Table 5. Temporal dynamics of the effects

CATEGORIES OF EFFECTS	SHORT RUN (1-5 YEARS)	LONG RUN (6-10 YEARS)	FUTURE YEARS	COMMENT
Economic growth	++	++	+/-	Relevant time savings, reduced congestion, increased reliability
Quality of life and well-being	+	+	+	Overall positive level of satisfaction of the connection users, although with some critics mainly regarding the capacity at the Warsaw Służewiec railway stop.
Environmental sustainability	+	+	+	Reduction in level of air pollution due to more extensive use of public transport; no impact on biodiversity.
Distributional issues	+	+	+	Improved sustainable transport accessibility to the airport for all transport users, including persons with reduced mobility.

Note: + = slightly positive, ++ = positive, +++ = strongly positive, +/- = mixed effect.

4 MECHANISMS AND DETERMINANTS OF THE OBSERVED PERFORMANCE

In this section the key mechanisms and determinants of the long-term effects illustrated in the previous chapter are commented and discussed along the different phases of the project cycle. Finally, the importance of each determinant for the project's final performance and the interplay between them and the observed outcomes is discussed.

Table 6. Determinants of project outcomes

DETERMINANT	STRENGTH*
Relation with the context	+4
Selection process	+3
Project design	+3
Forecasting capacity	+4
Project governance	+3
Managerial capacity	+3

*Note: * the strength score reflects the weight of the role that each determinant played with respect to the final judgment of the project. In particular:*
-5 = the determinant is responsible of the negative performance of the project;
-4 = the determinant provides a negative contribution to the overall performance of the project;
-3 = the determinant contributes in a moderate negative way to the overall performance of the project;
-2 = the determinant has a slightly negative contribution to the project performance;
-1 = the determinant plays a negative but almost negligible role to explain the overall project performance;
0 = the determinant does not play a role on the project performance;
+1= the determinant plays a positive but almost negligible role to explain the overall project performance;
+2 = the determinant has a slightly positive contribution to the project performance;
+3 = the determinant contributes in a moderate positive way to the performance;
+4 = the determinant provides a positive contribution to the overall performance of the project;
+5 = the determinant is responsible of the positive performance of the project.

4.1 RELATION WITH THE CONTEXT

As already mentioned in the previous sections, with the adoption of the 2001 Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw the development of a railway connection to the Chopin Airport became a priority of the transport and land-use policy of the Polish capital city in the wider context of the public transport system of the Warsaw metropolitan area and Masovian region. **The major project was deemed of strategic importance to improve accessibility to the airport and promote sustainable transport in the agglomeration of Warsaw, in a context of rapid increase in the total number of airport passengers and local motorisation rate, driven by the economic development of Poland** (see section 1.1).

The investment was accordingly in line with the targets and objectives of the most relevant strategies and investment plans for the development of the land-use and transport system of Warsaw as the capital city of Poland. **As such and due to its relevance to increase the transport offer in terms of transport modes and capacity, the major project was subject of specific agreements between the State Treasury, the City of Warsaw, the "Polish Airports" State Enterprise (PPL) and the national rail infrastructure manager PKP PLK S.A**.

Whilst the idea of interconnecting the Airport with the railway network was already identified in 2001, **the possibility for the development of the rail connection to the airport became more concrete in 2004 with the accession of Poland to the**

EU. Following this event, the national railway infrastructure manager PKP PLK S.A. defined a wide programme for the modernisation of the railway network. **The need to modernise the railway network in the Warsaw Urban Node and the location of the Chopin Airport close to the Okęcie station on railway line no. 8 represented the opportunity to develop a direct link to the airport**.

From the infrastructure standpoint, the development and construction of a dedicated link to the Chopin Airport in Warsaw was thus associated with the first phase of the modernisation works of railway line no. 8, within the metropolitan area of Warsaw. Further to the modernisation of railway line no. 8 and the construction of the link to the airport, additional initiatives were implemented, also co-financed from the EU, relating to the procurement and supply of new rolling stock to operate the services interconnecting the Chopin Airport with several destinations within the metropolitan area of Warsaw, including all main stations and interchange hubs in the city centre (see Box 1). These complementary initiatives also include the construction of the second terminal at the Chopin Airport. As part of this latter project the civil works for the basic infrastructure of the future railway underground railway station at the Chopin Airport were also implemented.

Figure 28. One of the 13 trains purchased by SKM in 2012 to operate on the railway line to Okęcie airport

Source: Authors

Another important driver particularly impacting on the timely completion of the major project was the selection of Warsaw by UEFA as one of the eight venues of the 2012 UEFA European Championship. This provided the Polish Authorities with an additional reason to commit to develop and implement the project in time for the start of this event. In view of the Euro 2012 Championship, the availability of the new railway services interconnecting to the Chopin Airport represented an opportunity to improve not just the accessibility to this hub, but also the image of the City.

Therefore, **it shall be concluded that the context in which the major project was conceived and implemented was favourable**. The project provided additional capacity in terms of accessibility to the Chopin Airport and an alternative sustainable transport solution to road transport at the same time comfortable and reliable not just for the airport passengers and employees but also for commuters and city users

travelling in the Warsaw metropolitan area and Masovian region. As such the investment was perceived as strategically relevant by the City Administration, the "Polish Airports" State Enterprise and the national railway infrastructure manager PKP PLK S.A.

4.2 SELECTION PROCESS

Selection process is understood as the institutional and legislative framework that determines how public investment decisions are taken, i.e. which is the process in place and the tools used to select among alternative projects.

Feasibility studies had been carried out before the commencement of the detailed design process, which aimed at optimising the technical solutions for the modernisation of the railway infrastructure and construction of the link to the Chopin Airport. Due to the favourable location of the airport by railway line no. 8, it was decided to construct a railway link between Warsaw Okęcie station and the Chopin Airport, also located at Okęcie, departing from railway line no. 8. For strategic planning and financial purposes the development and construction of the link was also appropriately considered to be done as part in the initiatives related to the modernisation of railway line no. 8. More specifically the development and construction of the link has been included in the first phase of modernisation of this line relating to the section within the urban area of Warsaw, between Warsaw Zachodnia (West) and Warsaw Okęcie.

The option selection process was ultimately completed by the project promoter – PKP PLK S.A. **also considering the activities, studies and works under implementation by the other interested parties such as the** "Polish Airports" State Enterprise as well as Warsaw City Hall.

Public consultations have been also performed as part of the EIA process. This was carried out and accompanied by public debate, and it proved strong interest and support by society of the proposed investment.

The analysis of the selection process does not reveal critical elements, representing a smooth phase of the project life cycle.

4.3 PROJECT DESIGN

Project design refers to the technical capacity to properly design the infrastructure project.

After completion of the feasibility studies and full definition of the project layout and solution, **the detailed design was carried out in 2008. The design of the project did not present specific technical difficulties.** The implementation of the major project related works, including the link to the airport did not involve any unconventional construction techniques and the probability of major engineering setbacks was considered low also by JASPERS in their assessment of the project occurred in 2009. There were however two aspects that were pointed out by JASPERS. The first one relating to the departure of the link to the airport from railway line no. 8, as any problems at this section might have interrupted the traffic flow on this main national route; and the second one regarding carrying out the construction works nearby the moat of the Zbarż Fort, with a possible risks of water spillages. This could result in potential negative effects on both the tunnel and Zbarż Fort surrounding groundwater levels.

Not related to the risks commented by JASPERS, as also commented at section 2.2, at the construction stage a failure of the underground tunnel drainage system occurred and landmines and other hazardous wastes were found in the ruins of Fort Zbarż. Both unexpected and unforeseeable events were properly addressed by the Polish Authorities, which also resulted in a marginal cost increase of EUR 3 million and 9 months of delay in the implementation of the project. **The slight additional costs have been nevertheless supplemented by means of savings at the tendering stage, and the project has been completed in time for the start of the 2012 European Football Championship**.

Another issue of the project design emerged at the operational stage, which is related to **the lack of throughput capacity of passengers outflows at the Warsaw Służewiec railway stop**. In the peak hours, in order to avoid queuing to exit the station using the existing overpass, commuters cross the railway line. The Polish Authorities have installed safety barriers and put in place a safety campaign and 'no passage' signs, promoting the usage of the overpass. These measures do not seem to have been entirely effective in solving the problem. **Technical solutions are under consideration by the City as well as PKP PLK S.A. to expand the capacity of the existing overpass, including the construction of an underpass**. This is expected to contribute to the improvement of the accessibility to the Służewiec business centre, which as already commented at section 3.2.2 suffered since its original development from inadequate road and parking accessibility; an issue which has been amplified by the significant development of the economic activities at this centre above the original expectations.

No other substantial issues occurred with reference to the project design. Therefore, it can be concluded that the project planning and design were overall a positive element in the implementation of the project.

4.4 FORECASTING CAPACITY

Forecasting capacity is understood as the possibility and capability to predict future trends and forecast the demand level and estimate the technical challenges, thus estimating correctly the required resources (e.g. looking at the dangers of over-predicting demand and under-predicting construction costs).

As mentioned above JASPERS supported the beneficiary during the project preparatory phase. This was also aimed at assessing the quality and solidity of the results of the demand analysis. In particular, JASPERS' experts commented the demand analysis, specifically the frequency of 6 trains per hour, which might seem high for an airport of this size.I It was however recalled by the Polish Authorities that these trains also serve general suburban and regional traffic on the main railway axis of Warsaw, therefore, the total passenger levels in the centre was expected to be even higher. As a result, **JASPERS' experts assessed the traffic forecast assumptions as conservative**.

Concerning the estimation of the project costs, it must be noticed that despite some additional works required to repair a failure in the tunnel drainage system and remove landmines and petroleum derivatives from the Zbarż Fort's ruins, **the predicted total project costs were not exceeded and were even slightly reduced as an effect of the public tendering process**. The savings from the tendering process can also be deemed an effect resulting from the experience and capacity of the management team at PKP PLK S.A. in preliminary cost estimations, additionally supported by the price competition on the construction works and supply market. The project was

examined at the preparatory phase and monitored during its implementation and after completion by CUPT (Centre for European Transport Projects)[15]. The involvement of CUPT assured correctness in the public funds spending. All the eligible and non-eligible costs were examined by CUPT together with the appropriateness of the procedures and forms related to the application for EU financial support.

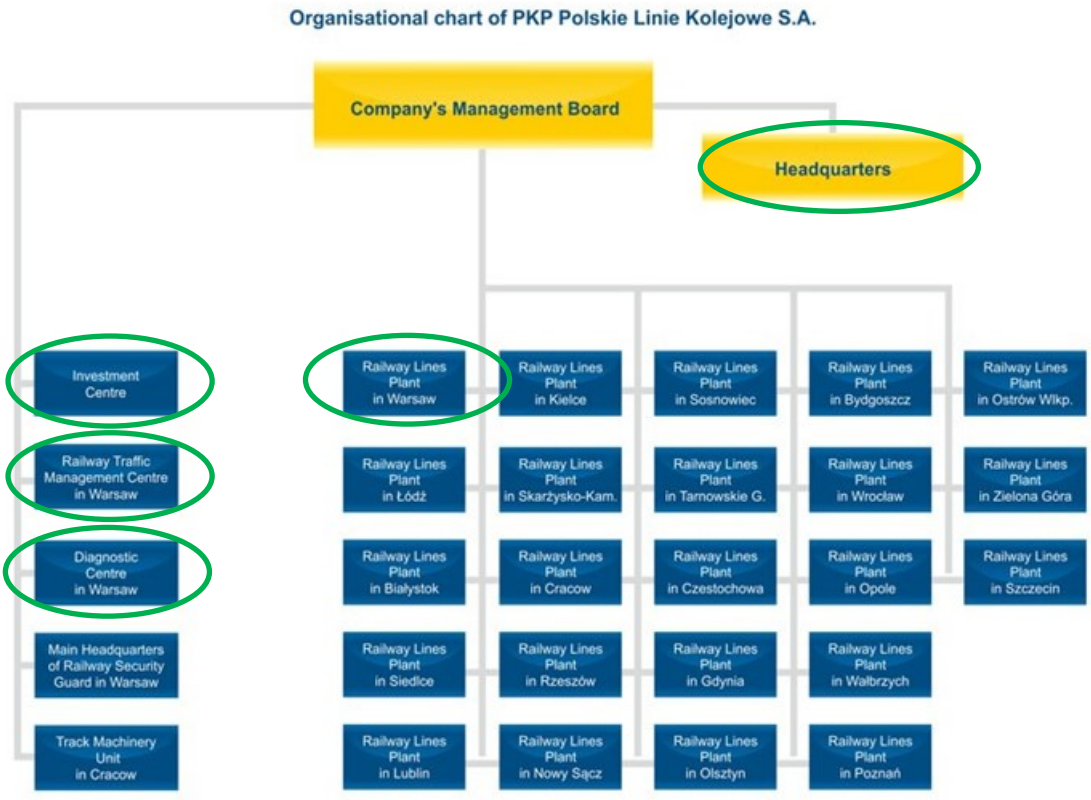
Overall the analysis shows a good forecasting capacity of the railway infrastructure manager, which benefitted from the previous experience in similar projects and from the support of JASPERS and CUPT.

4.5 PROJECT GOVERNANCE

The project governance concerns the number and type of actors involved during the project cycle and how responsibilities are attributed and shared. In this respect, the major project involved a wide number of stakeholders during the entire project cycle.

During the implementation phase, **the project was prepared, and its implementation was directly managed by PKP PLK S.A.**, the railway infrastructure manager. The operation and maintenance the infrastructure is also under the responsibility of PKP PLK S.A. representing at the same time the owner and manager of the constructed and modernised railway network.

