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

New West Bypass Road of Malaga

Spain

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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.

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

The main author of this report is Emanuela Sirtori. Research assistance was provided by Luca Bisaschi, while a scientific advisory role was played by Gianni Carbonaro. The authors are grateful to all the project managers, stakeholders and beneficiaries who provided data, information and opinions during the field work.

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LIST OF ABBREVIATIONS

B/C	Benefit/Cost ratio
CBA	Cost-benefit analysis
DG REGIO	Directorate-General for Regional and Urban Policy
EC	European Commission
ENPV	Economic Net Present Value
ERDF	European Regional Development Fund
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
GDP	Gross Domestic Product
GHG	Greenhouse Gas
INE	National Statistical Office (Instituto Nacional Estatística)
NPV	Net Present Value
O&M	Operating & Maintenance
OP	Operational Programme
PEIT	Strategic Plan for Infrastructure and Transport
SEITT	State Company for Land Transport (Sociedad Estatal Transporte Terrestre)
ToR	Terms of References
VAT	Value Added Tax
VOC	Vehicle Operating Cost

EXECUTIVE SUMMARY

This case study illustrates the story of the New West Bypass road of Malaga, a major infrastructure investment co-financed by the European Union (EU) during the programming period 2007-2013. More specifically, this is an ex-post evaluation assessing the long-term effects produced by the project aimed at disentangling the mechanisms and determinants likely to have contributed to produce these effects. The analysis draws on an ex-post Cost-Benefit Analysis (CBA)[1] and an extensive set of qualitative evidence, both secondary (technical reports, official reports, press articles, books and research papers) and primary (site visits and interviews with key stakeholders and experts have been carried out in the period from November 2017 to January 2018[2]).

OVERALL APPROACH AND METHODOLOGY

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

The Conceptual Framework delivered in the First Intermediate Report has been developed to answer the evaluation questions included in the Terms of Reference (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 effects 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 later on 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 under this dimension.
- **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 and influenced the observed project performance. To do this the Team identified six stylised determinants of projects' outcomes – the relationship 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 the ex-post Cost Benefit Analysis, complemented by qualitative techniques (interviews, surveys, searches of government and newspaper archives, etc.), **combined in such a way as to produce a project history**. CBA is an appropriate

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

analytical approach for the ex-post evaluation because it can provide the quantification and monetisation of some of the long-term effects produced by the project (in particular 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 critical 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. The qualitative analysis on the other hand is more focussed on understanding the determinants and causal chains of the delivery process, as well as assessing effects that may be difficult to translate into monetary terms.

MAIN PROJECT FEATURES

The project is located in the metropolitan area of Malaga, a popular tourism destination on the Mediterranean Sea, in the Spanish region of Andalusia. Specifically, the project crosses, to a great extent, the city of Malaga and, in small sections, the municipalities of Torremolinos and Aluahirín de la Torre. Malaga is the sixth largest city of Spain. Characterised by a vibrant and rising economic activity and population, for many years Malaga has grown faster than the Spanish and regional average. Between 2000 and 2016, population in the province of Malaga has grown by 27% and GDP has more than doubled. This positive trend is expected to continue in the future, driven by the tourism sector, logistics, high tech and other industrial activities.

The project under assessment concerns the **construction of a 21.4 km motorway bypassing the city of Malaga on the west side**, going through the industrial and logistic areas in the outskirt of the city. It has four lanes per carriageway in almost all its length, and three in one section. Since the bypass runs through a hilly area and crosses a number of local roads, the project includes the construction of **two bridges, eight viaducts, nine overpasses, fourteen underpasses and a 1,250 m long tunnel** in the mountain.

The project involved a total investment of EUR 434 million in nominal prices, which was co-financed by the State Company for Land Transport (SEITT), fully controlled by the Ministry of Infrastructure, and by a EUR 234 million ERDF grant, representing about 63% of construction costs and 54% of the total investment cost. The preparatory works started in 1997 and the final project design was developed between 2005 and 2007. The construction phase took place between 2007 and the beginning of 2012. Half of the bypass started operations at the end of 2010, and the other half was opened to traffic in October 2011.

Before the project implementation, the only motorway overpassing the city of Malaga was the MA-20, which corresponded to the route of the European Mediterranean motorway E-15. The road was used by both long-distance traffic, local population and tourists and was severely congested in the peak hours of the day. **In 2008, the MA-20 served more than 180 thousand vehicles per day and was near to collapse**.

In order to improve the road service conditions for long-distance transport in the area of Malaga, the Ministry of Infrastructure decided to build a new western bypass, the A-7, which would have become the new route around Malaga for the E-15 traffic. **The**

primary objective was to deviate long-distance traffic out of the city in order to reduce the travel time to pass over Malaga. The project was expected to achieve other two side objectives: a reduction of travel time for vehicles which would have continued using the MA-20, thanks to a decongestion effect, and the improved connection of the suburban areas of Malaga to the E-15 Mediterranean motorway and the rest of the metropolitan area. The project was given high priority by the Ministry of Infrastructure, which in 2005 included it into the national Strategic Plan for Infrastructure and Transport (PEIT).

PROJECT PERFORMANCE

Based on the findings of 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 highly relevant in the context where it was implemented and matched a real and urgent need. The sustained growth of population, tourism and economic activity in Malaga required a long-term solution to the severe traffic problems affecting long-distance as well as local users. At the same time, the concurrent decision of the Ministry to build another motorway to connect Malaga with the Northern city of Antequera (AP-46) would have conveyed additional new traffic to the Mediterranean motorway, thus making the bypass project even more urgent.

The project was coherent with the strategic priorities set at European and national level for long-distance transport, but also with objectives of sustainable growth at regional and local level. As the city progressively expanded westwards, the bypass was expected to improve mobility in the city hinterland and provide a better connection to the city outskirts, including logistic and industrial zones, the Technological Park of Andalusia, the airport and the university.

Project effectiveness

Overall the project achieved the expected objectives. More specifically:

- The project generates a positive economic return which is mainly due to travel time savings for both users of the new A-7 and of the existing MA-20, as compared to a business-as-usual scenario. Other minor benefits relate to vehicle operating cost savings, and reduction of air pollution and noise in the urban area of Malaga thanks to traffic diverted to the new bypass. The project also produces some marginal socio-economic economic costs in terms of safety, due to the increasing number of accidents on the new road, and climate change, due to CO_2 emissions from traffic induced by the project. These effects have been quantified in the ex-post CBA. **The analysis indicates that the Economic Net Present Value of the project in the baseline case amounts to EUR 600.5 million, with an internal rate of return of 7.61%**. The risk analysis indicates that the expected Economic Net Present value has a negligible probability of being lower than zero.
- Other non-measurable effects were identified, the most important of which are:
    - o **wider economic effects around the bypass**: the improved road accessibility of the metropolitan area of Malaga positively contributes to the development of the industrial areas localised near the bypass;
    - o **territorial cohesion in the province of Malaga**, by providing the cities in the western suburban ring and population living in the less

populated hinterland with a better connection to the city and its facilities, including the airport and university.

- The decision to expand the bypass and to build three/four lanes per carriageway, instead of two/three as initially planned, turned out to be appropriate to the traffic intensity forecasts in the long-run. **The project therefore will continue producing benefits until the end of its time horizon**, conventionally assumed at 2035.
- **Additional investments are needed to address the deficiencies that still affect the roads crossing the new bypass or in its vicinity**. The connection between the Technological Park and the industrial areas is particularly critical, with long queues caused every day on the connecting roads by vehicles that enter and exit the A-7 bypass. Even if these investments are outside the project scope and mainly concern roads that are under the responsibility of the Region, if implemented they would allow the full potential of the A-7 bypass to be exploited and its long-term benefits to be maximised. Yet, no satisfactory solutions have been approved yet, due to the Region's budgetary constraints but also poor coordination between relevant administrations at different institutional levels.

Project efficiency

The project was finalised 25 months after the original forecasts, due to an exceptional event during the construction phase (the flood of the Guadalorce river crossed by the bypass), but especially to the "last minute" decision to revise the project design and add a lane for each running direction of the bypass, just before the start of construction works.

The project recorded an overrun in construction and expropriation costs (respectively by 34% and 73%), compared to the official preliminary estimates included in the project dossier submitted to the European Commission. However, when the decision to expand the road to four lanes per carriageway was taken, the original cost estimates were not revised accordingly. Therefore, it is not possible to make a proper comparison between ex-ante and ex-post project cost.

Even if the project turned out to be more costly than initially communicated to the Commission, **the decision to build a more capacious road link was the right one to guarantee not only the project effectiveness, but also its efficiency**. Building a large road since the beginning, rather than upgrading the infrastructure some years after its finalisation, was both financially and technically more convenient.

The Ministry of Infrastructure is responsible for ensuring the project financial sustainability over its entire life time. The possibility to levy a toll was discarded because it would have discouraged vehicles, especially local users, from using the bypass. The Ministry also considered to grant the concession of the bypass project implementation and management to a private firm, more precisely the same firm that would have managed the tolled AP-46. However, it was eventually judged that the revenues from the AP-46 motorway would have not be sufficient to cover the construction cost of the bypass too. According to the interviewees, the decision to put the bypass under the Ministry's direct control would have given stronger assurance about the project's financial sustainability in the long-term.

EU added value

Even if the project has contributed to produce benefits at EU level, by reducing the travel time for long-distance traffic along the Mediterranean motorway and improving the connection to the Malaga International Airport, **the evidence collected and interviews with stakeholders did not reveal a significant EU added value for this project**. The application for co-financing was submitted by the Managing Authority when the project was already under construction and the Commission did not make any observations on the project before taking the financing decision.

The Commission was not even fully informed about the project features, because the project dossier, including the cost estimates and the CBA, was not revised by the SEITT when the Ministry decided to change the project design and increase the road's capacity. Because of this, the ERDF grant was computed as 80% of the eligible construction costs submitted by SEITT. If the correct cost estimates had been provided, the Community contribution, estimated by applying the same co-financing rate to a higher eligible construction cost, could have been higher.

Even if the ERDF grant still covered a substantial share of the construction cost (63%), given the strong national and local interest for implementing the bypass within the shortest possible time, the project would have probably been implemented even without the EU support. It is possible to assume that the availability of EU funds may have produced an additionality effect on national expenditure for other projects, but this cannot be ascertained in the context of this study.

In the future there could be some scope for the European Commission to play a greater and more decisive role to maximise the long-term benefits produced by the project. The Commission could encourage a stronger and effective integration of national transport investment with regional development strategies, as well as stronger cooperation between the Spanish national, regional and local authorities towards the achievement of common development goals.

MECHANISMS AND DETERMINANTS

The high **appropriateness of the project to the socio-economic context** in which it was embedded, convergence of interests around it and **smooth selection process**, **accurate forecasting capacity** and **appropriate project design** were all important determinants that paved the way for the project good performance.

The highly centralised and top-down decision process, along with good managerial capacity shown by the Ministry of Infrastructure were instrumental to produce an adequate project design, fast selection process and effective project implementation. On the other hand, **coordination between the central and regional authorities was, and still is, weak**. Even if this did not obstacle the implementation of the Malaga bypass project, it limited the capacity to adequately plan the complementary investments necessary to better integrate the bypass into the local transport network. While these interventions were out of the project scope, stronger cooperation would allow to better address not only national transport objectives, but also local transport and development needs.

CONCLUSIONS

In conclusion, the new west bypass of Malaga represents a good example of a successful project, which achieved the intended objective of improving the service conditions of a critical motorway infrastructure in the Malaga metropolitan area. To some extent, the project also contributed to local economic development objectives. It was an appropriate and necessary initiative to sustain local economic development, but it could not be sufficient by itself. Various complementary investments are necessary in order to maximise its positive spillovers.

The story of the new bypass of Malaga illustrates that even a project conceived to target primarily long-distance users can produce important development opportunities at local level, which ideally should be acknowledged and exploited by the project promoter from the start. For the transport project to play a pivotal role in promoting more ambitious economic development and territorial cohesion goals, it should be integrated into a comprehensive development strategy and rely on stronger cooperation between different institutional levels.

1. PROJECT DESCRIPTION

The project 'New West Bypass road of Malaga' (CCI 2009ES161PR017) **concerns the construction of a non-tolled road by-passing the city of Malaga**, in the Spanish region of Andalusia. The new bypass is part of the Mediterranean motorway A-7/E-15, a European route running from Algeciras (Spain) through France and England up to Inverness, Scotland.