Figure 29. Organisational scheme of PKP PLK S.A. project' related internal units



Source: Authors on the basis of PKP PLK S.A. information

At the time the project was implemented, an internal restructuring process at PKP PLK S.A. was in place aiming at increasing the effectiveness in implementing European

[15] The EU Transport Projects Centre was established by the Polish Ministry of Transport and was assigned with the responsibility of disbursing European Union grants towards proposed transport projects.

funded projects. Periodic and frequent internal reorganisations occurred in the past years and particularly during the implementation of the project, thus making it difficult to reflect an inner organisational scheme at that time. However, it is relevant to notice that regardless these changes, there was a continuity in the involvement of experienced project managers. The overall current organisational diagram of PKP PLK S.A. is presented in the figure above (the units involved in the implementation and operation of the project are marked with a circle).

The fact that the internal organization of the railway infrastructure manager was subject to changes over the years of implementation of the project, including the establishment of a centre dedicated to the development and implementation of European projects (Investment Centre), which occurred during the last year of project construction, did not have negative impacts on the good execution and implementation of the works. This is due to the long-lasting experience and stability in the management team involved in the construction of the link and modernization of railway line no. 8, including the project managers and coordinators.

As stated in the previous sections a formal agreement was signed in 2004 for the development of the road and rail infrastructure surrounding the terminal 2 at the Chopin Airport. This agreement was extended in 2006 by Annex no. 1, formally involving PKP PLK S.A. in the development of the infrastructure to access to the airport and setting the rules and conditions for the implementation of the major project, ensuring maximum commitment by all parties in the development of the investments associated with the expansion of the airport and its accessibility by road and rail

The necessary funding for ensuring the operation and maintenance of the project are secured by the railway infrastructure manager. **The financial sustainability of the operation and maintenance of the railway infrastructure relies on inflows from track access charges**. The track access charges for this section enable covering the yearly operating costs (without depreciation) and the assumed average yearly cost of repairs/renewal. Cumulated net cash flows are positive in each year of the financial projections.

According to the strategy for the development, implementation and operation of the project the financial model adopted for the project assumes that the railway infrastructure will be operated as part of the national railway network and that the railway services will be operated as part of the public transport system at the urban, suburban and regional scales. Accordingly the tariff adopted for the services is the same as the one applied in the urban area, including on the bus services, also the ones to the airport (see also section 2.3). Nowadays dedicated links to the airports are frequently implemented and operated with financial structures and tariff schemes which allow the partial/total repayment of the investment costs. This is of course not the case of the major project under assessment for which neither the revenues from access charges nor the ones from the tickets sold to the passengers (whose cost is at least between the city centre and the airport is about EUR 1) are not sufficient to repay the investment costs. In this regard and as a side note to this ex-post assessment it is worth to mention that considerations about the applicability of such a solution to this specific case study would however require adopting different assumptions than the ones effectively in place regarding the organisation and structure of the existing bus services as well as railway services on the S2, S3 and RL lines. It would basically imply a total different operational concept than the one

currently in place, which as explained above considers the link to the airport as part of the wider metropolitan, regional and national public transport system.

4.6 MANAGERIAL CAPACITY

The managerial capacity refers to the professional ability to react to changes in the context/needs and unforeseen events during the project implementation, as well as to the professional capability to manage the project ensuring the expected level of service in the operational phase.

No substantial technical changes occurred during the project implementation, **although some additional works were required,** for the repairing of a failure in the underground tunnel drainage system, and removal of landmines and hazardous wastes from the Zbarż Fort's ruins found at the construction stage. **These additional unpredicted activities and works caused a project implementation delay of 9 months and an additional project expenditure of EUR 3 million. However, considering some savings generated by the procurement procedures at the tendering stage, the final investment cost amounted to EUR 64 million, which is nearly 10% less than the planned investment cost of EUR 70.8 million.** In these terms no cost overruns occurred. The project was also completed in time for the start of the EURO 2012 Football Championship.

The project foreseen and unpredicted technical issues were addressed by PKP PLK S.A. with the support of technical engineers and designers involved in the supervision and execution of the works, resulting in a slight amendment of the project design and adjustment of its scope. In this regard it is worth to notice that **the tender procedure was launched in 2008 and was completed without recourses and complains in 2009**. The contract for the construction of the works was granted to Bilfinger Berger S.A., the construction works started in November 2009 and the permit to operate the services was issued in May 2012. The construction works were fully completed in 2013. According to law **the supervision of the works was appropriately undertaken by a different private engineering company, which was also selected by means of an open public tender procedure**.

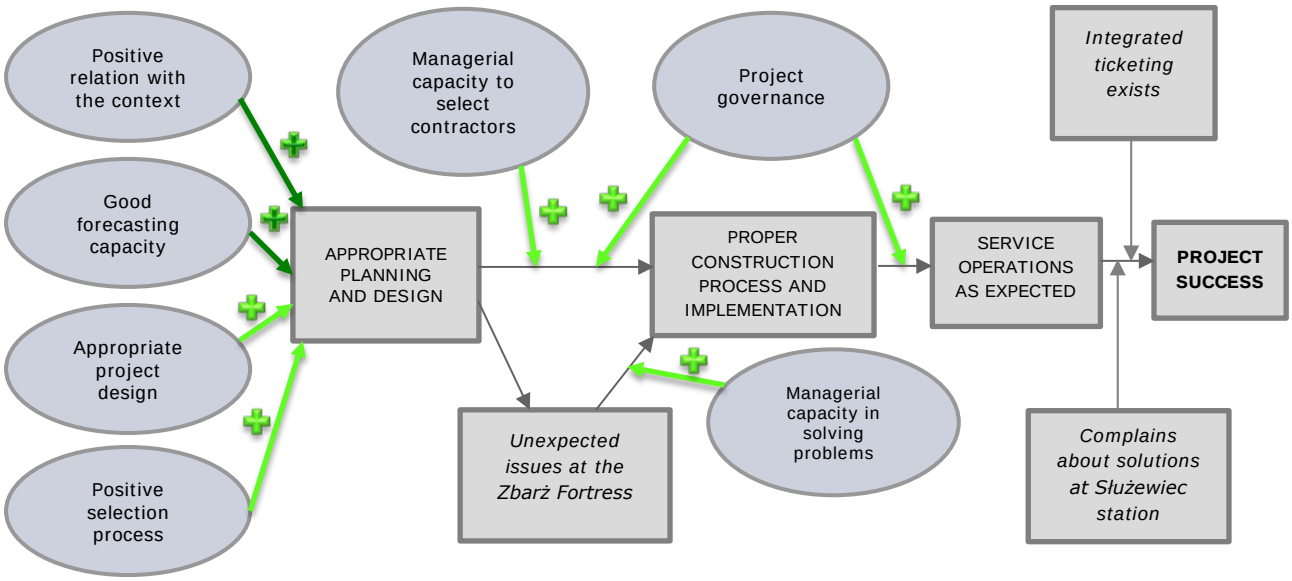
During the operation phase, **some issues regarding the passengers outflow capacity during peak hours at the Warsaw Służewiec station** were reported by journalists and citizens according to the review of publicly available sources and stakeholders' interviews. These claim about the inadequate throughput capacity of the existing overpass and poor quality of service resulting from queuing by commuters exiting from the station. **It seems that such an intensive use by commuters of the Warsaw Służewiec station was not expected at the planning stage of the modernization of the line, as at that time the Służwiec district, was not foreseen to grow so intensively, the site presenting overall accessibility problems**. Therefore, inappropriate and unsafe behaviour is observed especially in the peak hours when the passengers cross the tracks to avoid queuing at the overpass. As a first action to counteract this problem, safety barriers have been installed by the Polish Authorities and a safety campaign and 'no passage' signs have been put in place, to promote the usage of the overpass. However the problem still seems to be not entirely solved. As a matter of fact, **the authorities are currently considering the expansion of the existing bypass, by means of construction of an underpass**.

4.7 PROJECT BEHAVIORAL PATTERN

Following the identification of the typical determinants of the project performance and the main project outcomes, the final step entails describing the chain of interlinked causes and effects determining the project performance over time.

The behavioural pattern of the project under assessment is provided in the following figure. The round boxes in light blue indicate the projects' determinants, the rectangular boxes in light grey refer to the observed events, the '+' signs next to the green arrows indicate that the factor has positively influenced the project performance. In particular, arrows in light green indicate factors that had a positive but not very strong influence, whereas arrows in dark green indicate a stronger influence. No factors have been identified representing very strong positive, neither negative influence.

Figure 30. Behavioural pattern of the railway link to Okęcie airport - Star



Source: Authors

The major project is an example of a positive project – with overall marginal and minor issues occurred at the project construction and operational stages. After approximately 5 years since its completion the services on the S2, S3 and RL railway lines seem to show high utilisation, especially by commuters and city users, according to the available passengers volumes from SKM. Based on the results of the surveys on the accessibility to the airport published by the "Polish Airport" State Enterprise, it is also noticeable that since 2013 the modal share of the rail services passed from 8.1% to 13.5% in 2016 towards the airport and from 5.7% to 13.1% in the same period from the airport.

The overall positive project performance is the result of a combination of factors: a strong interest by the involved parties to develop the railway link, good project planning, appropriate selection process, good cooperation between the relevant stakeholders and the capacity to appropriately react to unpredicted events. **The positive results of the ex-post CBA and the overall ex-post assessment analysis confirm the effectiveness of implementing the major project as part**

of the modernisation and improvement of the public transport system by railway in the Warsaw urban and metropolitan areas and Masovian Region.

In terms of project determinants, **context is a relevant pre-requisite of the project's performance**. The construction of the railway link to Okęcie airport was in line with the context needs, including the fast-growing traffic at the airport and increase in the motorisation index in the Warsaw metropolitan area and surrounding territories, causing congestion on the main road arteries, affecting travel times and reliability of the journeys originated and directed to the main traffic generators, including the Chopin Airport.

The whole project definition and option selection process managed by the PKP PLK S.A. have also been crucial for the project's final performance. The process was based on two feasibility studies and analyses which have seen the involvement of JASPERS for the technical and operational elements of the railway link, as well as the involvement of the citizens through public consultation activities as part of the EIA process. Although the localisation of the station in a more central position with respect to both terminals could have been more optimal, no analyses have been ever performed to compare the functioning of the link assuming a different location of the station; and the project as it has been implemented proves to be effective.

Forecasting capacity and managerial capacity goes hand in hand in several ways with the project design and works implementation. The involvement of experienced professionals from PKP PLK S.A., familiar with railway investment development and construction processes in Poland allowed the project to appropriately react to some minor unpredicted issues i.e. the removal of landmines and other hazardous wastes identified at the construction stage in the ruins of Fort Zbarż. The costs for these additional activities these measures have been supplemented by means of savings at the tendering stage. And the delays in the implementation of the project also experienced due to these additional activities and works, did not obstacle the completion of the project in time for the start of the 2012 European Football Championship. **As a matter of fact, the total costs for the construction of the project is slightly lower than originally estimated in the ex-ante analysis**. Nowadays, the managerial capacity is challenged by the **complains related to inadequate passengers' outflow capacity at the Warsaw Służewiec station, which may be possibly solved also by means of construction of an additional railway pass.**

Finally, **project governance was relevant** as well because of the structure of the organisation responsible for the development of the railway network, with allocation of clear responsibilities to specific managers, which proved to be effective, despite frequent changes in the internal structure of PKP PLK S.A. during the development and implementation of the project. The interest by all parties in the development of the link led to a good cooperation between the railway infrastructure manager (beneficiary) and the State Treasury, the „Polish Airports" State Enterprise and the Warsaw City Hall, which made it also possible to complete the project in time for the 2012 European Football Championship.

5 FINAL ASSESSMENT

Based on the different findings produced by the project analysis both in terms of effects generated and measured through the CBA or qualitatively discussed, as well as of factors affecting the generation of those effects, the final assessment of the project performance is presented here after along a set of evaluation criteria.

5.1 PROJECT RELEVANCE AND COHERENCE

The project was relevant in the context where it was implemented, as it was the appropriate initiative to increase the overall capacity of the public transport system by railway in the Warsaw metropolitan area and Masovian region, also providing accessibility to the Chopin Airport. In a context of economic growth and increase in the total number of airport passengers and local motorization index, the major project responded to the need to provide a reliable alternative transport mode to road transport, promoting at the same time sustainable mobility in the Warsaw metropolitan area and Masovian region. These strategic goals of the project were fully in line with the priorities set in a number of strategic documents at local, regional and national levels, including the 2001 Study on the Conditions and Guidelines for the Spatial Development of the City of Warsaw, that first introduced the concept for the interconnection of the Chopin Airport to the national railway network.

The major project is overall coherent with the need to modernise and improve the quality of railway transport in the Warsaw metropolitan area and Masovian region and it is also consistent with the need to develop the accessibility to the Chopin Airport. Actually, from the infrastructure standpoint, the major project was both associated with the initiatives for the modernisation of the Polish national railway network in the Warsaw urban area and with the project for the expansion of the airport and specifically with the initiative for the construction of the second terminal. From the functional standpoint, it was furthermore aimed at increasing the offer and usage of public transport by railway in the wider Warsaw metropolitan area and Masovian region. Accordingly, the realisation of the link was considered for implementation as part of the plans, strategies and studies for the modernisation of national railway line no. 8 in the urban area of Warsaw. It was also assumed to increase the capacity of the transport system in providing accessibility to the airport, which was required to support the expected growth of passengers traffic at the Chopin Airport. Finally, upon completion of the project two railway lines were put into operation in addition to the existing suburban S2 line already reaching Okęcie station: the suburban railway line S3, and the regional railway line RL. New rolling stock was purchased to be used on the three lines which provided not only accessibility to the airport, but also served passenger and commuter traffic in the agglomeration of Warsaw. Interconnecting with the main railway stations in Warsaw, these lines were not just covering important sectors of the Warsaw metropolitan area and Masovian region, they were also allowing passengers from national railway and long-distance coach services reaching the airport by interchanging at this main transport hubs. Today a set of real data is available concerning the total number of passengers served by the S2 and S3 railway lines interconnecting to the Warsaw Chopin Airport. **The implementation of the project and the increase in the operation of the railway services interconnecting to the airport after its completion seem to have contributed to the growth in the usage of public transport by railways in the Warsaw metropolitan area and Masovian region**. Whilst detailed data on the railway trips having the airport as origin or destination are

only partially available (between the city centre and the airport and limited to RL services only), the project is reasonably expected to have turned public transport services to the airport more reliable and attractive as also confirmed by the results of the surveys on accessibility patterns to and from the airport, performed by the "Polish Airport" State Enterprise.

5.2 PROJECT EFFECTIVENESS

The investment was worthwhile because, while costing EUR 134.3 million (in nominal value, including EUR 64 million for the major project and EUR 70.3 million for the rolling stock), the socio-economic NPV of the project is equal to EUR 216.1 million[16], with an ERR of 12.9%. So the performance indicators confirm that the project was desirable for society and increased welfare. This is the result of the combination of two main drivers: first, cost savings in the construction phase; and secondly, a considerable reduction in the social costs of the trips served by railway transport, namely time savings, VOC reductions, reduction in accident cost, air pollution, GHG emissions, noise. **Additionally, the risk analysis shows that under the socio-economic perspective the project has a negligible risk level**, i.e. with negative variations from the reference case of the values of critical variables, there is no probability that the ENPV of the project become negative and a probability of nearly 50% that the expected ENPV is less than the reference one.

Based on interviews with the stakeholders, it is reasonable to assume that the quality of the rail services provided increased since the completion of the project and it is satisfactory. As a matter of fact, the rail services on the lines interconnecting to the Chopin Airport are all operated with new modern and comfortable trains and the stations and rolling stock are equipped with real time passenger information displays, and are accessible to persons with reduced mobility. The satisfactory level of the rail services is also proven by the fact that no complains have been registered about the quality of the public transport services providing accessibility to the airport. This is actually also the case of the city bus services, which are also operated with new comfortable low floor vehicles, also allowing transportation of persons with reduced mobility.

It is worth mentioning that along with an overall positive project assessment an unexpected inconvenience emerged after the completion of the project, at the operational stage, **which is related to the lack of throughput capacity of passengers outflows from the Warsaw Służewiec railway stop**. In the peak hours, in order to avoid queuing to exit the station using the existing overpass, commuters cross the railway line. **Technical solutions are under consideration by PKP PLK S.A. to expand the capacity of the existing overpass, including the construction of an underpass.**

As a final remark on project effectiveness, **an external factor which may affect the project performance in the future should be mentioned, which is related to the planned construction of a new airport located between Warsaw and Łódź (in Baranów)**. With a capacity up to 100 million passengers per year as indicated by the Resolution of the Council of Ministers dated 7th November 2017 on the "Concept of preparation and implementation of the Solidarity Port – Central Communication Port for the Republic of Poland", this airport is envisaged to be completed by 2027 and

[16] With the social discounted rates adopted at the level of 4.83% backward and 4.19% forward.

takeover the passengers' operations from Okęcie Airport, which will be used for military purposes only. Albeit at its inception stage, the construction of the Solidarity Port and the subsequent closure of civil aviation operations at the Chopin Airport would impact on the demand for railway services interconnecting to the airport thus reducing the benefits associated with the implementation of this major project.

5.3 PROJECT EFFICIENCY

Some delays in the implementation of the major project related works and a slight increase in the project costs occurred, associated with some additional unpredicted activities and works. **In any case the services interconnecting to the airport were put in operation in time for the start of the European Football Championship Euro 2012**. Thanks to savings in the tendering process, **the project's construction was ultimately completed with a budget slightly lower** (PLN 271.5 million) **than the one originally assumed** (PLN 300 million).

The financial sustainability has been assessed for the project by adjusting the ex-ante financial projections on the basis of 2009-2016 data and is positive. The project investment was co-financed by the EU (CF) and national resources. The overall level of EU co-funding for this project was 80% of eligible expenditures. The national contribution was partially covered by the direct subsidiary and PKP PLK S.A. own means. The revenues from stations and track access charges cover the operation and maintenance costs.

5.4 EU ADDED VALUE

On the basis of the available data and consultation of the concerned stakeholders it is reasonable to conclude that the major project has contributed to an increase in the use of railway transport in the Warsaw metropolitan area and Masovian region also increasing the attractiveness of the accessibility by public transport to the Chopin Airport. Overall **the project is worth generating positive effects and impacts which could not be achieved without the financial support from the EU**.

At the end of 2013, the Regulation EU 1315/2013 was published which set the basic rules for the development of the New TEN-T policy, also identifying 9 core network corridors, including the North Sea-Baltic and Baltic-Adriatic corridors. Warsaw is a core network node of both corridors. According to the Regulation Warsaw Airport shall be connected to the core railway network by 2030. **The major project allowed reaching this target of the TEN-T Regulation well in advance of the 2030 deadline, an objective which would have not been possible without the EU support**.

As a final remark, it is worth noting that **the role of JASPERS can be considered an additional element of the EU added value**. As a matter of facts, it helped the project beneficiary streamlining the project design in the completion of the preparatory phase, leading to a better definition of the risk associated with the construction works.

5.5 FINAL ASSESSMENT

In conclusion, **the major project represents a good example of railway transport infrastructure project to promote sustainable transport in a wider metropolitan area, including accessibility to a major transport hub and enhancement of transfer of passengers between transport modes in a core**

urban node of the TEN-T network. The project seems generating positive effects both by increasing the capacity and performance of the public transport system in the Warsaw metropolitan area and Masovian region, as well as by providing direct interconnection by railway to the international airport of the capital city of Poland. The project managed to deliver all the foreseen benefits at the expected time and costs. This achievement is due *in primis* to the strategic relevance of the project for all the concerned parties i.e. the "Polish Airports" State Enterprise, the Warsaw City Hall and the national railway infrastructure manager PKP PLK S.A. This ensured commitment in the planning and development of this initiative. This is also the result of good managerial capacity and effective project management and work supervision. The local authorities were in fact able to promptly provide an adequate response to the local needs and secure the financial and technical capacity available for the initiation and implementation of the project. The fact that the service operation is adequately provided by the operators and that the new vehicles are maintained in good conditions is another key factor explaining the positive performance of the project. As a matter of fact, the railway services are reliable and attractive which have reasonably contributed to an overall increase in the usage of public transport services in the Warsaw metropolitan area, as well as to keep high shares of accessibility by public transport to the airport. **The positive performance of the project, although it is expected to be maintained in the long-run, would possibly be affected by the evolving context**. More specifically and albeit at its inception stage, the construction of a new airport located between Warsaw and Łódź (nearby Grodzisk Mazowiecki), with a capacity up to 100 million passengers per year, currently at the planning stage and expected to be completed by 2027, would impact on the demand for railway services interconnecting the city centre with the airport, thus reducing the benefits associated with the operation of this major project.

Table 7. Evaluation matrix

CRITERION	EQ	ASSESSMENT	SCORE (*)
Relevance	To what extent the original objectives of the examined major project matched: • the existing development needs, • the priorities established at the programme, national, and/or EU level.	The project was and over the years remained fully in line with the development needs and the priorities established at various levels	**5**
Coherence	• Are the project components in line with the stated project objectives? • To what extent the examined the project were consistent with other national and/or EU interventions carried out in the same field and in the same area?	Fully consistent	**5**
Effectiveness	• Has the examined major project achieved the objectives stated in the applications for Cohesion policy support? • Was the actual implementation in line with the foreseen time schedule? • What factors, including the availability and the form of finance and to what extent influenced the implementation time and the achievement observed? • What has changed in the long run as a result of the project (for example, is there evidence showing contribution of the project to the private sector investments)? • Were these changes expected (already planned at the project design stage, e.g., in terms of pre-defined objectives) or unexpected (emerged, for instance, as a result of changes in the socio-economic environment)? • How have these changes matched the objectives set and addressed the existing development needs, the priorities established at the programme, national and/or EU level? • Did the selected project turn out to be the best option among all feasible alternatives?	The project has achieved the expected objectives in line with the foreseen time schedule and priorities set in the relevant programs. Nine months of delay and EUR 3 million additional costs occurred during its implementation associated to unpredicted events. However the project was completed in time for the start of the EURO 2012 Football Championship and some cost savings have been experienced at the tendering stage, largely offsetting the slight increase in the budget. Although the localisation of the station in a more central position with respect to both terminals could have been more optimal, no analyses have been ever performed to compare the functioning of the link assuming a different location of the station; and the project as it has been implemented proves to be effective. Overall the options considered for the interconnection of the link to railway line no. 8 have been assessed by the concerned stakeholders and the most advantageous solutions have been identified and selected on the basis of the economic costs and benefits associated to each alternative	**4**
Efficiency	• Are there any significant differences between the costs and benefits in the original cost-benefit analysis (CBA) and what can be observed once the project has been finalised? • To what extent have the interventions been cost effective?	No differences, actually a recent ex-post assessment by PKP PLK S.A. seems pointing to an overall underestimation of the benefits as calculated in the ex-ante CBA	**5**
EU added value	• What is the EU added value resulting from the examined major project (in particular, could any of the major projects examined, due to its risk profile, complexity or scope, have not been carried out if not for the EU support)? • Did the examined major projects achieve EU-wide effects (e.g. for preserving the environment, building trans-European transport networks, broadband coverage etc.)? • To what extent do the issues addressed by the examined interventions continue to require action at EU level?	High EU added value, i.e. the project achieved positive effects which would have been hardly achieved without the EU support	**5**

*Note: * Scores range from 1 to 5. Source: Authors*

6 CONCLUSIONS AND LESSONS LEARNED

The ex-post assessment of the major project relating to the interconnection of the Chopin Airport to the national railway network as part of the modernisation of railway line no. 8 within the Warsaw urban area, between the Warsaw Zachodnia, Warsaw Służewiec and Warsaw Okęcie stations, supports the conclusion that the project was overall technically sound under both the infrastructural and functional stand points, contributing to the main objectives of the EU transport and cohesion policies. The results of the ex-post CBA are positive also confirming that the project is adding value to the EU society.

From the functional standpoint, the project has been essential to increase the capacity of the public transport system by railway in the Warsaw metropolitan area and Masovian region. Also, thanks to the project the Warsaw Chopin Airport is now accessible by railway, which is also a legal requirement of the TEN-T Regulation 1315/2013. The airport currently benefits from the availability of an additional transport mode and the whole Warsaw agglomeration can now benefit from a better, reliable and comfortable transport solution capable of supporting the development of sustainable urban mobility in the area, contrasting the negative effects attributable to road transport and congestion.

The following lessons can be learned from the ex-post assessment of this major project:

- First, **the project allows to understand to what extent the institutional context's characteristics, may positively influence the development of a project**. A rail link to the airport was perceived as strategic by all concerned entities, namely: the "Polish Airports" State Enterprise, the Warsaw City Hall and the national railway infrastructure manager PKP PLK S.A. All these entities were firmly committed to the development and implementation of the project and entered into a specific agreement for the coordinated development implementation and future operation of the railway services interconnected to the Chopin Airport in the metropolitan area of Warsaw and Masovian region. The economic context in which the infrastructure works and railway services have been put into operation was characterised by a constant growth in the economy which was also determining an increase in the total number of passengers at the airport and a growth in the motorisation index. Additional and more environmental friendly transport capacity was required to support the planned expansion of the airport. Furthermore more sustainable transport services were required in the metropolitan area of warsaw and Masovian region. After the accession to the EU by Poland a nationwide modernisation programme of the railway network was agreed between the Union and PKP PLK S.A., which also affected the Warsaw metropolitan area. This represented an opportunity to construct the railway link to the Chopin Airport and introduce railway services both interconnecting to the airport and serving commuters and city users in the agglomeration of Warsaw. The 2012 European Football Championship, to be organised in Poland and Warsaw, also represented a key contextual element which contributed to the timely development of the project.
- Second, and in line with the above, the project demonstrates that **coordinated investment strategy** can maximise the benefits that can be possibly generated by a single investment **allowing reaching ambitious goals such as improving the performance of the public transport system to keep it**

competitive in face of a growing motorization rate supported by economic growth. The major project represents in fact a good example of a project that further to generate benefits due to the provision of a new sustainable transport mode to access the airport, is also contributed to the overall increase in the use of public transport in the Warsaw metropolitan area thanks to an increase in the offer of qualitative and attractive public transport services by railway.