Before the project implementation, traffic was concentrated in a previously existing motorway (MA-20) which crosses the city of Malaga and which during the Nineties was becoming increasingly congested. **The primary objective of the project was to relieve traffic from the MA-20 motorway by diverting long-distance travellers to the new bypass**, so as to ensure them a faster and more reliable transport service. As secondary objective, thanks to reduced traffic congestion, the project was expected to improve urban road mobility in the metropolitan area of Malaga for tourists and the local population.

The bypass is 21.4 km long. The construction works started in 2006 and the road was fully opened to traffic at the end of 2011. The total project cost amounted to EUR 434 million in nominal terms and excluding VAT.

The project was co-financed by an ERDF grant, with resources allocated to the Regional Operational Programme ERDF of Andalusia, in the 2007-2013 programming period. **The Ministry of Infrastructure was responsible for the project design and financing**, while the State Company for Land Transport (SEITT - Sociedad Estatal Transporte Terrestre) was in charge of the project's implementation, in the capacity of intermediate body for the Ministry of Infrastructure.

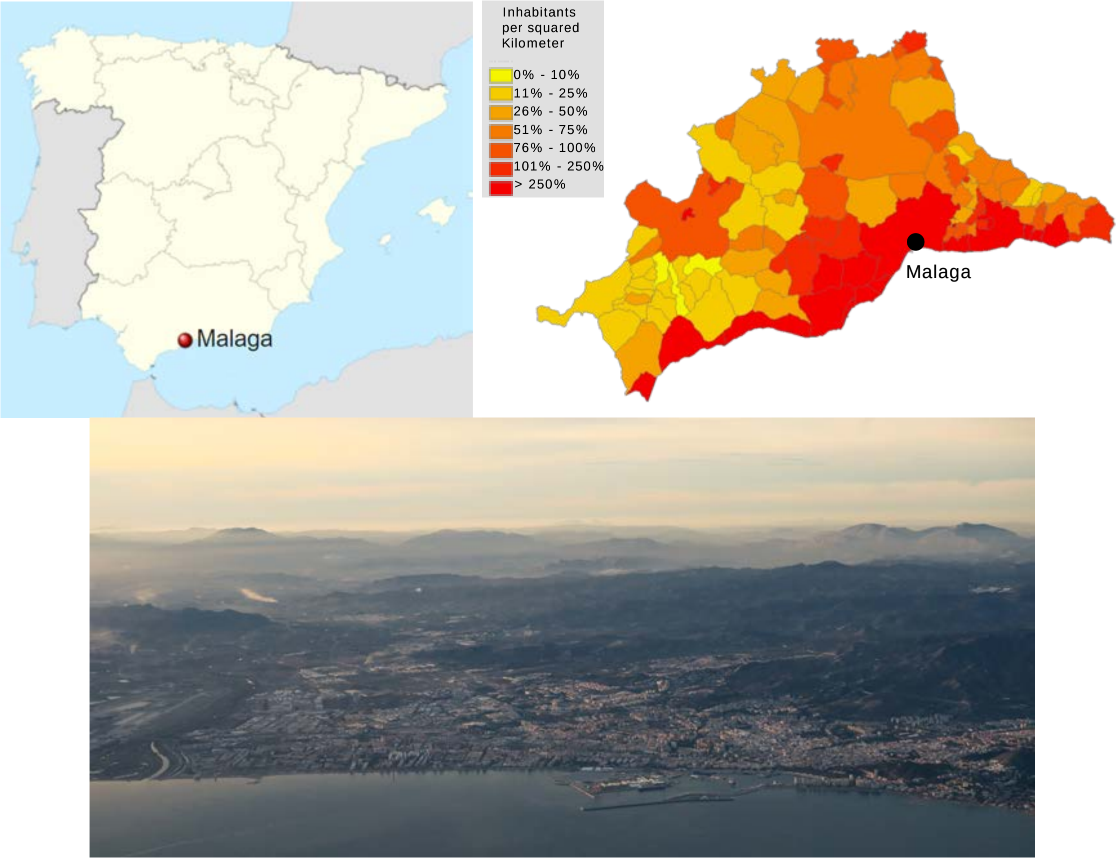
The first section of this case study report contains a brief description of the project. The socio-economic context, the target population and key structural features of the infrastructure and service delivered are outlined in order to give a general overview of the project context and objectives.

1.1. *CONTEXT*

The project is located in the metropolitan area of Malaga. With its 570 thousand inhabitants, in 2016 Malaga was the second most populous city of the Andalusia region and the sixth largest in Spain.[3] The population density of the city is above the Andalusia and national average, reaching 1,445 inhab/km².[4] Together with the resto of the metropolitan area, which includes the municipalities of Mijas, Fuengirola, Torremolinos, Benalmádena, Rincón de la Victoria, Alhaurín de la Torre y Cártama, the population of Malaga reaches 1 million inhabitants.

[3] Source: INE – National Statistics Institute.
[4] Source: INE from Municipal census, year 2016.

Figure 1. Location of the city of Malaga and population density in the province of Malaga (2016)



Source: Wikipedia[5] *and own air photo of Malaga*

The metropolitan area of Malaga is characterised by very high socio-economic dynamism, in line with the trend recorded in the entire province.[6] The province of Malaga witnessed a strong population growth in the last fifty years, going from 775 thousand inhabitants in the Sixties to the current 1.65 million. In the period 2000-2016, the population in the province of Malaga has grown by 27%, well above the national and regional average (respectively 15% and 14%). Unlike Spain and Andalusia in general, Malaga population is expected to continue increasing in the future by almost 7% from 2016 to 2031.

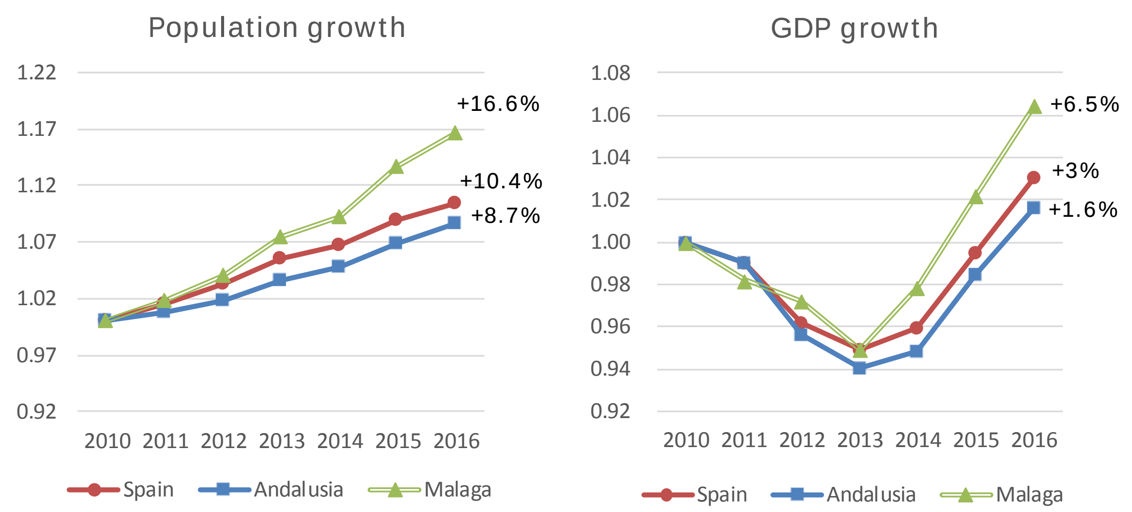
Along with such a significant demographic growth, Gross Domestic Product (GDP) more than doubled its nominal value during the 2000-2016 period, passing from EUR 14.9 billion in 2000 to EUR 31 billion in 2016. Until 2008 GDP was growing at nearly 10% rate per year. The world economic crisis interrupted the growing trend in 2009, when GDP decreased by 5.79%. Yet, Malaga recovered from the crisis faster than the rest of Spain and Andalusia. Since 2010, GDP has grown by 6.5%, more than double than the Spanish average (Figure 2) and has already reached the pre-crisis level.

[5] Source: Wikimedia Commons. Diputación de Málaga. Date = 2007-12-16, Author= ZephyrusCom.

[6] Besides the capital city of Malaga and its metropolitan area, the province includes other municipalities located in the coastal zone, such as Marbella, and in the interior, such as Antequera and Ronda.

Forecasts for 2017 indicates an annual growth of around 2.8%-3%.[7] Overall, the province of Malaga makes 21% of the regional GDP and 3% of the national one.

Figure 2. Population and GDP growth trend in Spain, Andalusia and the Malaga province (2010=1)



Source: Own elaboration based on INE data

The tourism sector is the main engine of growth of the Malaga economy. Malaga is located along the Costa del Sol, one of the most popular holiday destinations in Europe with miles of sandy beaches and all year round warm climate. According to the Tourism Observatory report (Turismo y Planificacion Costa del Sol, 2016), during the 2012-2016 period, tourist establishments in the province of Malaga have increased by more than 40%.[8] In 2016, the tourist accommodation offer in the province was made up of 8,847 establishments with 210,561 places. According to the same source, in 2016 the province of Malaga welcomed nearly 12 million visitors, 10.3% more than the previous year, making it the most visited province of the region. Around 4 million visitors were recorded in 2016 in the city of Malaga alone, attracted not only by its beaches, but also by a reach offer of museums, theatres, temporary exhibitions, historical sites, and events.[9] The majority of visitors to Malaga are foreigners:[10] around 28% are from the UK, 7% are German, 4% from Belgium and the Netherlands, 4% from France, 30% from the rest of Spain, and the remainder from other locations.[11]

The growth of visitors is reflected in the increasing traffic recorded by the Malaga International Airport, the main international airport serving the Costa del Sol, located 8 km far from the Malaga city centre. The airport reached 16.6 million travellers in 2016, with 60 flights connections to over 60 countries. This figure represents a 38% increase compared with 2010, a growth made possible by the opening of a second runway in 2012. Currently, **the Malaga airport is the third busiest airport in peninsular Spain, after Madrid and Barcelona**.

[7] Data provided by the Municipality of Malaga.
[8] Without taking into account housing for tourism purposes.
[9] Source: The Tourist Observatory and CIEDES Foundation data, provided by the Municipality of Malaga.
[10] This includes a high number of foreigners who have in Malaga their second/retirement homes.
[11] Source: interview to the Association of hotel businessmen of the Costa del Sol (AEHCOS).

Malaga is however more than a tourist destination. Its economy is marked by vibrant industrial, logistic and ICT sectors. According to La Caixa 2012 Report, in 2011 Malaga was the fourth Spanish province in terms of economic activity, thanks to the opening of more than 5.5 thousand new businesses. In 2016 provincial exports surpassed the national and regional average growing by 12.6% against a regional and national average below 3% and 2% respectively. **Sixteen different industrial zones are localized in the suburban area of Malaga, having nearly 4,000 enterprises and more than 40 thousand employees**.

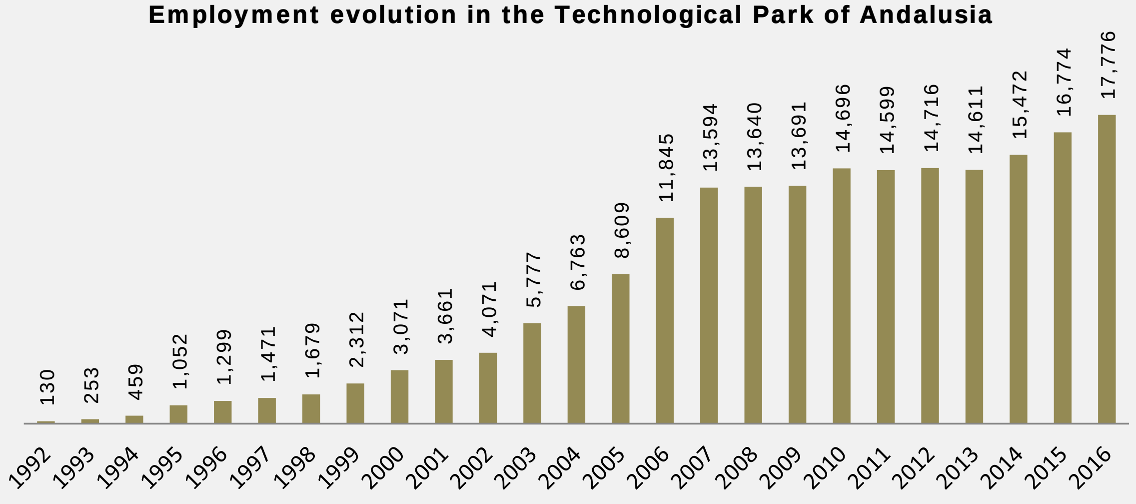
In the last two decades, Malaga has developed a specialisation in innovation and high tech industries. According to Extenda[12], Malaga contributes to ICT exports by 50% and to ICT employment in Andalusia by 34%. Malaga hosts in its neighbourhood the Technological Park of Andalusia, headquarter of more than 600 high-tech multinational companies and with 18,000 employees. The Technological Park, together with the University of Malaga, and several high-tech research and manufacturing companies are part of the so called Malaga Valley Club, an innovation and technology hub which aspires to become "the Silicon Valley of Europe".