ANNEX I. METHODOLOGY OF EVALUATION

This Annex summarises the methodological approach undertaken for carrying out the project case studies and presented in the First Intermediate Report of this evaluation study. The main objective is to provide the reader a concise account of the evaluation framework in order to better understand the value and reach of the results of the analysis as well as to enable him/her, if interested, to replicate this methodology.[17]

The Annex is divided into four parts, following the four building blocks of the methodological approach (mapping of effects; measuring the effects; understanding effects; synthesis and conclusions) laid down in the First Intermediate Report. Three evaluation questions, included in the ToR, guided the methodological design. They are:

- **What kind of long term contribution** can be identified for different types of investment in the transport field?
- **How is this long term contribution generated** for different types of investments, i.e., what is the causal chain between certain short term and log-term socio-economic returns from investments?
- **What is the minimum and average time** needed for a given long term contribution to materialise and stabilise? What are these time spans for different types of investments in the transport field?

A I.1 Mapping the effects

The Team developed a classification of long-term effects, with the aim of identifying all the possible impacts of transport investments on social welfare. Under four broad categories, a taxonomy of more specific long-term development effects of investment projects has been developed. The definition of each type of effect is provided in the Table below.

Far from being exhaustive, this list is intended to guide the evaluators in identifying, in a consistent and comparable way, the most relevant effects that are expected to be identified and included in the analysis. Additional effects could possibly be relevant in specific cases and, if this is the case, they can be added in the analysis.

In researching all the possible long-term effects of project investments, it is acknowledged that there could be a risk of duplication. In addition, the allocation of some effects under different categories is to some extent arbitrary and thus it may happen that categories overlap. That said, caution will be paid in order to avoid double counting when performing the ex-post CBA.

[17] Specific recommendations which may enable application of the same evaluation methodology to future projects are discussed in the Final Report of this evaluation study.

Table 8. Taxonomy of effects

	DIRECT EFFECTS	DESCRIPTION
EFFECTS ON ECONOMIC GROWTH	Travel time	Reduction in travel time for business travellers, shippers and carriers (including the hours gained because of a reduction of congestion) is a typical positive outcome of transport project, except those that specifically aim at environmental or safety benefits.
	Vehicle operating cost	Vehicle operating cost savings for the travellers (fuel costs, fares) and for transporters of goods (this refers to the distance-dependent transport costs) are relevant if the project aims at reducing congestion and/or the journey distances.
	Reliability of journey time	It means reduced variation in journey times. Reliability benefits are potentially important for many projects, unless journey times are already quite reliable. However, often forecasting models or other information for the impacts on and through reliability are missing (de Jong and Bliemer, 2015)
	Income for the service provider	It includes the revenues (e.g. rail ticket income increase) accrued by the producer (i.e. owner and operators together) as well as the operational cost savings. To some extent it can reflect the previous aspects (i.e. the service fare is increased to reflect a better service allowing for significant time saving for the users) so double counting shall be avoided. This aspect might be particularly relevant for public transport projects or toll road projects, especially if the project is expected to feature significant traffic (generated or induced) or a substantial change in fares.
	ADDITIONAL EFFECTS	**DESCRIPTION**
	Wider economic impacts	It refers to the agglomeration effect on productivity (the productivity of the economy is increased because the project leads to a clustering of economic activities together in a core city which makes these sectors produce more or better goods and services together than before). Agglomeration effects are unlikely to occur for small projects and even for large projects there are specific pre-conditions (see for instance Chen and Vickerman, 2017). Wider economic impacts (agglomeration effects) depend on whether the project makes a potential economic cluster location substantially more accessible. This is only possible if the infrastructure network before the project had important missing links which the project effectively removes.
	Institutional learning	It refers to wider spillover effects that any investment project may bring to the Public Administration and other institutions at national or regional levels in terms of expertise gained by working on large scale projects. Learning may lead to productivity gains by stimulating the improvement of existing technical know-how, improved policy-making, competitive tendering and divert resources towards the most growth enhancing projects.

EFFECTS RELATED TO QUALITY OF LIFE AND WELL-BEING	**DIRECT EFFECT**	**DESCRIPTION**
	Travel time	Leisure time saving relates to projects that provide a reduction in travel time for non-business travellers.
	Safety (accident savings)	It relates to the amount of fatalities, serious and slight injuries, damage-only accidents. Safety impacts should possibly be included in all project evaluation.
	Security	Safety of travellers in the vehicle and at stations, platforms and stops, safety of the goods transported (often damaged or stolen). Security impacts are often neglected in project evaluation, but for public transport projects (both urban and intercity) they can be of considerable importance.
	Noise	It refers to the exposure of population to noise measured in dB
	ADDITIONAL EFFECT	**DESCRIPTION**
	Crowding	A reduction of crowding in public transport is mainly relevant for projects that provide significant additional capacity in public transport.
	Service quality (other than crowding)	It refers mainly to the availability of specific service features increasing the journey comfort e.g. smoother movement of the vehicles, more comfortable seats, provision of electricity, Wi-Fi, catering.
	Aesthetic value	This relates to projects that provide infrastructure with positive visual effects (e.g. a beautifully constructed bridge) or when public transport provides a better image in the eye of the public. Also, it refers to projects that lead to a less attractively looking landscape (e.g. constructing high walls).
	Urban renewal	It refers to the spillover effects of urban transport projects on residents (not necessarily users of the project) due to an improved local context and possibly reflected in an increase in real estate values.
EFFECTS ON THE ENVIRONMENT	**DIRECT EFFECT**	**DESCRIPTION**
	Local air pollution	Local air pollutants are typically small particles, NO_x, VOCs and SO_2. The increased/decreased volume of local air emissions is a typical effect of transport projects.
	Climate change	Climate change refers to the volume of greenhouse gases (GHG) emitted by transport infrastructure. The increased/decreased volume of GHG emissions is a typical effect of transport projects.
	ADDITIONAL EFFECTS	**DESCRIPTION**
	Biodiversity	This refers to the reduction of biodiversity through the extinction of species in a specific area. It is not a common effect but it can be relevant in selected cases.
	Water pollution	Emissions of substances, e.g. from the road, into watercourses, that are harmful for people (as drinking water) or for life in the water
EFFECTS RELATED TO DISTRIBUTIONAL ISSUES	**ADDITIONAL EFFECTS**	**DESCRIPTION**
	Social cohesion	It encompasses the allocation of the main benefits over income and social groups
	Territorial cohesion	It encompasses the allocation of the main benefits over central (core) and peripheral areas

Source: Authors

A I.2 Measuring of effects

Because of the variety of effects to be accounted for, a **methodological approach firmly rooted on CBA (complemented by qualitative analysis** when necessary) is adopted in order to grasp the overall long-term contribution of each project.

In terms of their measurement level, the effects can be distinguished into:

A. **Effects that by their nature are already in monetary units** (e.g. transport costs savings). These can therefore be easily included in a cost-benefit analysis (CBA).
B. **Effects that are quantitative, but not in money units, and that can be converted into money units in a reasonably reliable way** (e.g. transport time savings, accidents, air pollution)[18]. These effects can also be included in the CBA.
C. **Effects that are quantitative, but not in money units, for which there are no reasonably reliable conversion factors to money**. We propose not to try to include such effects in the CBA, but to discuss them in a qualitative way together with the overall outcome of the CBA.
D. **Effects that are difficult to measure in quantitative (cardinal) terms, but do lend themselves for ordinal measurement** (a ranking of the impact of different projects on such a criterion can be provided, such as very good, good, neutral, bad, very bad). We propose to discuss these effects in qualitative terms.
E. **Effects that might occur but that are subject to a high degree of uncertainty:** these will be treated as part of the risks/scenario analysis that will be included in the CBA.
F. **Effects that might occur but that we cannot even express in an ordinal (ranking) manner:** they are residual effects that can be mentioned in qualitative description in case study report.

In short, all the projects' effects in A and B are evaluated by doing an ex-post cost-benefit analysis (CBA)[19]. Reasonably, these represent the most significant share of long-term effects. Then the outcome of the CBA (e.g. the net present value or benefit-costs ratio) is complemented by evidence from C and D, while E is used for descriptive purposes. Moreover, qualitative techniques are used to determine why certain effects are generated, along what dimensions, and underlying causes and courses of action of the delivery process (see below).

Section 3 of each case study includes a standardised table in which scores are assigned to each type of long-term effect. Scores ranging from -5 to +5 (5 = very strong negative effect; 0 = no effect; 5 = very strong positive effect) are given in order to intuitively highlight which are the most important effects generated for each case study.

[18] Methods to establish such conversion factors include: stated preference surveys (asking respondents about hypothetical choice alternatives), hedonic pricing or equating the external cost with the cost of repair, avoidance or prevention or with the costs to achieve pre-determined targets.
[19] More details on the approach adopted to carry out the ex-post CBA exercise and, in particular, indications on project identification, time horizon, conversion factors and other features are extensively described in the First Intermediate Report of this evaluation study.

A I.3 Understanding the effects

Once the project effects have been identified and measured, and the causal chain linking different categories of short-term and long-term effects has been investigated, the third building block of the methodological approach entails reasoning on the elements, both external and internal to the project, which have determined the observed causal chain of effects to take place and influenced the observed project performance.

Taking inspiration from the literature on the success and failure of projects, and particularly on costs overruns and demand shortfalls, and on the basis of the empirical evidence which develops from European Commission (2012) six stylised determinants of projects' outcomes and their development over time have been identified (see table below).

The interplay of such determinants may reinforce or dilute one effect over the other. Moreover, each determinant may contribute, either positively or negatively to the generation/speed up/slow-down of certain short-term or long-term effects. For this reason it is important not only to understand the role that each determinants has on the observed project outcome, but also their interplay in a dynamic perspective.

In doing this, it is useful to refer to stylised, typical "paths" of project behaviours outlined in the following table. Such patterns capture common stories and reveal recurring patterns of performance, as well as typical problems that may arise and influence the chronicle of events. Case studies test the validity of such archetypes and are used to specify in better nuances or suggest possible variations or additions.

Section 4 of each case study includes standardised tables in which scores are assigned to each determinant. Scores ranging from -5 to +5 are given in order to intuitively highlight which are the most relevant determinants explaining the project outcomes (5 = very strong negative effect; 0 = no effect; 5 = very strong positive effect). Moreover, section 4 of each case study includes a graph describing the project's behavioural pattern, i.e. describing the chain of interlinked causes and effect determining the project performance over time.

Table 9. Stylised determinants of projects' outcomes

DETERMINANT	DESCRIPTION
Relation with the context	It includes the considerations of institutional, cultural, social and economic environment into which the project is inserted, was the project appropriate to this context?; is there a problem that the project can solve?; does the project remain relevant over the years?
Selection process	It refers to the institutional and legislative framework that determines how public investment decisions (and especially those co-financed by ESIF) are taken, i.e. which is the process in place and the tools used to select among alternative projects. The selection process is influenced by incentive systems that can lead politicians and public institutions to either take transparent decisions or strategically misrepresent costs and/or benefits at the ex-ante stage.
Project design	it refers to the technical capacity (including engineering and financial expertise) to properly design the infrastructure project. Under a general standpoint, we can distinguish: the technical capacity to identify the most appropriate conceptual design, which best suits the need of a specific context. Even when a region really is in need of the project, it usually requires a well-designed project to solve the observed problems. This, in turn, involves that different alternatives are considered and the best option in terms of technical features and strategical considerations is identified; the technical capacity to develop the more detailed level of design (preliminary and detailed), thus identifying most effective and efficient detailed infrastructure solutions and construction techniques, thus avoiding common pitfalls in the construction stage (such as introducing variants that are not consistent with the original conceptual design) and the risk of cost overruns during the construction phase by choosing inappropriate technical solutions.
Forecasting capacity	It regards the possibility and capacity to predict future trends and forecast the demand level and estimate the technical challenges, thus estimating correctly the required resources (e.g. looking at the dangers of over-predicting demand and under-predicting construction costs). In particular, technical forecasting capacity is related to the quality of data used and forecasting/planning techniques adopted. At the same time, forecasting capacity includes the ability of the project promoter and technical experts not to incur in the planning fallacy (the tendency to underestimate the time or cost needed to complete certain tasks) and optimism bias (the systematic tendency to be overly optimistic about the outcomes of actions).
Project governance	It concerns the number and type of stakeholders involved during the project cycle and how responsibilities are attributed and shared. This is influenced by the incentive mechanisms. If bad incentives exist, this can lead different actors involved in the project management to provide benefits for their members, thus diverting the funds away

	from their optimal use, or forcing them to delegate responsibilities according to a non-transparent procedure.
Managerial capacity	It refers to the: professional ability to react to changes in the context/needs as well as to unforeseen; professional capability to manage the project ensuring the expected level of service in the operational phase. To ensure a project success, it is not enough that it is well planned and designed, but also that the organizations in charge of the management and operations provide a good service to the end users (e.g. ensuring a good maintenance of the infrastructure).

Source: Authors

Table 10. Behavioural patterns archetypes

Behavioural patterns are illustrated by use of diagrams linking determinants and project outcomes in a dynamic way

TYPE	DESCRIPTION
Bright star	This pattern is typical of projects where the good predictions made ex-ante (both on the cost side and demand side) turn out to be accurate. Proper incentive systems are in place so that the project actually delivers value for money and success. Even in the event of exogenous negative events, the managerial capacity ensures that proper corrective actions are taken and a positive situation is restored.
Rising sun	This pattern is typical of projects which, soon after their implementation, are affected by under capacity issues because of a combination of low demand forecasting capacity, weak appropriateness to the context, and weak technical capacity to design the infrastructure. However, due to changed circumstances or thanks to responsible management and good governance the project turns around to reap new benefits.
Supernova	This pattern is typical of projects for which the good predictions made ex-ante (both on the cost and demand side) turn out to be accurate. However, due to changed circumstances or because of weak management capacity and/or governance the project eventually turns out to be unsuccessful.
Shooting star	This pattern is typical of projects starting from an intermediate situation and resulting in a failure. This outcome can be explained by a low forecasting capacity affected by optimism bias which yields a cost overrun. Then during project implementation, because of low managerial

	capacity and/or poor governance (also due to distorted incentives) corrective actions are not implemented, this leading to project failure. The situation is exacerbated if unexpected negative events materialise during the project implementation.
Black-hole	This pattern is typical of projects that since the beginning of their life fail to deliver net benefits. This is a result of a combination of ex-ante bad factors (i.e. low technical capacity for demand forecasting, optimism bias, inappropriateness to the local context and bad incentives affecting both the selection process and the project governance) and careless management during the project implementation or bad project governance (e.g. unclear divison of responsibilities, bad incentive schemes).