Box 1. The Technological Park of Andalusia

The Technological Park of Andalusia is an industrial cluster specialised in high tech and telecommunications sector. It is located in the neighbourhood of Campanillas, in the northern area of Malaga. It was established in 1992 by the Andalusian Regional Government and the Municipality of Malaga. During the late 90's and early 00's, several international firms settled their headquarters in the Technological Park, which soon became one of the most important Spanish tech-hub. Amongst the most significant multinational enterprises headquartered in the Park, there are Oracle Corporation, Huawei, Accenture, and TDK.

In 2016, the Park hosted nearly 18,000 employees, 635 enterprises, with an annual turnover of EUR 1,750 million. It contributed to the employment in the municipality and province of Malaga respectively by 20% and 8.27%. In terms of GDP, the Park produces 19.5% of the GDP of the city and 7.95% of the province.

Employment evolution in the Technological Park of Andalusia



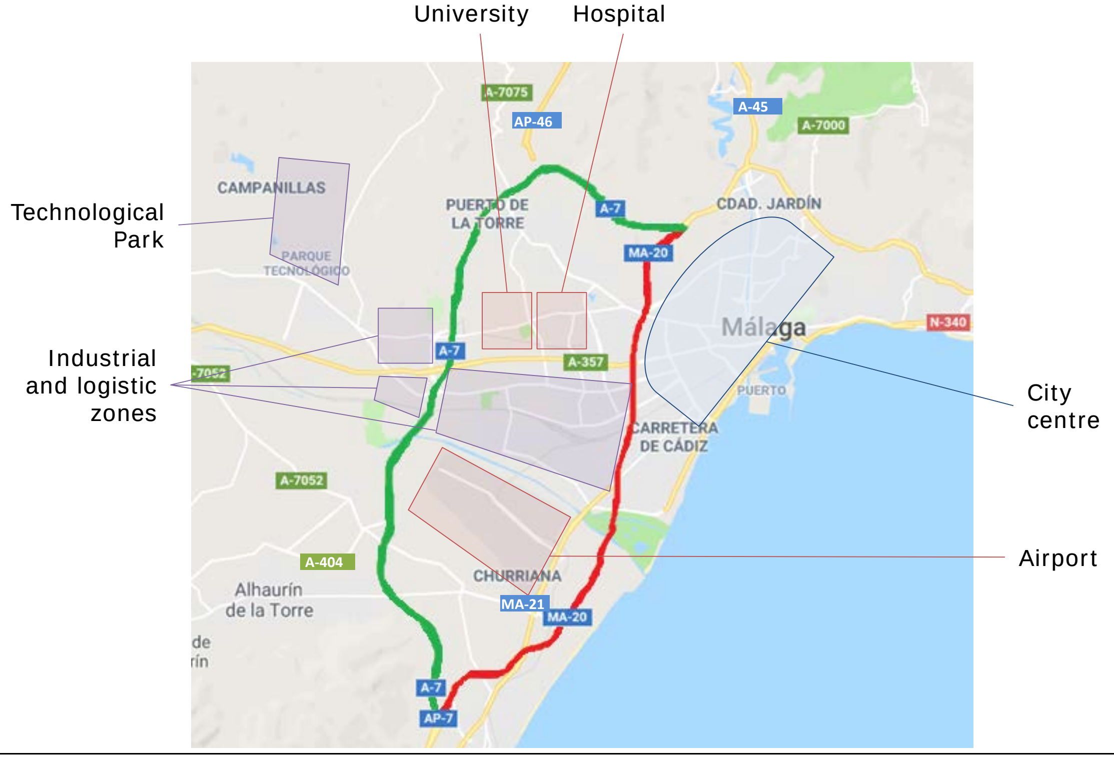
Source: Authors based on Technological Park of Andalusia (2017).

12 https://www.extenda.es/web/opencms/extenda/noticias/noticia_1714.html

As a result of the economic opportunities offered by the province of Malaga, many people are used to travel from other provinces to Malaga, with a net balance of almost 15 thousand workers in 2016. The metropolitan area of Malaga, it is indeed very common that workers who reside in the nearby municipalities, such as Alhaurín de la Torre o Cártama, travel daily to perform their work activity in Malaga and other places along the Costa del Sol.

The spatial configuration of the socio-economic activities of the Malaga area, is strictly linked to the configuration of the road network. The residential area is located along the coastline, in the inner circle bounded by the MA-20 motorway, the so-called "Old Malaga bypass". This area also hosts the sea Port, whose activities include cruise shipping, as well as import of containerised manufactured products, break bulk and vehicles. The airport is located South West of the city centre. between the MA-20 and the new bypass road A-7/E-15. The industrial and logistic activities are also concentrated in the strip of land between the old and the new by-pass road. The Technological Park is positioned in the outer circle of Malaga, in the quartier of Campanillas.

Figure 3. Spatial configuration and road network of Malaga



Note: the new bypass A-7 is green coloured; the MA-20 is red coloured.
Source: Own elaboration of Google Map image

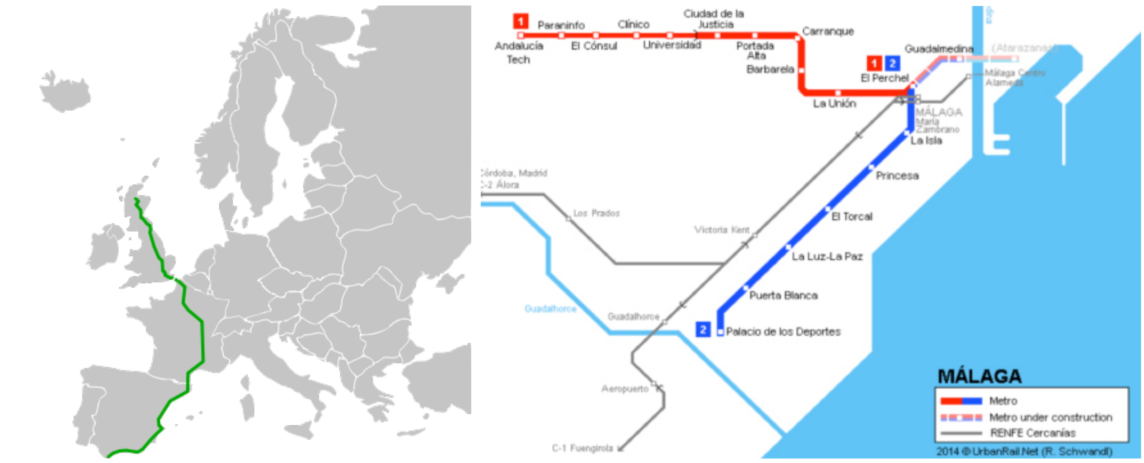
Both the MA-20 and the A-7 bypass roads run parallel to the coast line. The 11.4 Km long MA-20 is a major transport axis running through the city of Malaga. It is a national motorway of two/three lanes for each carriageway. It doubles itself into the MA-21 road in the Southern area of the city in order to facilitate connection to the airport. The new A-7 bypass road circumvents Malaga, from the district of Ciudad Jardín, North of Malaga, almost until the city of Torremolinos, South of Malaga. It is part of the European road E-15, the longest national motorway in Europe, connecting Algeciras to the French border, continuing then up to England and Inverness, in Scotland.

The road network is crossed by other important roads, linking Malaga to the inner areas of the peninsula. They include two national motorways, the non-tolled A-45 and the tolled AP-46, and some important regional roads. Among these, there are the A-357 (Guadalhorce motorway) and the A-404 to Alhaurín de la Torre (see their location in Figure 3 above).

Against such an articulated road network, the railway is characterised instead by higher degree of fragmentation. Malaga is served by a high-speed railway connecting the city to Madrid. However, there are currently no other direct and high-speed railway lines between Malaga and other Andalusian cities. Furthermore, the Mediterranean railway corridor, the main East-West Trans-European network providing multimodal link for the ports of the Western Mediterranean with the centre of the EU, does not provide a coastal direct link between Malaga and the port of Algeciras.

A light commuter rail service (the so-called *Cercanías*) is however operational between the Malaga city centre and towns in the province, both along the coastline and to the inner areas. Since July 2014 Malaga is also served by an 11.7 km long metro, with two lines covering the areas to the West and South-West of the city.

Figure 4. The E-15 Route (left-hand side) and Malaga light railway and metro network (right-hand side)



Source: Wikipedia and Andalucia.com[13]

1.2. *PROJECT OBJECTIVES*

Until 2011, the E-15 European route in the area of Malaga coincided with the MA-20 motorway, thus making it the motorway used by long-distance travellers along the Mediterranean coast. Since the MA-20 crosses the city of Malaga, it also serves local users. **Due to growing population, economic activities and incoming tourists in Malaga, already in the late Nineties the MA-20 was suffering from intense traffic and severe congestion during the peak hours** (7-9 am and 5-7 pm). In 2008 more than 180 thousand vehicles per day were using the MA-20, which was close to the road's maximum capacity of 200 thousand vehicles per day. In view of the future growth expectations of the area, the MA-20 bypass road was expected to collapse in few years.

[13] http://www.andalucia.com/cities/malaga/metro.htm.

The under capacity of the MA-20 road as respect to existing and forecasted traffic demand was causing several problems in the road transport system, specifically:

- Even if congestion was high during the entire year, it further intensified during the summer season, with long queues of cars entering and exiting the city to reach the destination sites along the coast.
- High congestion was linked to higher probability of collisions between vehicles, which could result in longer queues and greater bottlenecks.
- Travellers (both tourists, commuters and business travellers) from the inner area of Andalusia and directed to the coast, were forced to reach and use the MA-20 due to the lack of better alternatives. This was causing high congestion also on the regional A-357 road.
- Industrial, logistic and ICT areas located in the suburbs of the city were not served by adequate transport infrastructures and this was posing limits to their development and expansion. Most of employees of the technological park or freight traffic originating in the industrial area could only use the MA-20 and the A-357 roads, which were both highly congested.
- Long-distance travellers (especially freight traffic) not aiming to enter the city of Malaga but to pass over it, were still forced to take the MA-20 motorway. On the one hand this contributed to increase road congestion, as well noise and air pollution in the urban area of Malaga; on the other hand it severely hampered service reliability and timeliness of long-distance traffic. The problem was exacerbated by the lack of a direct rail connection between Algeciras and Malaga, which was inducing (and still is) higher freight traffic on road.

Before the new west bypass was opened and when the MA-20 was the only motorway crossing the city of Malaga, you could never be sure of how long you could take to reach the airport. (Source: interviewed taxi driver)

The Ministry of Infrastructure took the decision to build the new west bypass in Malaga together with the new AP-46 motorway, running for 28 kilometres in a north-south direction from Antequera to Malaga and joining the E-15 European route. The increasing traffic, especially of long-distance type, that the new AP-46 would have brought to Malaga, made the construction of a new bypass road even more needed. **The primary objective pursued by the Ministry with the implementation of the new bypass was to facilitate long-distance transport in the area of Malaga**, by deviating the European route E-17 from the inner MA-20 to the new external bypass A-7 and thus diverting the long-distance traffic to the new A-7 section. By allowing long-distance travellers to use an alternative route, the new west bypass road aimed at reducing travel time and improving the logistic connection of the city with the rest of the country.