Source: Author

A I.4 Synthesis and conclusions

Qualitative and quantitative findings are integrated in a narrative way, in order to develop ten project 'histories' and to isolate and depict the main aspects behind the project's long-term performance. A final judgment on each project is then conveyed in the case studies with an assessment structured along a set of evaluation criteria, as suggested in the ToRs. Evaluation criteria are the following:

Relevance (were the project objectives in line with the existing development needs and the priorities at the programme, national and/or EU level?);
Coherence (with other national and/or EU interventions in the same sector or region);
Effectiveness (were the stated objectives achieved, and in time? Did other effects materialise? Were other possible options considered?);
Efficiency (costs and benefits relative to each other and to their ex-ante values);
EU added value (was EU support necessary, EU-wide effects, further EU action required?).

ANNEX II. EX-POST COST-BENEFIT ANALYSIS REPORT

This Annex illustrates the ex-post CBA of the project under consideration, undertaken to quantitatively assess the performance of the project. The methodology applied is in line with the one illustrated in the First Interim Report and, more generally, with the EC Guide (European Commission, 2014). This annex aims to present in more detail the assumptions, results of the CBA and the scenario analysis for the project under consideration.

A II.1 Methodology, assumption and data gathering

In what follows, the main assumptions and the procedure of data gathering are described in detail.

- Project identification:

  The unit of analysis of this CBA is the project 'Modernisation of railway line no. 8, construction of new rail link to Chopin Airport (from passenger station Warsaw Służewiec to Chopin Airport)'. As explained in Section 1 of the main report, the project constitutes a stage of a wider investment scheme aiming at modernising railway line no. 8, in particular covering works on the section between Warsaw Zachodnia (West) and Warsaw Okęcie stations, including construction of a new railway link to the Chopin Airport, but also related to the rehabilitation and improvement of the railway line between Warsaw Okęcie station and the city of Radom. The project under assessment is composed of the following main components:

  - Construction of a dual track railway link – partially in underground alignment – together with a tunnel access ramp of 420 meters length, from the existing railway line no. 8 at Warsaw Służewiec station (km 10.800) to the terminus station located within the Chopin Airport. The length of the newly constructed section equals 1.990 km; the total length of the 15m wide tunnel is 1,183m;
  - Reconstruction of the passenger station Warsaw Służewiec;
  - Provision and instalment of underground railway stations related equipment;
  - Modernisation of railway track no. 1 of the line no. 8 on the section from km 10.512 to km 11.809, including replacement of the catenary and instalment of other railway infrastructure facilities and equipment. The length of the reconstructed railway line equals 1.243 km.

  The project was implemented between 2007 to 2014 as detailed below. Although the newly constructed railway link was put into operation in June 2012, some final works were conducted afterwards and lasted until 2014, but none of them affected the operation of the line.

Table 11. Synthesis of the interventions

ACTIVITY	IMPLEMENTATION PERIOD
Preparatory phase (design, documentation, FS)	2007-2010
Land utilisation agreements	2009-2011
Construction Works	2009-2013
Supervision and management	2009-2014
Supply of the equipment	2012-2013

Source: Authors

- Time horizon:

  In line with the First Interim Report, the time horizon for the CBA of the project is set at 30 years (incl. 8 years of implementation). Accordingly, the timeframe for the project's evaluation runs from 2007, when the first capital expenditure occurred, to 2036. A mix of historical data from 2007 to 2016 (covering 10 years) and forecasts from 2018 to 2036 (covering 19 years) is used. Costs of main repairs and revisions of the railway network are included after 20 years following the project completion as well as periodic renewals to preserve their functionality.

- Constant prices and discount rates:

  In line with the guidelines of the First Interim Report, the CBA was performed using constant prices. Historical data have been adjusted and converted into Euro at 2017 prices by using the yearly average percentage variation of consumer prices provided by the International Monetary Fund. As for data from 2017 onwards, they have been estimated in real terms (no inflation is considered).

  Coherently with the choice of using constant prices, financial and social discount rates have been adopted in real terms. Specifically, inflows and outflows of the financial analysis - for both the backward and forward periods of analysis – have been discounted and capitalised using a 4% real rate, as suggested in the EC CBA Guide (2014). With regard to the economic analysis, a real backward social discount rate of 4.83% and a real forward social discount rate of 4.19%, specifically calculated for Poland (see the First Interim Report for the calculation), have been adopted.

- Without the project scenario:

  As explained in Section 2 of the main report, before the project implementation, private cars, bus and taxi were the transport modes providing accessibility to the Chopin Airport. On that basis, the reference scenario for the CBA (Without the project scenario) is a "Business as usual" scenario, which means that no railway connection is constructed to the Chopin Airport and no modernisation of the short section of the railway line no. 8 is undertaken as well as no improvement of the train stop at Warsaw Służewiec is performed. Maintenance is only ensured in order to avoid collapse of the system.

- Data sources:

  The analysis relies on data provided by the PKP PLK S.A. (the railway infrastructure manager and project beneficiary) as well as the Warsaw City Hall

and on the opinions of the interviewed stakeholders (see Annex III). Moreover, information has been gathered from a review of the documents available online and on the local press.

- Technical features:

  The project consists of the construction of a 1.990 km long dual track railway line partially running in a 15 m wide tunnel of 1.183 km length, and includes provision of equipment and facilities for the underground railway station. As part of the project modernisation works for a single track 1.243 km long section of the existing railway line on line no. 8, including replacement of the catenary system, reconstruction of the passenger railway stop at Warsaw Służewiec station. Facilities and installations to ensure the operation of the new as well as modernised railway infrastructure were also included in the technical scope of the project.

A II.2 FUTURE SCENARIO

Demand

In order to assess the project's performance in the future, hypotheses have been made regarding the future trends of the main variables. In particular, future costs and benefits have been estimated in relation to the evolution of passengers on the services with the Chopin Airport. To develop the demand analysis, the original demand and assumptions included in the ex-ante analysis have been reviewed based on the basis of the available information and stakeholders' consultation.

The traffic forecasts for the ex-ante analysis, in particular the assumptions concerning modal shift, were prepared covering the period 2008 to 2039 limited to the section between the city centre and the Chopin Airport. This was done applying the general travel cost method (for buses, taxi and personal car as well as for rail) adjusted by the results of travel behaviour researches available for this area, including the willingness to change the transport mode.

This approach is correct, as it fully covers the project scope including the nearly 2 km of newly constructed link and 1.2 km of the modernised railway line. It is also deemed conservative considering that the implementation of the major project was also associated with the entry into operation of two new railway lines, the S3 and RL, increasing the offer of public transport services in the wider Warsaw metropolitan area and Masovian region. Such an approach was considered conservative, also under the JASPERS assessment.

The ex-ante demand analysis took into account the passengers' traffic between the city centre and the airport and assumed that people travelling on the S2, S3 and RL services could be divided into the following categories: air passengers; friends and relatives accompanying the passengers and people working at the airport and its surroundings, each of these groups characterized by different travel preferences that depend on the kind of travel, the value of time (business or leisure), purchasing power and willingness to pay.

For the purpose of the ex-post assessment, data provided by PKP PLK S.A. were adopted, which were prepared in 2014 for the purpose of an ex-post assessment of the project result indicator – travel time savings. Data for this ex-post assessment exactly followed the ex-ante approach. The most relevant assumption was to use the demand using the services between the city centre and the airport only, without

considering the other traffic using the S2, S3 and RL services outside this segment. The assumptions and data included in the PKP PLK S.A. model were carefully reviewed and checked also against the real observed available data. The model is considered reliable.

The ex-post analysis provides the volumes of passengers as well as vehicle kilometres shifted from other transport means, bus, taxi and private cars. The traffic forecast does not consider any generated and induced demand. Whilst it is appropriate not to consider generated and induced demand for an airport direct link as the airport represents the main origin/destination of the trips, the same assumption for the other stations in between the airport and the city centre may be conservative. The table below shows the assumptions concerning the incremental passenger diverted from other public transport modes (bus), taxi and private car.

Table 12. Incremental demand split by previous mode of travel

YEAR	INCREMENTAL PAX ON TRAIN (thousand)	PASSENGERS DIVERTED FROM BUS	PASSENGERS DIVERTED FROM CAR	PASSENGERS DIVERTED FROM CAR
2012	0.0	0.0	0.0	0.0
2013	6,477.0	3,181.4	963.9	2,331.7
2014	6,684.5	3,283.2	994.8	2,406.4
2015	6,943.3	3,410.5	1,033.3	2,499.5
2016	7,052.6	3,225.1	1,073.1	2,754.3
2020	7,986.8	3,652.2	1,215.3	3,119.3
2025	9,294.9	4,250.5	1,414.3	3,630.2
2030	10,521.0	4,790.8	1,628.0	4,102.2
2035	11,358.2	5,129.7	1,814.0	4,414.5

Source: Authors based on the ex-post model

The trip purpose distribution was done for each mode and in three groups (business, commuting, others) with a different distribution per mode, which is in line with the CBA methodology.

Supply

On the supply side, the information about the change in the total railway length is provided together with the total annual km of service operated by the train operators using the line.

A II.3 FINANCIAL ANALYSIS

Investment cost

The investment cost of the project with reference to the main cost categories is depicted in the table below: the most relevant share of the budget is allocated to the construction works corresponding to 85% of the total project costs, out of which the most expensive component relates to the tunnel (approximately EUR 34 million) and the track construction and modernisation (approximately EUR 9 million); the remaining project components, including project preparatory works, site preparation, supply of the equipment, project supervision and promotion correspond to 15% of the entire investment value.

The information on the investment cost was provided by the PKP PLK S.A.

Table 13. Investment cost breakdown by work component

COST ITEM	NOMINAL VALUE		PRESENT VALUE (2017)	
	PLN	EUR	PLN	EUR
Preparatory phase (design, documentation, FS)	817,400	192,783	901,563	212,633
Land access	649,857	153,268	716,612	169,012
Construction works	230,861,738	54,448,523	246,184,422	58,062,364
Supply of the equipment	2,672,884	630,397	2,660,960	627,585
Supervision and management	7,051,065	1,662,987	7,394,156	1,743,905
Promotion and other costs	29,429,506	6,940,921	31,494,991	7,428,064
Total	**271,482,451**	**64,028,880**	**289,352,705**	**68,243,563**

Source: Authors

The investment cost split by main cost components has not been made available.

Residual value

The income methodology was applied to the residual value calculation, which is based on the assessment of net present value of the financial flows at the end of the project reference period.

Operating & Maintenance costs

The O&M costs carried by the railway infrastructure manager have been calculated according to the same methodology used in the ex-ante assessment, updating the price base to 2017. The costs were split into fixed and variable. The historical values up to 2016 have been provided by PKP PLK S.A. for each cost category and applied to the ex-post analysis, adopting the same methodology for the reference option and for the investment option. Therefore, the incremental operating costs of the project consider changes in the track kilometres in the railway operations and additional necessary asset renewal and repair needs over the reference period.

Cost for maintenance and renewal of the infrastructure is estimated on the basis of the maintenance plans as provided in the ex-ante analysis.

Operating revenues

Project revenues constitute the incremental inflow coming from access charges paid by the train operators on the basis of the type of trains. The tariff increase is assumed in both the reference case as well as investment scenario, in both cases calculated on the basis of fees for each specific section and train type and depreciation. Additionally, access charges are also considered for stops at the train stations. In 2016, an increase in the range of 13%-23% (depending from the train type) in the fee per train kilometre was noted compared to 2008.

Project's Financial Performance

On a financial basis, the profitability of the project is negative. The Financial Net Present Value (NPV) on investment is equal to nearly EUR -85 million (at a discount rate of 4%, real), with an internal rate of return of -14.6%. Also, the Financial Net Present Value on national capital is negative, which corresponds to EUR -37 million; the internal rate of return for capital is -14.9%. These negative values confirm that the project was in need of EU funding. The results of the project financial performance are presented in the tables below.