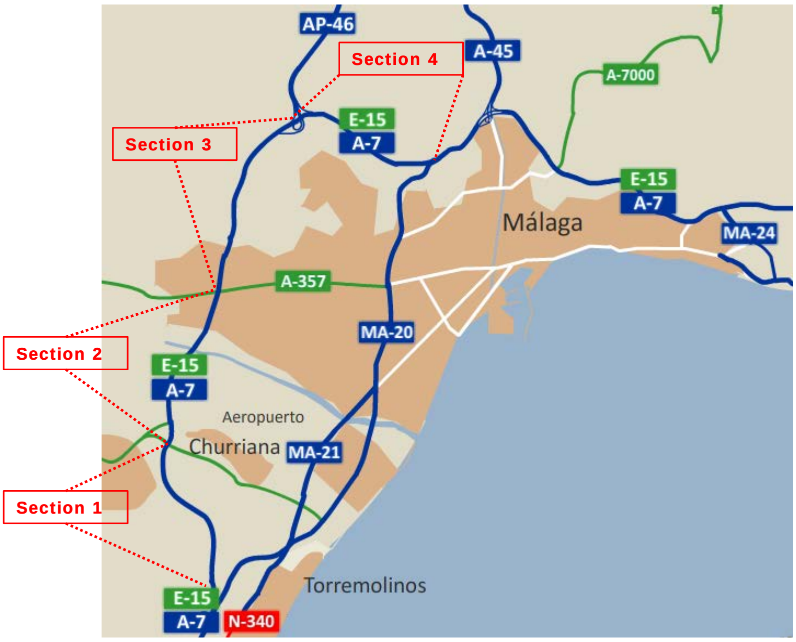
Thanks to the decongestion effect that this intervention would have realised along the MA-20, **the project was expected to produce two side objectives: i) reduced travel time for vehicles which would have continued using the MA-20, and ii) improved connection of the suburban areas of Malaga to the Mediterranean motorway and to the rest of the metropolitan area**. These objectives were regarded as very important by the municipal and regional authorities, as they would have affected primarily local users and tourism traffic.

Even if conceived by the Ministry of Infrastructure to serve primarily long-distance traffic, by its own nature a bypass has a critical importance also for an urban area and its users (see e.g. Collins and Weisbrod, 2000) and this was the case of the new A-7 section of Malaga too. **The dual function of the new west bypass and the dual interests for it, related to the Ministry's goal to improve long-distance transport and the municipality's ambition to improve local transport mobility, is an important feature of this project** to take into account when assessing the project's effect and determinant factors behind the project performance.

1.3. *STRUCTURAL FEATURES*

The project consisted of the construction of a 21.4 km road. It was a greenfield project, as no previous road was existing before along the same route. It crosses for most of its route the city of Malaga and in small sections areas belonging to the municipalities of Torremolinos and Aluahirín de la Torre. Although it was conceived as unique project, during the construction phase it was divided into the following four sections.

Figure 5. Route and sections of the new West Bypass of Malaga



Source: Own elaboration based on Wikipedia[14]

- Section 1 spans from the tolled highway AP-7 (Mediterranean motorway), nearby the city of Torremolinos, up to the intersection with the regional road MA-417;
- Section 2 goes from the intersection with road MA-417 up to the intersection with another regional road, the A-357 (Autovía del Guadalhorce) highway, crossing the river Guadalhorce through a 800 m long viaduct15 and surpassing the Malaga international airport from its north side;

14 https://es.wikipedia.org/wiki/Ronda_Oeste_de_M%C3%A1laga#/media/File:Mapa_MA-21_A-7_-_hiperronda.png)

15 More precisely, the viaduct is 840 m and 791 m long on the left and right carriageway respectively.

- Section 3 extends from the intersection with the A-357 and reaches the interconnection with the local road A-7075 and the tolled national motorway AP-46;
- Section 4 goes from the interconnection with the A-7075/AP-46 to the A-7 Mediterranean Motorway nearby the district of Ciudad Jardín, north of Malaga.

Since the bypass runs through a hilly area and surpasses a number of local roads, the project includes the construction of two bridges, eight viaducts, nine overpasses, fourteen underpasses and a 1,250 m long tunnel in the mountain Sierra Churrania. The road has a double carriageway, with four lanes per direction in three sections and three lanes in the fourth section.

The structural features of each section are illustrated in Table 1. Due to their complex structure and the special elements included in the road design, Sections 1 and 2 were the most costly and had the highest cost per Kilometer (respectively EUR 29.5 and 37 million per Km).

Table 1. Structural features and total cost of the four sections

PROJECT SECTION	LENGTH (Km)	NUMBER OF LANES	SPECIAL ELEMENTS	CONSTRUCTION COST	UNIT COST (EUR million per Km)
1	6	4	1 tunnel	EUR 177 million	29.5
2	3.9	4	1 bridge, 1 viaduct	EUR 145 million	37
3	5	4	1 viaducts, 5 overpasses and 12 underpasses	EUR 110 million	22
4	6.5	3	6 viaducts, a bridge, 2 underpasses and 4 overpasses	EUR 96 million	14.7
Total	**21.4**			**EUR 528 million**	

Source: Ministry of Infrastructure data provided upon request

Figure 6. View of the A-7 new west bypass road – the tunnel Churrania (left-hand side) and interconnection with the A-367 (right-hand side)

Source: Techniberia and OHL websites

In total the project investment cost was EUR 528 million including VAT, and 434 million net of VAT.[16] Construction works represented the highest share of cost, amounting to 86% of the total investment cost, followed by land expropriation cost (11%). The cost for monitoring and control activities during the construction works and design were a marginal share (2% and 1% respectively).

Table 2. Investment cost breakdown by project item

PROJECT ITEM	NOMINAL VALUE including VAT (EUR)	% ON TOTAL
Construction	453,429,413	86%
Expropriation	56,965,592	11%
Monitor and control	11,539,727	2%
Design	6,377,601	1%
Total	**528,312,334**	**100%**

Source: Ministry of Infrastructure data provided upon request

[16] These are ex-post costs. The official figure by the Ministry of Infrastructure amounts include VAT, which was equal to 16% until 2010, 18% in the period 2010-2012 and 21% after 2012.

2. ORIGIN AND HISTORY

2.1. *BACKGROUND*

After the transition from the dictatorship regime to democracy, between the late Eighties and the beginning of the Nineties the Spanish government significantly invested in the improvement of transport infrastructure nationwide. In this context, the first west bypass of Malaga, the MA-20, was implemented and opened to traffic in 1992. At that time the city of Malaga was lacking an articulated and high capacity transport network. **The MA-20 motorway was supposed to bypass the densely populated city centre** and alleviate the traffic congestion problems in the urban area of Malaga. **However, as the city continued its expansion westward, it became clear very soon that this new road would have provided only a short-term solution to the problem**. From 1992 to 2000, the average number of daily vehicles on the MA-20 almost doubled, passing from nearly 50,000 to 92,000 (+84% in eight years). The share of heavy vehicles increased from 2% in 1992 to 10% in 2010, which underlines the growing trend of long-distance freight traffic along the Mediterranean coast axis.

Being the MA-20 a national motorway, the municipality asked the Government for a solution to address the congestion problems in Malaga. **The municipality advocated the construction of new bypass, passing farther from the city centre and ensuring a better accessibility to the industrial zones that were developing in the outskirt of the city**. In 1997 a preliminary study for a second bypass in Malaga was drafted by the Ministry of Infrastructure, which led to the drafting of a preliminary informative study in 2001. Four technical options were designed, each one characterised by slightly different alignments of the new west bypass. As foreseen by the national legislation, a public consultation process was launched, followed by the Environmental Impact Assessment by the Ministry of Environment. On the basis of a multi-criteria analysis putting together technical, financial and environmental considerations, an option was selected as the most favourable alternative out of the four.

The project for a new bypass road of Malaga was included in the Strategic Plan for Infrastructure and Transport (PEIT) published by the Ministry of Infrastructure in 2005 and covering the medium-long term investment needs in the country. The PEIT envisaged a total investment of EUR 241 billion between 2005 and 2020, out of which EUR 60.6 billion for motorway infrastructures.[17] The bypass project was seen by the Ministry as an essential building block of a network of freight transport corridors of national and international relevance. In fact, it was not only a section of the Mediterranean motorway, but the junction between the coastal motorway and the new radial motorway between Antequera (Alto de Las Pedrizas district) and Malaga (AP-46), which was also under design at that time.

Due to the strong relationship between the Malaga bypass and new AP-46 projects, between 2003 and 2004 the Ministry of Infrastructure prepared a joint technical study

[17] Source: Ministry of Infrastructure, 2005a. PEIT: Plan estratégico de infraestructuras y transporte. Ministerio de Fomento, Centro de Publicaciones, Madrid. http://www.fomento.es/MFOM/LANG_CASTELLANO/_ESPECIALES/PEIT/

and traffic forecast model for the two motorway sections. In this preliminary design, the two projects were supposed to be implemented as a unique contract and managed by a private concessionaire selected with open tender. This also meant that, just like the AP-46, the Malaga bypass could have been tolled. An alternative idea was to use the revenues originating from the AP-46 to cover also the construction and operational cost of the Malaga bypass. **Eventually the Ministry decided to split the two projects and to take full ownership of the construction and implementation of the Malaga bypass section, without imposing any toll on direct users**.

Table 3. Milestones of the project 'New West Bypass road of Malaga'

YEARS	MILESTONES
1997	Preliminary study of the "Segunda Ronda de Circumvalacion Oeste de Malaga"
2001	Informative study «Autovia del Mediterraneo, N-340, Nueva Ronda de Circunvalacion Oeste de Malaga»
2002	Public consultation process launched by the Ministry of Infrastructure and drafting of the Technical report replying to the allegations
2004	Environmental Impact Assessment Final approval of the Informative study and selection of Option 2 Draft of the detailed project Blueprint ("Anteproyecto") Second public consultation on the project Blueprint
2005	Final approval of the project Blueprint ("Proyecto")
2005	Publication of the Strategic Plan for Infrastructure and Transport (PEIT)
2006	Drafting of the detailed design for the four sections of the new bypass
2006-2007	SEITT awards the construction contracts to four companies Land expropriations
04.2007	Start of construction of the new bypass of Malaga
13.10.2009	Application for ERDF co-financing
21.12.2009	European Commission's co-financing decision - C(2010) 10586
28.12.2010	Started operation of Sections 3 and 4 of the new bypass
28.10.2011	Started operation of Sections 1 and 2 of the new bypass Started operation of the AP-46
12.03.2014	European Commission's decision to revise the co-financing rate of the Andalusia Regional Operational Programme ERDF 2007-2013 - C(2014) 1488

Source: Authors

The new bypass is not the only important transport investment project in Malaga that was approved in the early 2000s. Other projects initiated by the central government included the high-speed railway Madrid-Malaga, inaugurated in 2007, and the enlargement of the Malaga airport with the opening of the second runway in 2012. It is worth to mention that the Minister of Infrastructure in charge between 2004 and 2009 had been previously elected as member of the Congress of Deputies for the province of Malaga. Under her legislation and thanks to the impulse given by the PEIT, Spain became the third country in the world with more kilometres of motorway and highway, only behind the United States and China.

I think there are two investment projects that stand out above the others for what they will mean for Malaga, that they will change Malaga: the airport and the second bypass […]. The second bypass will end traffic jams and will give a huge vitality to the traffic of the entire province, and interestingly, the airport will bring more traffic to the road because many people will enter through it. (Source: Press interview to the Minister of Infrastructure 2004-2009)[18]

Box 2. Complementary projects

- The motorway Alto de Las Pedrizas – Malaga (AP-46) is a 28 Km motorway implemented to provide an alternative route to the existing A-45, which represented the only North access to the city of Malaga and its metropolitan areas. Construction works lasted 22 months and the motorway was opened in October 2011. The implementation and management were entrusted to a concessionary company.[19] The AP-46 is tolled, with a differentiated tariff by months (higher during summer) and by hour of the day: the motorway if free for light vehicles travelling from midnight to 6am and for heavy vehicles travelling overnight from 10pm to 8am. It construction cost was above EUR 400 million.
- In June 2012 the second runway of the Malaga International Airport was opened. Investment costs borne by the Ministry of Infrastructure included EUR 474 million for construction and EUR 168 million for expropriations. The runway is currently used only during the summer period of the year. The only existing access to the airport is from the South side. A North access connecting the airport directly to the new west bypass is planned to be implemented in the near future (see section 2.3 below).