Table 14. Financial performance indicators of the project

INDICATOR	PLN	EUR
FNPV/C	- 361,076,865	- 85,159,638
FRR/C	-14.6%	
FNPV/K	- 155,591,473	- 36,696,102
FRR/K	-14.9%	

Source: Authors

Table 15. Financial return on investment (EUR)

IT	PROJECT FINANCIAL EFFECTIVENESS	Present value	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	**Operational income**	`	**0**	**0**	**0**	**0**	**0**	**2,096,733**	**2,159,351**	**2,270,498**	**2,396,712**	**2,737,840**	**2,754,367**	**2,754,367**	**2,754,367**	**2,754,368**	**2,754,368**	**2,754,368**
1.1	Passenger trains	**43,407,618**	0	0	0	0	0	1,826,915	1,864,069	1,948,867	2,050,931	2,267,064	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748
1.2	Access and use of platforms	**8,593,191**	0	0	0	0	0	269,818	295,282	321,630	345,782	470,776	473,618	473,618	473,618	473,618	473,618	473,618
2	**CAPEX**	**87,222,997**	**2,754**	**0**	**11,242,958**	**10,873,267**	**23,796,124**	**18,490,277**	**4,093,010**	**115,125**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	**OPEX**	**50,331,283**	**0**	**0**	**0**	**0**	**0**	**927,584**	**2,615,259**	**2,591,932**	**2,591,932**	**2,615,471**	**2,631,259**	**2,631,259**	**2,785,960**	**2,641,932**	**2,638,170**	**2,684,241**
3.1	Infrastructure OPEX - fixed	**8,726,550**	0	0	0	0	0	268,626	442,207	438,263	438,263	442,243	444,913	444,913	444,913	451,824	451,824	497,895
3.2	Infrastructure OPEX - variable	**39,726,947**	0	0	0	0	0	561,001	2,078,590	2,060,050	2,060,050	2,078,759	2,091,307	2,091,307	2,246,008	2,095,069	2,091,307	2,091,307
3.3	Other	**1,877,786**	0	0	0	0	0	97,957	94,462	93,619	93,619	94,469	95,040	95,040	95,040	95,040	95,040	95,040
4	**Residual value**	**393,833**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5	**Total**	**-85,159,638**	**-2,754**	**0**	**-11,242,958**	**-10,873,267**	**-23,796,124**	**-17,321,128**	**-4,548,918**	**-436,559**	**-195,220**	**122,368**	**123,108**	**123,108**	**-31,593**	**112,435**	**116,198**	**70,127**

IT	PROJECT FINANCIAL EFFECTIVENESS	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	**Operational income**	**2,754,368**	**2,754,369**	**2,754,369**	**2,754,369**	**2,754,369**	**2,754,370**	**2,754,370**	**2,754,370**	**2,754,370**	**2,754,370**	**2,754,371**	**2,754,371**	**2,754,371**	**2,754,371**
1.1	Passenger trains	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748
1.2	Access and use of platforms	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618
2	**CAPEX**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	**OPEX**	**2,638,170**	**2,638,170**	**2,638,170**	**2,638,170**	**2,638,170**	**2,792,871**	**2,638,170**	**2,648,843**	**2,645,081**	**2,729,228**	**2,683,157**	**2,683,157**	**2,683,157**	**2,683,157**
3.1	Infrastructure OPEX - fixed	451,824	451,824	451,824	451,824	451,824	451,824	451,824	458,735	458,735	504,806	458,735	458,735	458,735	458,735
3.2	Infrastructure OPEX - variable	2,091,307	2,091,307	2,091,307	2,091,307	2,091,307	2,246,008	2,091,307	2,095,069	2,091,307	2,129,382	2,129,382	2,129,382	2,129,382	2,129,382
3.3	Other	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040
4	**Residual value**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**829,746**
5	**Total**	**116,198**	**116,199**	**116,199**	**116,199**	**116,199**	**-38,502**	**116,200**	**105,527**	**109,289**	**25,142**	**71,214**	**71,214**	**71,214**	**900,961**

Source: Authors

Table 16. Financial return on national capital (EUR)

IT		Present value	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1	**Inflow**	**52,394,642**	**0**	**0**	**0**	**0**	**0**	**2,034,291**	**2,172,562**	**2,304,947**	**2,433,077**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**
1.1	Passenger trains	**43,407,618**	0	0	0	0	0	1,772,508	1,875,473	1,978,437	2,082,049	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748
1.2	Access and use of platforms	**8,593,191**	0	0	0	0	0	261,783	297,089	326,510	351,028	473,618	473,618	473,618	473,618	473,618	473,618	473,618
1.3	Residual value	**393,833**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	**Outflow**	**89,090,744**	**1,314**	**0**	**5,363,224**	**5,186,871**	**11,351,457**	**9,747,995**	**4,567,747**	**2,646,850**	**2,591,932**	**2,615,471**	**2,631,259**	**2,631,259**	**2,785,960**	**2,641,932**	**2,638,170**	**2,684,241**
2.1	National contribution	**38,759,461**	1,314	0	5,363,224	5,186,871	11,351,457	8,820,410	1,952,487	54,918	0	0	0	0	0	0	0	0
2.2	OPEX	**50,331,283**	0	0	0	0	0	927,584	2,615,259	2,591,932	2,591,932	2,615,471	2,631,259	2,631,259	2,785,960	2,641,932	2,638,170	2,684,241
3	**Total**	**-36,696,102**	**-1,314**	**0**	**-5,363,224**	**-5,186,871**	**-11,351,457**	**-7,713,703**	**-2,395,185**	**-341,902**	**-158,855**	**138,895**	**123,107**	**123,107**	**-31,594**	**112,434**	**116,196**	**70,124**

IT		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	**Operational income**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**2,754,366**	**3,584,112**
1.1	Passenger trains	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748	2,280,748
1.2	Access and use of platforms	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618	473,618
1.3	Residual value	0	0	0	0	0	0	0	0	0	0	0	0	0	829,746
2	**Outflow**	**2,638,170**	**2,638,170**	**2,638,170**	**2,638,170**	**2,638,170**	**2,792,871**	**2,638,170**	**2,648,843**	**2,645,081**	**2,729,228**	**2,683,157**	**2,683,157**	**2,683,157**	**2,683,157**
2.1	National contribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.2	OPEX	2,638,170	2,638,170	2,638,170	2,638,170	2,638,170	2,792,871	2,638,170	2,648,843	2,645,081	2,729,228	2,683,157	2,683,157	2,683,157	2,683,157
3	**Total**	**116,196**	**116,196**	**116,196**	**116,196**	**116,196**	**-38,505**	**116,196**	**105,522**	**109,285**	**25,137**	**71,209**	**71,209**	**71,209**	**900,955**

Source: Authors

Financial Sustainability

The financial sustainability has been assessed for the project – by adjusting the ex-ante financial projections according to 2009-2016 data, also based on interviews with PKP PLK S.A. It shall be added that in practical terms PKP PLK S.A. is balancing costs with track access charges at the entire network level, therefore no major risk is foreseen in the possible imbalance in the future real net cash flows related to the analysed railway line section. Appropriate long-term agreements have been signed between the city and the two rail service operators (SKM and KM). The project investment was co-financed by the EU (CF) and the national contribution. The overall level of EU co-funding for this project was 80% of eligible expenditures. The national contribution was partially covered by the direct subsidiary and PKP PLK S.A. own means.

The project financial sustainability is presented in the table overleaf; the analysis is developed from the project standpoint. Cash inflows therefore include only the project revenue; cash outflows include operating and maintenance costs for the project.

Table 17. Financial sustainability of the project (EUR)

PROJECT SUSTAINABILITY IN EURO	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Sources of financing	2,261	0	9,858,218	9,858,218	22,135,633	17,939,629	4,118,050	116,871	0	0	0	0	0	0	0	0
Total revenues	0	0	0	0	0	2,034,291	2,172,562	2,304,948	2,433,078	2,754,367	2,754,367	2,754,367	2,754,367	2,754,368	2,754,368	2,754,368
Total inflows	**2,261**	**0**	**9,858,218**	**9,858,218**	**22,135,633**	**19,973,920**	**6,290,612**	**2,421,819**	**2,433,078**	**2,754,367**	**2,754,367**	**2,754,367**	**2,754,367**	**2,754,368**	**2,754,368**	**2,754,368**
Initial investments	2,261	0	9,858,218	9,858,218	22,135,633	17,939,629	4,118,050	116,871	0	0	0	0	0	0	0	0
O&M fixed	0	0	0	0	0	260,626	444,913	444,913	444,913	444,913	444,913	444,913	444,913	451,824	451,824	497,895
O&M variable	0	0	0	0	0	544,294	2,091,307	2,091,307	2,091,307	2,091,307	2,091,307	2,091,307	2,246,008	2,095,069	2,091,307	2,091,307
Other costs	0	0	0	0	0	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040
Taxes	0	0	0	0	0	23,717	22,785	24,958	30,166	24,356	24,356	24,356	24,356	24,356	24,356	24,356
Total outflows	**2,261**	**0**	**9,858,218**	**9,858,218**	**22,135,633**	**18,863,306**	**6,772,094**	**2,773,089**	**2,661,424**	**2,655,615**	**2,655,615**	**2,655,615**	**2,810,316**	**2,666,288**	**2,662,526**	**2,708,597**
Net cash flow	**0**	**0**	**0**	**0**	**0**	**1,110,614**	**-481,481**	**-351,269**	**-228,347**	**98,752**	**98,752**	**98,753**	**-55,948**	**88,080**	**91,842**	**45,771**
Cumulated net cash flow	**0**	**0**	**0**	**0**	**0**	**1,110,614**	**629,133**	**277,863**	**49,517**	**148,269**	**247,021**	**345,774**	**289,825**	**377,905**	**469,747**	**515,518**

PROJECT SUSTAINABILITY IN EURO	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Sources of financing	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total revenues	2,754,368	2,754,369	2,754,369	2,754,369	2,754,369	2,754,370	2,754,370	2,754,370	2,754,370	2,754,370	2,754,371	2,754,371	2,754,371	2,754,371
Total inflows	**2,754,368**	**2,754,369**	**2,754,369**	**2,754,369**	**2,754,369**	**2,754,370**	**2,754,370**	**2,754,370**	**2,754,370**	**2,754,370**	**2,754,371**	**2,754,371**	**2,754,371**	**2,754,371**
Initial investments	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O&M fixed	451,824	451,824	451,824	451,824	451,824	451,824	451,824	458,735	458,735	504,806	458,735	458,735	458,735	458,735
O&M variable	2,091,307	2,091,307	2,091,307	2,091,307	2,091,307	2,246,008	2,091,307	2,095,069	2,091,307	2,129,382	2,129,382	2,129,382	2,129,382	2,129,382
Other costs	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040	95,040
Taxes	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356	24,356
Total outflows	**2,662,526**	**2,662,526**	**2,662,526**	**2,662,526**	**2,662,526**	**2,817,227**	**2,662,526**	**2,673,199**	**2,669,437**	**2,753,584**	**2,707,513**	**2,707,513**	**2,707,513**	**2,707,513**
Net cash flow	**91,843**	**91,843**	**91,843**	**91,843**	**91,844**	**-62,857**	**91,844**	**81,171**	**84,933**	**786**	**46,858**	**46,858**	**46,858**	**46,859**
Cumulated net cash flow	**607,361**	**699,203**	**791,046**	**882,890**	**974,733**	**911,876**	**1,003,720**	**1,084,890**	**1,169,824**	**1,170,610**	**1,217,468**	**1,264,326**	**1,311,184**	**1,358,043**

Source: Authors

A II.4 Economic Analysis

From market to accounting prices

In line with the CBA Guide (2014), the social opportunity cost of the project's inputs and outputs has been considered in the economic analysis. For this purpose, market prices have been converted into accounting prices by using appropriate conversion factors. In particular, reference has been made to the Blue Book for the Railway Sector in Poland[20]. As for labour, it is worth noting that the shadow wage estimated by Del Bo *et. al* (2011) for Masovian Region (0.73) has been adopted to correct past values, instead 0.81 has been used to correct future values. The table below summarises the conversion factors applied for each cost item.

Table 18. Conversion factors for input

ITEM	CONVERSION FACTOR	SOURCE
Labour cost under investment costs and operating costs	0.73 backwards 0.81 forwards	Conversion factors for labour as reported in the First Interim Report, Volume I
Land acquisition, supply, other costs under investment costs	1	JASPERS Blue Book for Public transport sector
Material cost under operating costs	1	JASPERS Blue Book for Public transport sector
Residual value	0.83	JASPERS Blue Book for Public transport sector

Source: Authors based on cited sources

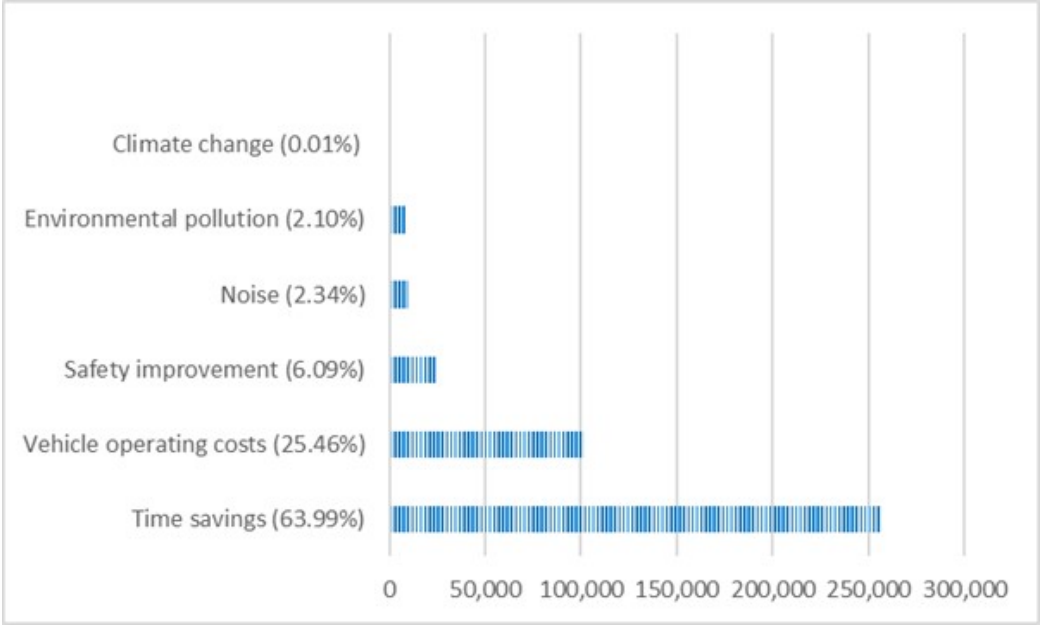
Project's effects

Benefits generated by the implementation of the project can be distinguished into:

- Change in consumer surplus, represented by the time savings;
- Changes in producer surplus, represented by trip cost savings for transport producers including car traffic;
- Reduction in negative externalities as a result of the traffic diverted from road to rail, including air pollution savings, GHG savings, reduction of collisions and accidents, reduction of traffic noise.