2.2. *FINANCING DECISION AND PROJECT IMPLEMENTATION*

After the decision to uncouple the Malaga bypass project from the AP-46 project, **another important change in the project design was made by the Ministry of Infrastructure just before the start of construction works**. The project Blueprint (2004) and the final construction project (2006) provided the technical specifications of the project. They specified that the new bypass would have had two or three lanes per carriageway, depending on the section, and that sufficient space would have been left between them for a possible enlargement to three and four lanes, in case of future need. However, before contracting the works, the Ministry of Infrastructure carefully reviewed the assumptions of the traffic model. In particular, the future traffic scenarios were reconsidered on the basis of more updated data on traffic growth. A decision was taken to equip the new bypass with three and four lanes for each running direction since the very start of its operational phase.

Since the preliminary project dossier already envisaged the possibility of a future enlargement of the bypass, the Ministry considered not to be necessary to formally revise it. The implementation phase started immediately afterwards. In 2006 the State Company for Land Transport (SEITT) was entrusted by

[18] http://www.diariosur.es/20080511/malaga/magdalena-alvarez-nuevo-aeropuerto-20080511.html.
[19] Ministry of Infrastructure, 2005b.

the Ministry of Infrastructure the project implementation. Between December 2006 and February 2007, SEITT awarded the construction of the four sections of the new bypass to four different private companies. Around 500 workers participated in construction activities. Field work was supervised and coordinated by two technical directors appointed by the Ministry.

The environmental mitigation measures required by the Environmental Impact Assessment were implemented.[20] Among these, the most significant were the inventory and transplant of native or interesting trees, the chameleon protection program, the replenishment of livestock trails, acoustic protection screens and the plan for the prevention and extinction of forest fires.

The large size of the carriageway and the large number of special elements along the route, such as the tunnel, viaducts and interconnections with other roads, made the **project implementation relatively complex**. Moreover, in 2009 heavy rains caused a flood of the river Guadarlhorce, which affected the work site and caused some delays. Another factor of complexity was the need to coordinate works with the ongoing construction of the AP-46 motorway and, particularly, the interconnection between the two roads. The A-7 had to be ready for service when the AP-46 was expected to be open. The implementation of Sections 3 and 4 of the bypass were given higher priority and were opened to traffic on 28 December 2010. Section 1 and 2 were inaugurated on 27 October 2011, the same day when the AP-46 started being operational. Overall, the new west bypass of Malaga was opened with 25 months of delays.

Figure 7. Inauguration of the first half of the new west bypass of Malaga (28 December 2010)

Source: Ministry of Infrastructure webpage[21]

Note: The Minister of Infrastructure, José Blanco, the president of the Region Andalusia José Antonio Griñán, and the major of the city of Malaga, Francisco de la Torres Prados, attended the inauguration

Cost of land expropriation much higher than what originally forecasted (+73%), the decision to enlarge the road's size to three/four lanes, the project technical complexity, and force majeure events, such as the river's flood, resulted in **higher investment cost as compared to official estimates included in the 2006**

[20] The Environmental Impact Assessment is a national requirement for projects of this kind.

[21] http://www.fomento.gob.es/MFOMBPrensa/Noticias/El-Ministerio-de-Fomento-pone-en-servicio-la-mitad/1196a39d-3101-4ee0-a7fa-46dbd2c987f6.

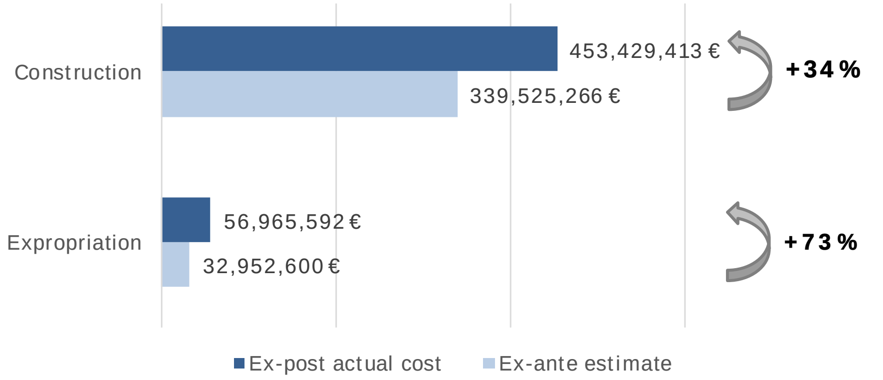
project dossier. More specifically, construction costs raised from EUR 340 million to EUR 453 million (+34%).

Table 4. Planned and actual calendar of construction works and months of delays by road section

Road's section	Planned construction period	Actual construction period	Months of delays in project completion
1	04/2007 - 01/2010	04/2007 - 10/2011	21
2	04/2007 - 01/2010	04/2007 - 02/2012	25
3	04/2007 - 12/2009	04/2007 - 06/2011	18
4	05/2007 - 12/2009	05/2007 - 04/2010	4

Source: Authors based on the project dossier and press release.

Figure 8. Ex-ante and ex-post deviation of construction and expropriation cost (nominal terms, VAT included)[22]



Source: Authors based on the project dossier and data provided by the Ministry of Infrastructure upon request

The project was co-financed by the Ministry of Infrastructure through its implementing body, SEITT, and the European Regional Development Fund (ERDF). The new west bypass of Malaga was funded under the Operational Programme (OP) ERDF Andalusia 2007-2013, under the Axis "Transport and Energy". In fact, during the 2007-2013 programming period, the Spanish regional OPs could include both national and regional measures of intervention, which were managed either by the national Managing Authority (Ministry of Finance and Public Administration) or by the regional authority, depending on the type of investment. As far as transport projects were concerned, investments targeting the local and regional transport network felt under the Region's responsibility; conversely, investment projects of national relevance were directly managed by the State.[23] This was the case of the Malaga bypass project. Since it was affecting a national and European corridor and it was embedded in the PEIT, the national government took full responsibility for it and the Region did not participate in the project financing.

[22] For a direct comparison between ex-ante and ex-post cost estimates to be made, it is preferred to use the Ministry's official figures, which include VAT.

[23] In the current programming period, in order to simplify the EU funds management and audit, all regional OPs have only regional co-financing and all national investments have been concentrated in a multi-regional programme.

In October 2009, when the bypass was already under construction, the Ministry of Finance and Public Administration on behalf of SEITT, submitted to the European Commission the application for ERDF co-financing. The requested Community contribution amounted to EUR 190 million, equal to 65% of the eligible construction costs. In December 2009, the Commission approved the co-financing decision.[24] **No requests for clarifications were asked or observations made by the Commission**.

Since the project dossier was not modified after the decision to expand the bypass track, the information that the Commission received about the project were not reflecting the latest characteristics of the road under construction. Moreover, the ex-ante Cost Benefit Analysis submitted by SEITT was referring to the 2006 project design, traffic demand assumptions and estimated investment cost, which had never been revised ever since.

In order to support the Spanish economy recovery from the crisis and ensure it had enough resources to complete the investment projects already started, in 2014 the Government of Spain and the European Commission agreed to increase of the EU co-financing rate applying to some regional OPs, among which the Andalusia regional OP. The EU co-financing rate increased from 65% to 80%.[25] As a direct consequence, the Community contribution for the Malaga bypass major project was recalculated and rose to EUR 234 million. This amount corresponds to 80% of the same eligible construction costs presented in the project dossier. This means that **all incremental costs that the modification in the project design caused were entirely covered by SEITT through funds of the Ministry of Infrastructure**. It also means that, if a correct cost estimation had been provided by SEITT to the Commission, the Community contribution, estimated by applying the same co-financing rate to a higher eligible construction cost, could have been higher.

2.3. *CURRENT PERFORMANCE AND OTHER INVESTMENT NEEDS*

The opening of the new west bypass of Malaga immediately diverted a share of vehicles away from the old bypass (MA-20) to the new one. The number of daily vehicles running in the central and most congested section along the MA-20 decreased by over 50,000 vehicles in 2015, as compared to the hypothetical situation without the project, where the MA-20 traffic would have continued increasing following its historical trend (see Figure 9 below).

The share of heavy vehicles on the MA-20 decreased from an average of 8% before the project implementation, to 4% in 2015, thus confirming that a share of the long-distance freight traffic was redirected to the A-7 new bypass.

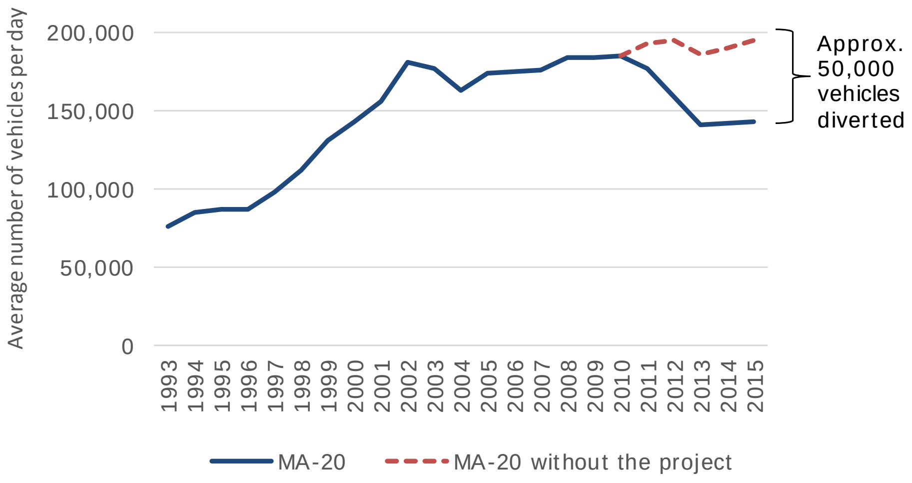
The traffic on the new bypass reached in 2015 40,000 vehicles as an average over the entire route. Section 2 is the busiest one, with more than 57,000 vehicles in 2015. Its location between two important regional motorways, the MA-417 and the A-357, makes it the most used by both light and heavy vehicles. The share of the latter is 7.5% over the total number of vehicles and is expected to reach 10% in the

[24] Decision C(2010) 10586 final dated 21.12.2009.

[25] Decision C(2014)1488 final dated 12.03.2014.

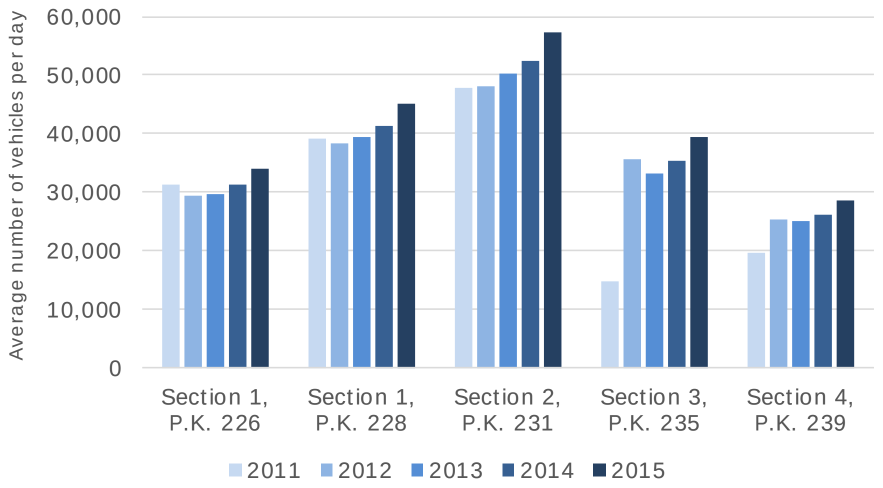
near future.[26] These traffic data are overall in line with the last estimates made during the project design phase, which were supposing about 55 thousand users for the new bypass in the first years after its opening.[27]

Figure 9. Daily traffic intensity on the MA-20 motorway, central section (Km 6.9) (1993-2015)



Source: Own elaboration based on historical data by the Ministry of Infrastructure.

Figure 10. Daily traffic intensity on the A-7 new bypass motorway recorded by five traffic metering stations (2011-2015)



Source: Own elaboration based on historical data by the Ministry of Infrastructure.

In addition to traffic diverted from the MA-20, the new bypass attracted a small share of new traffic. Based on data provided by the Ministry and interviews to stakeholders, the share of induced traffic is approximately assumed at 10%. Induced traffic may be to some extent due to a sort of "novelty effect" of the new bypass in the very first years after its opening, but also to an increase of road users which before were using other transportation means or preferred not to travel at all to/from Malaga because of the highly congested road network.

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[26] Source: Ex-ante traffic estimates.

[27] http://www.europapress.es/andalucia/malaga-00356/noticia-ponen-servicio-tramos-hiperronda-estara-completa-2011-junto-autopista-pedrizas-20101228202223.html.

The maximum speed on the A-7 bypass is generally 100 km/h, allowing a 120 km/h speed only in some segments. The average speed recorded by the metering stations in all sections of the new bypass is over 110km/h for light vehicles, thus above the maximum speed limit. Average speed is 92 km/h for heavy vehicles. Since 2011, the average speed recorded on the MA-20 is lower (92 Km/h for light vehicles and 83 km/h for heavy vehicles), but the occurrence of bottlenecks during the peak hours has significantly reduced.

Traffic on the new bypass is expected to maintain a positive growth trend in the future as an effect of the continuous expansion of economic activities in Malaga and the sustained growth of tourists and population. According to our forecasts, also based on future scenarios developed by the Ministry of Infrastructure before the project implementation, the number of daily vehicles on the A-7 will steadily increase and approach 85,000 vehicles on average by year 2035. The central and busiest section will likely exceed 140,000 vehicles per day. The current road configuration, with its three and four lanes, provides sufficient capacity to accommodate such traffic. Actually, ex-ante forecasts of the Ministry showed that, without any modification to the project design, a 2/3 lanes bypass could have faced capacity problems already in its first decade of life.

> ***The new west bypass of Malaga is a project conceived and implemented with the future in mind. (Source: interviewed representative of SEITT)***

In order to ensure an increasing number of users on the bypass, some complementary investment are needed. The project could not solve all the problems of the road network in the metropolitan area of Malaga. **Existing deficiencies affecting the roads nearby or crossing the new bypass prevent to exploit the full potential of the A-7 bypass and to reach all its intended objectives**. Additional investments have already been planned to solve some deficits, but for others a long-term solution still has to be found by the responsible administrations.

More specifically, even if the Malaga bypass offers an excellent solution for long-distance travellers who are now no longer obliged to cross the city of Malaga through the highly congested MA-20, **the conditions of the A-7/E-15 Mediterranean motorway immediately before and after Malaga are critical**. Traffic is growing along the entire Costa del Sol and having the motorway passing within the city centres, as it was with the MA-20 in Malaga, is no longer a viable and sustainable solution. Discussion about a possible bypass in the municipalities of Torremolinos, South of Malaga, and Rincón de la Vitoria (North-East) have just started. These bypasses would provide direct continuation to the existing Malaga bypass, running parallel to the coast but outside the urban areas. The responsibility for designing and implementing them would be with the Ministry of Infrastructure.

The objective of reducing travel time for urban travellers and tourists that use the MA-20 has been achieved at the moment. However, **the new bypass has only temporarily alleviated the traffic mobility problems in the city**. Traffic growth rates indicate that the MA-20 will still face congestion issues in the next years. A long lasting solution involves the implementation of the following investments:

- **The capacity expansion of the MA-20**. The Ministry of Infrastructure is planning to enlarge the south section of the road, nearby the airport, by adding one lane for each running direction.
- **The improvement of other light urban transport modes**, among which the metro and the light railway (*Cercanías*). As to the former, in the Infrastructure Plan for the Sustainability of Transport in Andalusia (Plan PISTA 2020), signed in December 2016, the Region of Andalusia has committed to finalise the extension of the Malaga metro line until the neighbouring municipality of Rincón de la Vitoria. As to the latter, the Ministry of Infrastructure has just started to design an extension of the railway until the city of Marbella, South of Malaga, one of the most important tourist destination of the Costa del Sol. The design phase would take at least four years, meaning that construction would not start before 2022.[28] Both the projects would contribute to reduce road traffic on the MA-20.

Significant additional investments are also needed to completely achieve the third objective of the new bypass project, i.e. ensuring better connection of the suburban areas of Malaga to the city and the rest of the metropolitan area. **The bypass has improved accessibility and connection to these areas, but the regional and local transport network has not been upgraded**. The high traffic intensity generated by the industrial and logistic areas and the Technology Park demands for new transport solutions, and at the same time new transport solutions are needed to push the economic growth of Malaga.

Figure 11. Bottleneck at the A-7 exit to Alhaurín de la Torre

Source: Google map

Note: The screenshot was taken on 7 February 2018 at 7.45 am.

An example of poor connection between the bypass and the local road network, is the A-7 exit to the municipality of Alhaurín de la Torre. Vehicles coming from the bypass and directed to Alhaurín, have necessarily to take the one-lane regional road A-404. The intense traffic causes bottlenecks especially during peak hours (see the Figure 11 below and the picture on the cover page of this report). **An enlargement of the A-**

[28] Press news, 2017. http://www.diariosur.es/malaga/fomento-retoma-prolongar-20170707222332-nt.html.

404 road would be desirable. At the moment of writing, there are no concrete plans by the Region to implement this investment.[29]

A similar situation occurs in the district of Campanillas, where the access to the Technological Park of Andalusia is located. The Park currently employs 18,000 people, most of which are daily commuters, and is planning an expansion in the next 15-20 years that would welcome up to 20,000 more employees. The regional roads A-357 and A-7056 that link the west bypass to the Park are unsuitable to sustain the huge volume of traffic entering and exit the Park every day, especially in the early morning and late afternoon. **Every day, long queues of cars generate and cause inconvenience and irritation among the local population**, as frequently reported in the press.[30] Some vehicles have even started passing through the fields along private pathways to avoid the traffic jam on the main road (see picture below).

> ***The access road to the Technological Park is more like a "sheep path". Vehicles cross over fields and small rivers to get out of traffic. The situation is unbearable. Traffic is out of control and hinders mobility in Campanillas. (Source: interviewed representative of the Association of Neighbours of Campanillas)***

The Region's Plan PISTA 2020 foresees a partial enlargement of the A-7056 road, for a cost of around EUR 10 million, which however would provide only partial and short term solution to the problem. Since when the design of new west bypass of Malaga was under preparation, the Technological Park has been advocating for the implementation of a direct link between the Park and the bypass. During the public consultation phase, the representative of the Park submitted to the Ministry of Infrastructure different ideas, but none of them were retained, on the ground that the Region should be responsible for such an investment, not the Ministry.

Figure 12. Bottleneck to enter and exit the Technological Park of Andalusia

Source: Press[31] (left-hand side) and Association of Neighbours of Campanillas (right-hand side)

[29] Press news, 2018. http://www.laopiniondemalaga.es/municipios/2018/02/05/villanova-clama-desbloqueo-proyectos-desarrollo/984968.html.

[30] For instance: El Mundo (2014). http://www.elmundo.es/andalucia/2014/08/14/53eca6f6268e3e743b8b457a.html; La Opinion de Malaga (2017). http://www.laopiniondemalaga.es/malaga/2017/10/01/barrio-atascos-eternos/958921.html; Malaga Hoy (2018). http://www.malagahoy.es/malaga/solucion-PTA-pendiente-administracionesLas-extranjeras_0_1183681889.html

[31] Diario Sur, 2017, "Un carril bus y un acceso desde la Hiperronda, propuestas contra los atascos en el PTA", http://www.diariosur.es/malaga-capital/carril-20171021222928-nt.html

The extension of the Malaga metro line until the Park is another option that has been proposed and discussed by the Malaga and Campanillas representatives. This alternative option would reduce the number of commuting vehicles on roads and improve mobility in Campanillas. However there are currently no plans to make this idea come true in the near future.

The industrial and logistic zones localised east of the new bypass are suffering from road congestion too. Thousands of trucks enter and exit every day from the industrial areas and, in order to reach the A-7 motorway, have to cross a network of local and regional roads whose capacity is largely inadequate. **The need to ensure proper connection of the Malaga industrial area to the A-7 was already clear at the time when the by bypass was designed**. In 2003, the Region Andalusia drafted the project “West Metropolitan Distributor Road of Malaga”, a 6 km road running parallel to the A-7 and connected to it at two of its exits. The Distributor Road was aimed to collect the traffic originating from the industrial poles and fasten their access to the bypass. The same road was also expected to provide a North access to the airport. The estimated investment cost amounted to EUR 56 million.[32] The project was awarded in 2009 but construction never started because of financial difficulties encountered by the Region in a period of economic crisis and budgetary constraints.

Figure 13. Plan of the West Metropolitan Distributor Road

Source: Region Andalusia (2009)

In order to provide a quick solution to the problem of the missing North access to the airport, the Ministry of Infrastructure and AENA (the State-owned company managing the airports in Spain) agreed to realise a road to link the airport to the A-7, which would serve the airport users only. In October 2017 the construction works were tendered for a total investment cost of EUR 42 million. According to interviews, the opening of a direct access from the A-7 to the airport will deviate some of the traffic now using the coastal MA-20 and MA-21 motorways, thus increasing traffic on the bypass.

The responsibility to realise the Distributor Road serving the industrial area remains under the Region’s responsibility. In September 2007 the Regional Government

[32] Junta de Andalucia, Consejeria de Transporte y Vivienda, 2009, Vial Distribudor Oeste de Malaga, http://slideplayer.es/slide/1108391

approved its construction, by including the project into the Plan PISTA 2020, for a total cost estimate of approximately EUR 40 million.[33] Unlike the previous design, this road would be separate from the access road to the airport; both new roads would be linked to the A-7 in its junction leading to Alhaurín de la Torre, running one parallel to the other.

[33] Source: Interviews.

3. DESCRIPTION OF LONG-TERM EFFECTS

This chapter presents and discusses the main long-term effects produced by the project. 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 is considered under the following four main categories: economic growth, quality of life and well-being, environmental sustainability and distributional effects.

The **economic growth** aspect includes the quantifiable benefits derived from shorter travel time for long-distance and local users of the new west bypass of Malaga, especially thanks to the decongestion effects on the MA-20, as well as some vehicle operating cost savings arising from improved transport service and reduced congestion in the local urban network. These effects are incorporated in the Cost Benefit Analysis (CBA).

The project contributes to **social well-being and quality of life** by reducing traffic noise in the urban area of Malaga, thanks to the diversion of traffic to the new west bypass, which crosses a suburban and mostly industrial area. On the other hand, the increasing traffic produces a higher number of accidents on the new bypass. The benefit from noise reduction and the socio-economic cost of safety almost compensate each other in the CBA.

Mixed effects are observed also as far as **environmental sustainability** is concerned. While the induced traffic on the new bypass generates incremental CO_2 emissions, with a negative impact on global climate change, the traffic diversion from the MA-20 to the A-7 road produces a reduction of air pollution in the urban area.

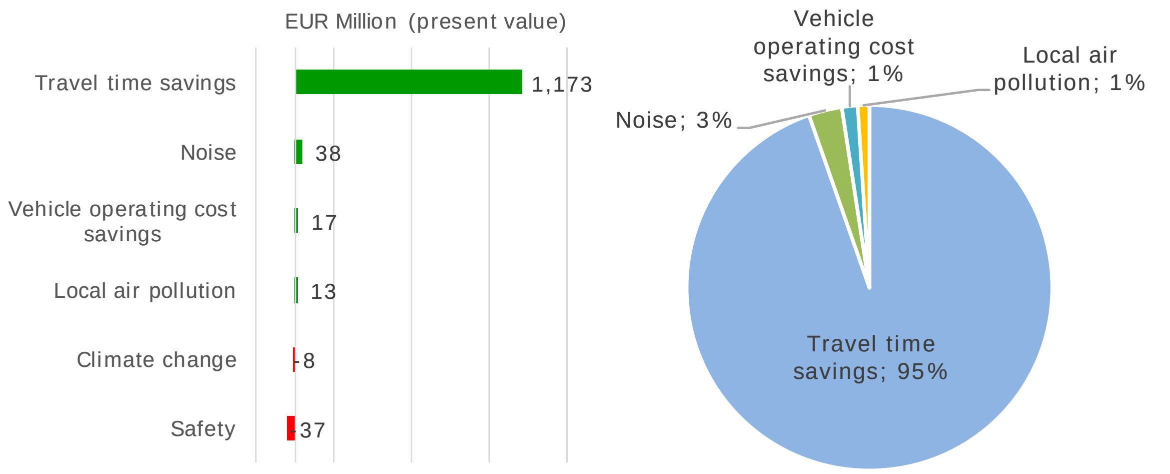
In addition to these measurable impacts, there are other effects difficult to be captured in monetary terms, but relevant for the comprehensive assessment of the project, which are discussed in the following sub-chapters. Among these, positive **distributional effects** are generated by the project thanks to improved accessibility of the peripheral areas of the province of Malaga.