[20] Blue Book, New edition 2014-2020, September 2015, Railway sector. Railway infrastructure.

Figure 31. Main socioeconomic benefits (Present Value, EUR)



Source: Authors

The climate cost decrease impact, due to a modal transfer from road to rail transport, is quite marginal for this project, such as the environment cost decrease and noise impact, which appears to be reasonable considering the scale of the project.

In what follows a description of each benefit's components is provided.

Time savings

The travel time savings arise for the city bus, taxi and private cars' users that shifted to the rail, being a faster and more reliable transport mode. Time savings have been calculated for all the travel motivations: business, commuting and other, representing respectively 17% / 36% / 47% of the total demand. The ex-post time savings were calculated as p*erson-hours saved due to project implementation*[21] * *unit cost of time for Poland* for different trip purposes (commuting, business and other), according to the methodology described in the First Interim Report, Volume I (i.e. according to JASPERS Blue Book for the railway sector in Poland). The time savings appear to be the most dominant benefit in line with other investments of similar nature and represent 64% of the total economic benefits coming out from the ex-post CBA.

Trip cost savings

The trip cost savings were calculated in line with the conservative approach adopted in the ex-ante analysis as *number of vehicle kilometres diverted from the car traffic * unit vehicle operating cost for personal vehicle travelling with certain average speed in the urban area*, as recommended in the JASPERS Blue Book for the railway sector in Poland. This external benefit represents approximately 25.5% of the total economic benefits resulting from the project ex-post CBA.

[21] It has been assumed that users shifted from cars and taxis will save 5 minutes, whereas the ones shifted from bus will save 17 minutes.

Air pollution savings

The calculation of air pollution savings follows the methodology recommended by the JASPERS Blue Book for the railway sector in Poland and is in line with the one adopted in the ex-ante analysis. The number of vehicle kilometres including private cars and taxi was multiplied by the unit parameter appropriate for this type of vehicles for certain average speed in urban area. This external benefit represents approximately 2.1% of the total economic benefits resulting from the project ex-post assessment.

GHG emission savings

The GHG emissions' savings have not been calculated at the ex-ante stage. In this ex-post CBA, the methodology recommended for the Polish railway sector has been again adopted to calculate this effect on the basis of cars (private cars and taxi) vehicle kilometres with a certain average speed, multiplied by the corresponding unit parameter recommended in the JASPERS Blue Book. This effect is marginal for the project in subject (0.01%).

Reduction of collisions and accidents

The effect resulting from reduction of accidents have been reflected in the decreased number of accidents including reduction of injuries and fatalities. The ex-post assessment follows the methodology applied in the ex-ante analysis and is based on the calculation of the number of vehicle kilometres shifted from cars and taxi to the railway mode, multiplied by unit cost of accident (per veh-km), counted on the basis of social accident unit parameters as recommended in the First Interim Report, Volume I, for fatalities, injuries and material loss applied to the operation of the services in the connection between the city centre and the airport (also in line with the ex-ante analysis).

Reduction of traffic noise

Noise is another effect that was not included in the ex-ante analysis. In the ex-post CBA noise benefits have been valued following the approach suggested in the JASPERS Blue Book for the railway sector in Poland, and adopting recommended unit parameters to the forecasted transport operation expressed in vehicle kilometres. This external benefit represents approximately 2.3% of the total economic benefits resulting from the project ex-post assessment.

Project's Economic Performance

The ERR for the major project is comparable to the results of other railway projects implemented in Poland. Also, the distribution of the economic effects is comparable to the ex-ante analysis. The socio-economic ex-post indicators confirm that the project is desirable for the EU society and increased welfare.

Table 19. Economic performance indicators of the project

INDICATOR	PLN	EUR
ENPV	916,323,470	216,114,026
B/C	3.01	
EIRR	12.91%	

Source: Authors

The results of the economic analysis are presented in the following table.

Table 20. Economic return of the project (EUR)

PERIOD	CORRECTION FACTOR		Present value	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Year	backwards	Forward																	
Time savings			255,513,741	0	0	0	0	0	5,458,180	8,554,827	9,057,288	9,598,156	9,561,966	10,063,262	10,581,915	11,107,869	11,652,055	12,219,270	12,808,945
Environmental pollution			8,102,408	0	0	0	0	0	203,864	310,833	320,794	333,195	360,994	372,537	384,324	396,398	408,825	421,499	434,594
Safety improvement			24,333,470	0	0	0	0	0	690,174	1,315,389	1,221,789	1,128,016	1,145,748	1,182,381	1,219,793	1,174,239	1,211,054	1,248,595	1,287,388
Vehicle operating costs			98,070,884	0	0	0	0	0	2,440,266	3,720,690	3,839,880	3,988,348	4,395,040	4,535,670	4,679,067	4,825,922	4,977,387	5,131,619	5,291,154
Climate change			35,317	0	0	0	0	0	889	1,355	1,398	1,452	1,573	1,624	1,675	1,728	1,782	1,837	1,894
Noise			9,011,862	0	0	0	0	0	226,747	345,722	356,801	370,594	401,514	414,352	427,462	440,891	454,714	468,810	483,375
Total external benefits			**395,067,682**	**0**	**0**	**0**	**0**	**0**	**9,020,120**	**14,248,815**	**14,797,951**	**15,419,761**	**15,866,836**	**16,569,826**	**17,294,237**	**17,947,046**	**18,705,818**	**19,491,630**	**20,307,350**
Direct benefits		1	51,768,724	0	0	0	0	0	2,034,291	2,172,562	2,304,947	2,433,077	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366
Total benefits			**446,836,406**	**0**	**0**	**0**	**0**	**0**	**11,054,412**	**16,421,377**	**17,102,898**	**17,852,838**	**18,621,202**	**19,324,191**	**20,048,602**	**20,701,412**	**21,460,183**	**22,245,996**	**23,061,716**
Residual value		**0.83**	**688,689**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Operational and maintenance total	0.73	0.81	47,254,850	0	0	0	0	0	677,136	1,909,139	1,892,110	1,892,110	1,909,294	1,920,819	1,920,819	2,033,751	1,928,610	1,925,864	1,959,496
CAPEX		0.73	62,092,485	2,492	0	10,174,427	9,839,871	21,534,540	16,732,961	3,704,011	104,183	0	0	0	0	0	0	0	0
Rolling stock		1	70,295,010	0	0	0	0	70,295,010	0	0	0	0	0	0	0	0	0	0	0
Total costs			**179,642,345**	**2,492**	**0**	**10,174,427**	**9,839,871**	**91,829,550**	**17,410,097**	**5,613,150**	**1,996,294**	**1,892,110**	**1,909,294**	**1,920,819**	**1,920,819**	**2,033,751**	**1,928,610**	**1,925,864**	**1,959,496**
Net cash flow			**216,114,026**	**-2,492**	**0**	**-10,174,427**	**-9,839,871**	**-91,829,550**	**-6,355,686**	**10,808,227**	**15,106,604**	**15,960,728**	**16,711,908**	**17,403,373**	**18,127,783**	**18,667,661**	**19,531,573**	**20,320,132**	**21,102,220**

PERIOD	CORRECTION FACTOR		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Year	backwards	forwards														
Time savings			13,414,546	14,038,765	14,685,814	15,375,532	16,055,582	16,756,822	17,310,420	17,887,584	18,479,431	19,095,475	19,736,005	20,391,241	21,067,642	21,676,589
Environmental pollution			447,976	461,658	475,775	468,199	481,440	471,447	481,246	491,317	501,562	512,092	522,944	534,044	545,391	554,397
Safety improvement			1,327,028	1,367,557	1,308,707	1,287,866	1,324,290	1,296,801	1,323,755	1,351,459	1,379,639	1,408,603	1,327,803	1,355,987	1,384,799	1,407,666
Vehicle operating costs			5,453,916	5,620,598	5,792,581	5,700,281	5,861,597	5,739,850	5,843,800	5,950,683	6,059,243	6,170,946	6,286,003	6,403,784	6,524,080	6,619,647
Climate change			1,953	2,012	2,074	2,041	2,098	2,055	2,098	2,142	2,186	2,232	2,279	2,328	2,377	2,416
Noise			498,259	513,476	529,178	520,751	535,480	524,364	535,263	546,465	557,860	569,572	581,642	593,987	606,608	616,625
Total external benefits			**21,143,678**	**22,004,066**	**22,794,130**	**23,354,670**	**24,260,488**	**24,791,339**	**25,496,581**	**26,229,649**	**26,979,921**	**27,758,921**	**28,456,676**	**29,281,370**	**30,130,898**	**30,877,340**
Direct benefits		1	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366	2,754,366
Total benefits			**23,898,044**	**24,758,432**	**25,548,496**	**26,109,036**	**27,014,854**	**27,545,705**	**28,250,947**	**28,984,014**	**29,734,287**	**30,513,287**	**31,211,042**	**32,035,736**	**32,885,264**	**33,631,706**
Residual value		**0.83**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**688,689**
Operational and maintenance total	0.73	0.81	1,925,864	1,925,864	1,925,864	1,925,864	1,925,864	2,038,796	1,925,864	1,933,656	1,930,909	1,992,337	1,958,705	1,958,705	1,958,705	1,958,705
CAPEX		0.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rolling stock		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total costs			**1,925,864**	**1,925,864**	**1,925,864**	**1,925,864**	**1,925,864**	**2,038,796**	**1,925,864**	**1,933,656**	**1,930,909**	**1,992,337**	**1,958,705**	**1,958,705**	**1,958,705**	**1,958,705**
Net cash flow			**21,972,180**	**22,832,568**	**23,622,632**	**24,183,172**	**25,088,990**	**25,506,909**	**26,325,083**	**27,050,359**	**27,803,378**	**28,520,950**	**29,252,338**	**30,077,032**	**30,926,559**	**31,673,002**

Source: Authors

A II.5 Sensitivity analysis

A sensitivity analysis has been carried out on the key variables in order to determine whether they are critical or not. The procedure requires to make them vary one at a time by a +/-1%, and then to assess the corresponding change in the Economic NVP and IRR. A variable is referred to as "critical" if the corresponding variation in the economic output is greater than 1% in absolute value.

A number of different variables have been tested as part of the sensitivity analysis performed as part of this ex-post assessment. As a result of the sensitivity tests (see table below), only one critical variable has been identified: *average travel time saved*, which is however close to the border threshold of 1%.

Table 21. Results of the sensitivity analysis

INDEPENDENT VARIABLE	VARIATION (in %) of the economic NPV due to a ± 1% variation	CRITICALITY JUDGEMENT *
Travel time savings	1.18%	Critical
Number of accidents	0.99%	Not critical
Transport work shifted from car transport	0.50%	Not critical
Other passengers shifted to rail	0.46%	Not critical
Commuting passengers shifted to rail	0.33%	Not critical
OPEX	0.17%	Not critical
Business passengers shifted to rail	0.16%	Not critical

Very critical: ΔNPV > +5%; Critical: ΔNPV > +1%; Not critical: ΔNPV < +1%.

A II.6 Risk assessment

The risk assessment has been conducted on the four variables with the highest results resulting from the sensitivity analysis: *travel time savings, number of passengers shifted to the rail, transport work shifted to the rail and number of accidents.* For the sake of simplicity, it was assumed that the probability distribution of each of these variables is triangular, the value with the highest probability being the reference one – that is, the "base value" adopted for carrying out the CBA – and the lower and upper bounds being the "pessimistic" and "optimistic" values defined in the scenario analysis.

The analyses have been elaborated using the Monte Carlo simulation technique with 1,000 random repetitions. In brief, at each iteration a value from the distribution of each of the independent variables is randomly extracted. The extracted values are then adopted for computing the ENVP and IRR. Finally, the 1,000 estimated values of ENPV and IRR are used to approximate the probability distribution of the two indicators.

The risk assessment shows that the expected value of the ENPV is equal to EUR 217.9 million (slightly higher than the reference case), and that the expected value of the ERR is 12.92% (against a reference case of 12.91%). The probability that the ENPV will become negative and that the ERR will be lower than the SDR adopted in the analysis is nil. Furthermore, there is a less than 50% probability that the two indicators assume a lower value than in the reference case (48% and 49%

respectively). Hence, the CBA outputs appear to be robust to future possible variations in the key variables. Overall, the risk analysis shows that the project has a negligible risk level.

Figure 32. Results of the risk analysis for ENPV (left-hand side) and ERR (right-hand side)

CBA Reference value
216,114,026

Estimated parameters of the distribution	
Mean	217,915,638
Median	217,521,652
Standard deviation	25,525,464
Minimum	133,048,060
Maximum	312,282,090

Estimated probabilities	
Pr. ENPV ≤ base value	0.477
Pr. ENPV ≤ 0	0.000

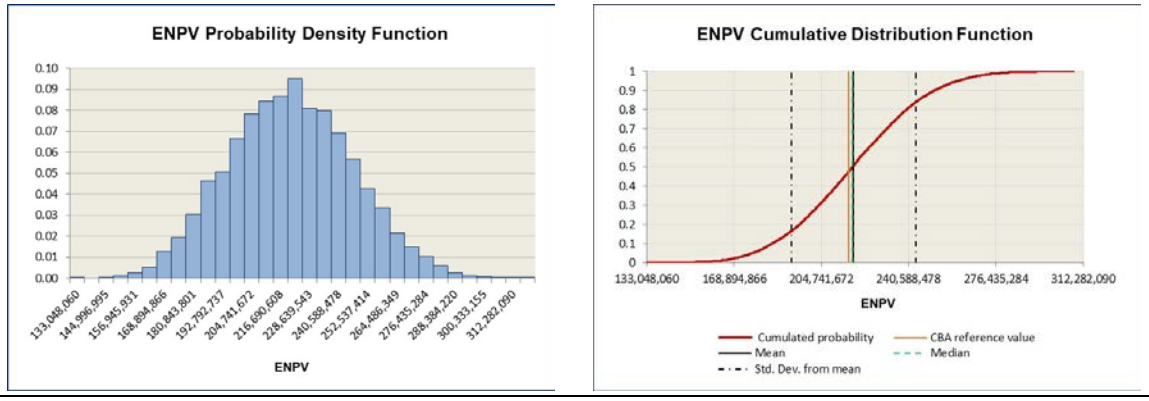
CBA Reference value
12.9090%

Estimated parameters of the distribution	
Mean	12.9204%
Median	12.9272%
Standard deviation	0.69%
Minimum	10.544%
Maximum	14.998%

Estimated probabilities	
Pr. ERR ≤ base value	0.490
Pr. ERR ≤ Social discount rate	0.000

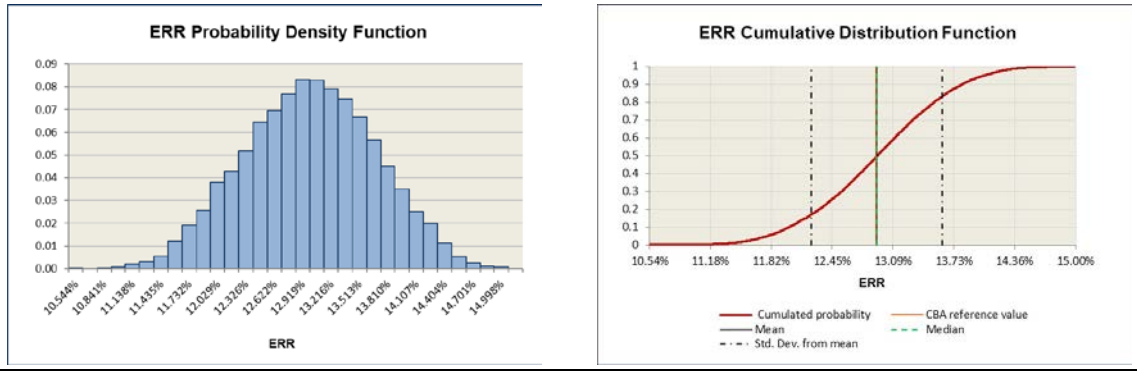
Source: Authors

Figure 33. Probabilistic distribution of the Economic Net Present Value (EUR)



Source: Authors

Figure 34. Probabilistic distribution of the Economic Internal Rate of Return



Source: Authors

ANNEX III. LIST OF INTERVIEWEES

The following table provides details on the stakeholders that have been interviewed as part of the ex-post assessment. The stakeholders have been identified based on the authors referenced in the documents included in the application dossier provided by the European Commission. The institutions approached through these referenced contacts have been consulted in order to confirm the most appropriate and relevant persons to be involved in this ex-post analysis. Additional stakeholders have been identified on the basis of the review of articles and Web Sites, which have been consulted as part of this evaluation. Some passengers and journalists interviewed as part of this ex-post assessment consider their contact details as private and confidential and are thus not reported in the table below. The list of stakeholders is thus predominantly showing institutional contact persons. NGOs have been approached which did not respond to our questions.

NAME	POSITION	AFFILIATION	DATE
Krzysztof Mrozicki	Head of Investment Strategies Division	Strategy and Development Office PKP PLK S.A.	11.09.2017
Gabriela Popowicz	Office Director	European Funds Office PKP PLK S.A.	04.01.2018
Katarzyna Ziarkowska	Project Director	Investment Preparation Office PKP PLK S.A.	04.01.2018
Anna Jędrzejewska	Head of European Projects Implementation Division III	European Funds Office PKP PLK S.A.	04.01.2018
Agnieszka Puzyńska	Chief Specialist in European Projects Implementation Division III	European Funds Office PKP PLK S.A.	04.01.2018
Marzena Krawczyk	Senior Specialist Analysis of European Investments Effectiveness Division	European Funds Office PKP PLK S.A.	04.01.2018
Krzysztof Wybieralski	Head of Division	European Funds Office PKP PLK S.A.	19.12.2017
Włodzimierz Rybarczyk	Chief Specialist in Transport Strategy and Mobility Division	Office for Mobility and Transport Policy Warsaw City Hall	12.12.2017
Andrzej Pieczara	Chief Specialist for research and analyses In Economic Division	Public Transport Authority (Zarząd Transportu Miejskiego - ZTM)	15.12.2017
Martyna Kozieł	Specialist in Financing and Investments Unit of European Funds and Public Aid Division	"Polish Airports" State Enterprise (PPL) Chopin Airport in Warsaw	27.12.2017
Marta Hasiak	Head of Organisation and Internal Monitoring for the Management Office	Koleje Mazowieckie Sp. z o.o. (KM)	05.01.2017

NAME	POSITION	AFFILIATION	DATE
	Division		
Krzysztof Piotrowski	Chief Specialist	Planning, Controlling and European Funds Settlements Szybka Kolej Miejska (SKM)	10.01.2018
Artur Rudnicki	Project manager	JASPERS	12.12.2017 by e-mail
Maria Galewska	Programme Manager - EU policies	DG Regio Desk Officer. Unit F3 - Programmes and Projects in Poland	13.02.2018 by e-mail
Dorota Comberska	Evaluation Team Expert	Centre for European Transport Projects	10.2017 by phone and e-mail
Hanna Bałos	Department of Infrastructural Programmes	Ministry of Development	10.2017-02.2017 by phone and e-mail
Krzysztof Rzeźnikiewicz	Technical Director of the Engineering Division	Bilfinger Industrial Services Polska Sp. z o.o. (currently PORR S.A.)	14.02.2018 by phone and e-mail
Henryk Kozłowski	President	Torprojekt Sp. z o.o.	01.03.2018
Aleksander Janiszewski	Railway Transport Expert	Torprojekt Sp. z o.o.	01.03.2018
Sławomir Kuliś	Passenger	Warsaw Inhabitant	14.03.2018

REFERENCES

Fundacja Rozwoju Inżynierii Lądowej, 2015. Strategia Transportu i Mobilności Obszaru Metropolitalnego do roku 2030. Program Rozwoju Transportu Obszaru metropolitalnego w perspektywie finansowej 2014 – 2030. Gdańsk

TTS, 2014. Plan zrównoważonej mobilności miejskiej jako kompleksowe podejście do planowania mobilności w miastach. Gdańsk

Zespół Doradców Gospoadrczych TOR, Stowarzyszenie Transportu Publicznego, 2015. Biała Księga Mobilności. Warszawa

City of Warsaw, 2015. Strategia Rozwoju Obszaru Metropolitalnego Warszawy do roku 2030. Warszawa

City of Warsaw, 2015. Plan zrównoważonego rozwoju transprotu zbiorowego dla m.st. Warszawy z uwzględnieniem publicznego transportu zbiorowego organizowanego na podstawie porozumień z gminami sąsiadującymi. Warszawa

City of Warsaw, 2010. Strategia zrównoważonego rozwoju systemu transportowego Warszawy do 2015 roku i na lata kolejne. Synteza, Warszawa

GUS, 2016. Rocznik Statystyczny Warszawy, Warszawa

City of Warsaw, 2003. Barometr warszawski. Warszawa

City of Warsaw, 2004. Barometr warszawski. Warszawa

City of Warsaw, 2005. Barometr warszawski. Warszawa

City of Warsaw, 2006. Barometr warszawski. Warszawa

City of Warsaw, 2007. Barometr warszawski. Warszawa

City of Warsaw, 2008. Barometr warszawski. Warszawa

City of Warsaw, 2009. Barometr warszawski. Warszawa

City of Warsaw, 2010. Barometr warszawski. Warszawa

City of Warsaw, 2011. Barometr warszawski. Warszawa

City of Warsaw, 2012. Barometr warszawski. Warszawa

City of Warsaw, 2013. Barometr warszawski. Warszawa

City of Warsaw, 2014. Barometr warszawski. Warszawa

City of Warsaw, 2015. Barometr warszawski. Warszawa

City of Warsaw, 2016. Barometr warszawski. Warszawa

City of Warsaw, 2017. Barometr warszawski. Warszawa

Warsaw Chopin Airport, 2017. Sposób dojazdu do / z Lotniska Chopina, Warszawa

ZDM, 2016. Raport o stanie bezpieczeństwa drogowego w Warszawie, Warszawa

Sudop Praha a.s., 2007. Raport o oddziaływaniu na środowisko projektowanego przedsięwzięcia p.n. Modernizacja linii kolejowej nr 8 wraz z budową łącznicy z terminalem Okęcie. Zadanie II – budowa łącznicy kolejowej biegnącej w tunelu pomiędzy stacją Warszawa Służewiec a Międzynarodowym Portem Lotniczym Okęcie, im. F. Chopina, Wrocław

PKP PLK S.A. 2012. Raport końcowy z realizacji działań informacyjnych i promujących. Warszawa

PKP PLK S.A., 2004. Porozumienie w sprawie realizacji infrastruktury okołolotniskowej w związku z budową terminala 2 w Porcie Lotniczym Warszawa Okęcie in. Fryderyka Chopina zawarte w dniu 19 lutego 2004 r. w Warszawie, Warszawa

PKP PLK S.A., 2006. Aneks nr 1 do Porozumienia z dnia 19 lutego 2004 r. w sprawie realizacji infrastruktury okołolotniskowej w związku z budową terminala 2 w Porcie Lotniczym Warszawa Okęcie in. Fryderyka Chopina

PKP PLK S.A., 2011. Modernizacja linii kolejowej nr 8, budowa łącznicy do lotniska Okęcie (od przystanku osobowego Służewiec do stacji MPL Okęcie) – ppt. Warszawa

CUPT, 2016. Aneks nr POIS.07.01.00-00-011/09-04 do Umowy o dofinansowanie nr POIS.07.01.00-00-011/09-04 z dnia 22 lipca 2010 r. projektu „Modernizacja linii kolejowej nr 8, budowa łącznicy do lotniska Okęcie (od przystanku osobowego Służewiec do stacji MPL Okęcie)" w ramach działania 7.1: Rozwój transportu kolejowego priorytetu VII: Transport Przyjazny środowisku Programu Operacyjnego Infrastruktura i Środowisko 2007-2013 z dnia 20.09.2016. Warszawa

CUPT, 2016. Załącznik nr 3 do Aneksu nr POIS.07.01.00-00-011/09-04 do Umowy o dofinansowanie nr POIS.07.01.00-00-011/09-04 z dnia 22 lipca 2010 r. projektu „Modernizacja linii kolejowej nr 8, budowa łącznicy do lotniska Okęcie (od przystanku osobowego Służewiec do stacji MPL Okęcie)" w ramach działania 7.1: Rozwój transportu kolejowego priorytetu VII: Transport Przyjazny środowisku Programu Operacyjnego Infrastruktura i Środowisko 2007-2013 z dnia 20.09.2016. Warszawa

City of Warsaw, 2015. Warszawskie Badanie Ruchu 2015 wraz z opracowaniem modelu ruchu. Sopot/Kraków/Warszawa

PKP PLK S.A., 2017. Website: http://www.plk-inwestycje.pl/inwestycje/program-operacyjny-infrastruktura-i-srodowisko/poiis-71-18/

CUPT, 2017. Website: https://www.cupt.gov.pl/archiwum/indexd5a4.html?id=1184

Managing Authority, 2017. Website: https://www.pois.2007-2013.gov.pl/Projekty/Strony/Modernizacja_linii_kolejowej_Okecie_Sluzewiec_29052013.aspx

EC, 2017. Website: http://ec.europa.eu/regional_policy/en/projects/major/poland/providing-better-rail-services-to-warsaws-airport

CUPT, 2015. Raport z osiągniętych efektów. Warsaw: CUPT

CUPT, 2016. Raport z osiągniętych efektów. Warsaw: CUPT

European Commission, 2010-2015. Project dossier: Application form with the annexes

JASPERS, 2012. JASPERS Completion note for the project: 2008 182 PL RAL RAL Construction of a new rail link from Warszawa Służewiec to F. Chopin Intl. Airport and modernisation of the railway line no. 8 between Warszawa Zachodnia and Warszawa Okęcie station

Getting in touch with the EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

– at the following standard number: +32 22999696 or

– by email via: https://europa.eu/european-union/contact_en

Finding information about the EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1952 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu

Open data from the EU

The EU Open Data Portal (http://data.europa.eu/euodp/en) provides access to datasets from the EU. Data can be downloaded and reused for free, for both commercial and non-commercial purposes.

KN-04-20-151-EN-N

Publications Office
of the European Union

ISBN: 978-92-76-17419-6