The results of the CBA, included in the Annex II of this report, indicate that the project adds value to the European society under the social and economic point of view, when compared to a Business-As-Usual scenario, where no west bypass is build and the MA-20 continues being the only motorway to North-South bypass the city of Malaga. **In the baseline case, the Socio-Economic Net Present Value (ENPV) equals EUR 600.5 million, whereas the Economic Internal Rate of Return is at the level of 7.61%**.[34] These results show that the project yields positive socio-economic net benefits. As confirmed by the probabilistic risk analysis, the CBA results are robust to future possible variations in the key variables and the project has a negligible risk

[34] A social discount rate of 2.88% before 2017 and of 3.22% for the future years were applied.

level. The distribution of benefits in the CBA is presented in the figure below. All assumptions underlying the benefit and cost estimations are presented in Annex II.[35]

Figure 14. Present value of the socioeconomic benefits and costs (left-hand side); share of benefits on the total benefits (right-hand side)



Source: Authors

The table below summarises the nature and strength of the project's effects, as well as the territorial levels where these are visible. The time-horizon of their materialisation is shown in section 3.6.

Table 5. 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	+5	Local – regional - national
	Vehicle operating cost	+2	Local – regional - national
	Reliability of journey time	+2	Local - regional
	Income for the service provider	N.R	
	Wider economic impacts (development of industrial areas)	+2	Local - regional
	Learning effect**	+1	National
Quality of life and well-being	Safety	-2	Local - regional
	Service quality	N.R.	
	Security	N.R.	
	Noise	+2	Local
	Crowding	N.R	

35 The ex-ante CBA returned a positive, and much higher, result: the ENPV was equal to EUR 4.95 billion, the EIRR was estimated at 46%. While the purpose of the evaluation is not to compare ex-ante and ex-post CBAs and the results of these assessments cannot be easily compared due to different underlying methodological assumptions, the main cause of discrepancy is due to the change in the scope of the project. In both the analyses, however, the most important benefit of the project is referred to the travel time savings for both users of the new bypass motorway and the old MA-20 road.

	Aesthetic value	N.R	
	Urban renewal	No data	
Environmental sustainability	Local air pollution	+1	Local
	Climate change	-1	Local – regional – global
	Biodiversity	N.R.	
	Water pollution	N.R.	
Distributional issues	Social cohesion	N.R.	
	Territorial cohesion	+2	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 THE ECONOMIC GROWTH*

Measurable effects

The most important positive effect produced by the project is a reduction of travel time for all types of vehicles bypassing the city of Malaga on both the MA-20 and the A-7. Such an effect concerns not only long-distance traffic and commuters to the suburban areas (e.g. people working in the Technological Park) which can now use the new west bypass road, but also the local population and tourists who travel within the urban area, mainly along the MA-20.

As emerged from interviews, **the greatest travel time saving is produced for vehicles using the MA-20 mid-section during the peak hours**. They save on average 14 minutes after the project implementation. Traffic diverted from the MA-20 to the A-7 also enjoyed some travel time savings compared to the situation before the project. They save 10 minutes to travel from north to south of Malaga along the A-7 as compared to the counterfactual scenario. The time saving is lower than for MA-20 users, due to the longer length of the A-7 (21.4 Km vs 11.4 Km).

The benefit produced by the new bypass is expected to further increase in the future, since its capacity allows it to accommodate the growing traffic that is expected in the future; on the contrary, the increasing traffic on the MA-20, especially in its mid-section, will generate in the next years new bottlenecks in the road. The Ministry's plan to partially enlarge the southern section of the MA-20 will only partially alleviate the problem.

The travel time benefit for both A-7 and MA-20 current users was quantified and valued against the hypothetical scenario where the project was not implemented and the MA-20 continued being the only road bypassing the city. Overall, travel time savings represent 95% of the project's benefits.

Even if the new bypass is two times longer than the older one, the project is expected to produce vehicle operating cost savings over its entire life time. **The fuel consumption for vehicles running along the MA-20 road in the scenario without the project would be higher**, due to higher traffic congestion.[36] The higher cost of fuel for running along the A-7 is therefore outweighed by the higher fuel consumption for vehicles using the MA-20 in the hypothetical counterfactual scenario. This benefit is however marginal, representing 1% of the benefits captured by the CBA.

Non measurable effects

A more remarkable effect of the project is the wider economic benefit around the bypass, i.e. its positive contribution to the development of the industrial areas. The director of the Technological Park recognises that the construction of the new west bypass was essential for sustaining the growth of the park. The representative of Mercamalaga, the largest wholesale market of Western Andalusia, extending for over 300,000 mq nearby the bypass route and hosting 130 enterprises, declared that their logistic firms have grown considerably. Today the occupancy rate in the area has reached 100%.[37] The Association of Industrial and Commercial Zones and Parks of Malaga and province confirms that those enterprises located nearby the bypass and having easy access to it could benefit from a competitiveness advantage as compared to the previous situation, thanks to reduced travel time. No similar benefits were enjoyed by industrial poles localised in a more distant position from the bypass, which still have to use small and congested local roads before reaching the motorway. The implementation of complementary investments, such as an improved access to the Technological Park or the Metropolitan Distributor Road, would have further reinforced the wider economic development benefit. In line with the current CBA practice (EC Guide 2014; EIB 2013, OECD/International Transport Forum 2008, 2016), these wider economic impacts have not been measured in quantitative terms.

Interviews to local stakeholders have highlighted that, thanks to improved road service ensured by the MA-20 after the project completion, **the reliability of journey time for the taxi and local public services has increased too**. The journey time to reach the airport through the MA-20, for instance, is now shorter and more predictable. The benefit could be expressed by the users' willingness to pay for reaching their destination point on time. No specific quantification of this benefit was made in the CBA due to lack of data.

[36] The relationship between traffic congestion and fuel consumption is widely explored in the empirical literature. See for instance Treiber (2008).

[37] Source: Own interviews.

An additional, although marginal, positive effect that is worth mentioning is the learning-by-doing benefit for the project designers. The technical complexity of some parts of the new bypass required to design ad-hoc and innovative solutions. For instance, the viaduct nearby the airport has a sill plate surface which is one of the biggest realised in the last years. The words pronounced by the SEITT representative during the interview explain well the essence of the learning effect generated by the project:

> ***No innovative or disruptive technologies were required to construct the new bypass. However, its extraordinary size and some peculiar elements along its track required careful design. We could draw some lessons from that.***
> ***(Source: Interviewed representative of SEITT)***

3.3. *EFFECTS ON QUALITY OF LIFE AND WELL-BEING*

Measurable effects

By diverting a share of traffic from the MA-20 to the new A-7 bypass, **the project contributes to improve the quality of life for the local population, by reducing noise in the urban area**. This effect was quantified in the CBA by estimating the socio-economic cost produced by noise for each vehicle kilometre on the A-7 and the MA-20 motorways, distinguishing between light and heavy vehicles, as well as night and day traffic. Interestingly, even if the project induces some new traffic on the A-7, thus producing negative noise externalities, the diversion of traffic away from the urban area crossed by the MA-20 to a more suburban area produces a benefit.[38] When comparing the current situation with the counterfactual scenario, a net noise cost reduction is found. Its present economic value is estimated at EUR 38 million and represents 3% of the total project's benefits. Even if its contribution to the overall project performance is minor, this is the second largest project benefit that was valued in the CBA.

The project affects the quality of life and wellbeing of travellers in Malaga in another way. Historical data, available only from 2006 to 2017, show that after the opening of the new bypass, a lower number of accidents of any types was recorded on the MA-20. **The number of accidents[39] on the A-7 is expected to increase over time, due to higher speed of vehicles**, in many cases travelling even beyond the legal limit, and increasing traffic.

As traffic on both roads increases, the project produces a negative safety effect for travellers. This negative effect is partially compensated by a positive effect. The traffic growth on the MA-20 and the amplification of the congestion problem in the counterfactual (without-the-project) scenario, would reduce the average travel speed on the MA-20 and prologue the vehicles queues. As empirically shown by the literature (for a review, see Marchesini and Weijermars, 2010), congestions make the risk of occurrence of fatalities and severe injuries decrease and the risk of slight injuries increase. Therefore, **the higher number of accidents on the A-7 is partially**

[38] This is due to the application of a lower socio-economic unit cost for noise produced in a suburban rather than urban area.

[39] Expressed per vehicle kilometer.

offset by a reduction of severe accidents and an increase of light damages in the counterfactual scenario. Overall, the effect over the entire time horizon of the project is negative. Safety effects represent a socio-economic cost of the project, which reduces the project Net Present Value by EUR 36.8 million.

Table 6. Average number of accidents per year before (2006-2011) and after (2012-2017) the opening of the new bypass

ROAD	TYPE OF ACCIDENT	AVERAGE 2006-2011	AVERAGE 2012-2017	% CHANGE
New bypass A7	Fatality	-	1	
	Severe Injury	-	2	
	Slight Injury	-	27	
Old bypass MA20	Fatality	3	1	-60%
	Severe Injury	4	3	-21%
	Slight Injury	94	74	-21%

Source: Authors based on data provided by the Ministry of Infrastructure and the Municipality of Malaga.

Non measurable effects

If the positive effect from noise saving is summed to the negative effect of higher road accidents, the project's net impact on quality of life turns out to be (marginally) negative. Yet, even if it is true that, without the project, a lower number of serious accidents would have occurred on the MA-20, the growing traffic congestion would have brought road users to exasperation. By preventing the MA-20 from totally collapsing, the project produced a positive effect which, although not been measurable, is clearly perceived when talking with the local population.

Interviewer: "As a user, are you satisfied of having the new bypass today?"
Interviewee A: "Absolutely, the new bypass is spectacular"
Interviewee B: "I recently travelled to Malaga and I wonder how those people could live there before this bypass"
Interview C: "Not only I'm satisfied, I'm proud of it"
(Source: different stakeholders interviewed)

Moreover, by improving mobility in the city of Malaga and reducing noise and air pollution in the urban area, the project may have in principle brought other positive spillover effects to residents, which could possibly be reflected in an increase in real estate values. Although an assessment of this benefit was attempted through the interviews, neither quantitative data nor qualitative evidence was found to either confirm or disconfirm that such effect occurred. **If any urban renewal effect existed, it would probably be negligible** as compared to the other quantified benefits.

The same applies to the project impact on the landscape's aesthetical value. In spite of the big size of the infrastructure, this effect is not perceived as particularly significant by any of the stakeholders interviewed.

3.4. *EFFECTS ON ENVIRONMENTAL SUSTAINABILITY*

Measurable effects

Traffic induced on the A-7 bypass is only a small share as compared to traffic deviated from the MA-20. Even so, **induced traffic generate some greenhouse emissions** whose socio-economic value can be estimated. By applying the unit cost of CO_2 emissions to the average volume of emissions produced by cars and trucks, it results that the project produces a negative climate change effect of around EUR 8 million over its entire life climate change cost.

The approach to evaluate the impact of other air pollutants (NMVOC, NOx and PM 2.5) is different and brings to different results than with CO_2 emissions. As shown in the First Intermediate Report, the shadow price of PM 2.5 is assumed to be higher in an urban environment than in a suburban or rural context. Therefore, if on the one hand the induced traffic on the A-7 produces some negative environmental externalities, on the other hand **the traffic deviation from the urban MA-20 to the suburban A-7 determines a positive effect on air pollution**. The benefit that diverting traffic to the external bypass had on the local air quality is estimated at EUR 13 million, i.e. 1% of total quantified benefits.

Overall, the project's net effect on environmental sustainability is positive, but negligible as compared to its economic effects.

3.5. *EFFECTS RELATED TO DISTRIBUTIONAL ISSUES*

Non measurable effects

One of the project objectives was related to the improved connection within the metropolitan area of Malaga. This objective, although not being the main goal of the Ministry of Infrastructure, was very important from a regional perspective. The Plan of the Territory of Andalusia, drafted by the Regional Administration in 2006, made explicit the aim to improve the regional connection between the coastline and internal areas of the province of Malaga. Even if the new west bypass project was not mentioned in that Plan, it nevertheless **contributes to increase territorial cohesion in the region of Andalusia, and in the province of Malaga particularly**.

In the province about 80% of population live in the urban areas along the coast. The remainder (around 500,000 people) is located either in urban cores of the inland, such as Antequera or Ronda, or in more sparsely populated areas.[40] Especially for the latter, the risk of being cut off from the most dynamic and prosperous zones is real. The regional highway A-347 was the road most used by people living in the inner area to reach Malaga and the MA-20 motorway, for instance to get to the airport, the University, the Hospital or the seaside. As previously mentioned, this road was suffering from serious congestion when approaching the city of Malaga. Before the construction of the new west bypass, the poor transport service conditions in the area of Malaga were making less convenient for those people to travel there due to longer travel time.

[40] According to the interview to Province of Malaga, there about 300,000 people living in sparsely populated areas of the province.

Even if this benefit cannot be monetised in the CBA, interviews emphasised that the construction of the new west bypass of Malaga may have contributed to avoid or reduce the risk of depopulation of the inner province. The opening of the North access to the airport will further decrease travel time for vehicles originating from North-East of the city and directed to the international airport.

3.6. *TIME-SCALE AND NATURE OF THE EFFECTS*

The new bypass was opened to traffic only at the end of 2011, which means that consolidated quantitative data and other pieces of evidence are available only for five or six years at most since the project completion. Even so, sufficient information was collected to foresee the time-scale of effects materialisation in the longer run.

As previously discussed, **the project's effect on quality of life and environmental sustainability is mixed**, with both positive and negative impacts produced by the project under each of the two types of effects. No substantial change in these effect is expected in the future.

On the other hand, **both economic growth and distributional effects are positive and their intensity may change to some extent during the project life time**, subject to the implementation of other investments affecting the future volume and direction of traffic flows. The better connection to the airport, which will soon be implemented by the Ministry of Infrastructure, will bring additional travel time savings for vehicles headed to the airport and using the new west bypass. Improved connection to the airport may positively affect especially people living in the inner areas of the province. At the same time, the lack of any concrete and long-term plan to improve connection of the industrial poles and the technological park to the new bypass will limit the positive economic growth effects. Even if the project will continue producing positive effects (compared with the counterfactual scenario) and being the most convenient route for long-distance transport and for commuters directed every day to the periphery of the city, travel time savings could be higher if the existing local road network was adapted to address the higher and higher transport demand.

Table 7. 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, wider economic impacts, limited by the lack of long-term solutions to improve accessibility of industrial areas.
Quality of life and well-being	+/-	+/-	+/-	High level of satisfaction of inhabitants and tourists thanks to improved local road mobility and reduced noise in the urban area; slightly negative effect for safety due to higher accidents.
Environmental sustainability	+/-	+/-	+/-	Negative effect of climate change due to induced traffic, but positive effect on local air pollution due to traffic diversion from urban to suburban area.

Distributional issues	+	++	++	Improved accessibility to the transport network along the coast for population living in the inner areas, reinforced by the improved access to the airport.

Note: + = slight 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 discussed in the previous chapter are illustrated and discussed. Finally, the importance of each determinant for the project's final performance and the interplay between them and the observed outcomes is discussed.

Table 8. Determinants of project outcomes

DETERMINANT	STRENGTH*
Relation with the context	+5
Selection process	+3
Project design	+5
Forecasting capacity	+4
Project governance	Mixed result: +4 with reference to the project only, -3 with reference to the realisation of necessary complementary investments
Managerial capacity	+4

*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*

The project was embedded in a socio-economic context that was highly favourable for its planning and implementation. At the time when the project was conceived, all socio-economic statistics were pointing to a fast and durable growth trend of population, tourism and economic activities in Malaga and its province. The impact of the economic crisis on GPD and tourism was weaker in Malaga than in other parts of the region and country and/or the recovery was faster than in other regions. The Arab spring between 2010 and 2012 also played a role, as it negatively affected tourism in the Middle East and North African region and favoured instead trips to the Spanish tourist destinations.

The project reflected well both local and national political priorities. On the one hand, the spatial development of the municipality towards west and the agglomeration of the industrial and logistic services in the outskirt of the city demanded for improved connection to the main transport network. On the other hand, the project was included in an ambitious and far-reaching transport plan (the PEIT) which emphasised the national relevance of the new west bypass of Malaga, serving as junction between a new radial motorway (the AP-46, Alto De Las Pedrizas - Malaga) and the A-7/E-15 Mediterranean route, one of the most important motorway for long-distance traffic in Spain and Europe.

The implementation of the new bypass in Malaga was therefore considered by local, regional and national parties as a necessary and high priority investment not only to remedy the poor road mobility conditions in Malaga, but also to sustain the future development of the area and the country as a whole. **No opposition to its implementation was raised from any side**.

Evidence of project performance presented in the previous chapter however shows that the project by itself was not necessarily sufficient to achieve all the local mobility goals hoped for by the local and regional institutions. To this end, complementary investments on the rest of the road network and other transport means would be needed.

4.2. *SELECTION PROCESS*

The selection process leading to the public investment decision was highly centralised. Due to the road's national relevance, the Ministry of Infrastructure was responsible for designing and implementing the bypass since the beginning. Some collaboration with the Municipality of Malaga took place during the initial design phase and two rounds of public consultation. Discussions with the Regional administration were more limited. It was during the definition of the Regional Operational Programme of Andalusia 2007-2013 and discussion over the general strategy of use of ERDF resources, that the Region formally approved the project idea by accepting to include it in the Regional OP. The Region however did not participate in the prior decision to implement the project. **Since the Malaga bypass is part of the A-7 national corridor and the project was expected to serve primarily long-distance traffic in line with the Ministry's strategic objectives, the Region did not have any formal role in the project** (see the section on project governance below).

The European Commission did not have any role either during project selection and could hardly have any since the application for the ERDF financing decision was submitted when the project was already under construction.

Overall, since the very start of the design phase until its official opening, the project took ten years to be implemented (2001-2011). This time span is normal for a project of this nature. **No obstacles emerged during the selection process, which proceeded generally smoothly along its different phases**, including public consultation and the Environmental Impact Assessment. The project was given high priority. The decision to implement the new AP-46 motorway, taken in the same years by the Ministry of Infrastructure, made the Malaga bypass investment even more pressing. The Region's decision to stop the implementation of the Malaga Metropolitan Distributor Road, which was supposed to provide direct link between the bypass, the airport and the industrial zone, did not cause any delay in the start of project construction works.

In 2004, the Mayor of Malaga wrote a letter to the Prime Minister asking for immediate, but long-term solutions for the road mobility problems in the city. The fact that the Minister of Infrastructure in charge between 2004 and 2009 had been previously elected as Parliamentary member for the province of Malaga and had a strong bond with the territory of Malaga, may have contributed to accelerate transport public investment in Malaga. At that time the project had already been drafted and was in the pipeline. However, the Minister's public endorsement of the project and its inclusion in the PEIT at least to some extent may have helped the project quickly come true.

Figure 15. Extract from the press in 2004

El alcalde insiste en que la segunda ronda de circunvalación «no puede esperar más»

El regidor asegura que «cualquier día de retraso supondrá un lastre en la ejecución de esta obra, y ya van muchos días perdidos»

La ministra de Fomento anunció que este mes se conocerá el proyecto

Detrás de las kilométricas colas de coches hay miles de personas que sufren los atascos, y que piden soluciones

«Esto no puede seguir así ni un minuto más»

La hiperronda, ¿cuándo?

Gran Málaga

El alcalde pide rapidez con la hiperronda en una carta a Zapatero tras un atasco

De la Torre remitió la primera de sus misivas el 13 de octubre, cuando un accidente leve colapsó toda la mañana los accesos a Málaga

INFRAESTRUCTURAS

El sector turístico pide a Fomento un esfuerzo para impulsar la segunda ronda

A su juicio, es una «mala noticia» que aún no haya una fecha para el inicio de las obras de la hiperronda

Alertan de que la Costa del Sol puede perder competitividad

Source: Different historical press sources provided by the Municipality of Malaga.

There is an event that shows with how urgency the project was carried out. It was when the very last modification decision, involving the implementation of a total of six/eight lanes rather than four/six, was taken by the Ministry of Infrastructure, and construction orders were drafted accordingly, without however previously modify the project dossier and the ex-ante CBA. **Even if it is true that the project dossier explicitly put forward the possibility for a future expansion of the road and a redesign of the project design was not necessarily required, in fact this action limited to some extent the transparency of the decision process**. Both the Spanish Managing Authority and the European Commission were not properly informed about the actual number of lanes of the A-7 bypass and of its respective cost estimates when the application for ERDF co-financing was submitted. At the moment of writing, the Final Implementation Report of the OP ERDF Andalusia 2007-2013 is not yet published, therefore it is not possible to verify whether more updated information on this major project was eventually provided by the national authorities to the European Commission.

In general, the smooth selection process positively contributed to the project performance, by ensuring the implementation of the best option to achieve the project objective.

4.3. *PROJECT DESIGN*

The Ministry of Infrastructure had all the technical capacity to properly design the infrastructure project. The design of the Malaga bypass was marked by two distinct constraining factors, which the Ministry addressed well. On the one hand, **the physical features of the implementation area gave limited manoeuvre during the project design**. The localisation of the airport, the extension of the urbanised area towards the interior and the need for the bypass to avoid populated areas such as the Puerto de la Torre neighbourhood, the abrupt mountainous barrier surrounding the city, and the valley of the Guadalhorce River which has its estuary in Malaga, limited the degree of flexibility in the project design. The Ministry was constrained also in the decision of where to place the connections with the other roads due to the requirement, applying to national long-distance motorways, of keeping a certain minimum distance between one exit and the other. The Ministry ensured connection between the bypass and the main regional highways crossing its route.

Four technical options were originally formulated and the Ministry selected the most appropriate one based on a multi-criteria analysis. Financial, engineering and environmental criteria all led to selecting the same option that fit the best with the local geographical conditions. The air pictures below (Figure 16) clearly show how the bypass stretches through different impeding elements on one side or the other.

Figure 16. Design of Section I and IV

Source: Ministry of Infrastructure (2006)

On the other hand, **although not particularly long, the road is very wide and this determined some complexity in its technical design**. The Ministry took care of making accurate engineering estimates regarding the bypass and decided to split the project into four independent sections and contract the construction works to four different companies, in order to make the works more manageable and reduce the risk of delays. Even if some delays actually occurred, all in all this solution was key to ensure a smooth construction phase without major problems or surprises.

As a proof of the good design and construction abilities, in 2016 the engineering company in charge of building the bypass Section 1 was awarded with the 'FIDIC Award of Merit 2016' for the construction of the Churriana Tunnel.[41] The company succeeded to fulfil the term of 12 months, quite a short time for a project of this magnitude.[42]

[41] Press release: http://www.tecniberia.es/index.php/noticias/actualidad/los-tuneles-de-churriana-en-la-nueva-ronda-de-circunvalacion-oeste-de-malaga-de-acciona-ingenieria-premiado-en-la-conferencia-internacional-de-fidic-2016.html.

[42] The tunnel had to accommodate 4 lanes of 3.5 m, 2 shoulders of 1.0 m and 2 sidewalks of 0.9 m. This assumes a maximum width of 17.80 m and a maximum key height of 13.48 m.

Figure 17. Preliminary design of the Churrania Tunnel and the Guadalhorce viaduct

Source: Ministry of Infrastructure (2006)

The decision to expand the bypass with two additional lanes throughout its entire route also turned out to be sensible from a financial and technical point of view. The future traffic estimates were suggesting that the project would have soon be undersized, had it been implemented according to the original design, whereas four lanes for carriageway would have made it suitable to accommodate the volume of traffic expected over a longer time horizon. Moreover, modifying the project only once the road had already been built would have been more costly than building a large road since the beginning. The promptness by which the Ministry adjusted the initial design certainly increased the socio-economic benefits produced by the project, although this came at the expenses of full transparency of the selection process, as previously argued.

4.4. *FORECASTING CAPACITY*

The ability of the Ministry of Infrastructure to design a project which was adequate to meet the actual traffic intensity depended on their good capacity to predict the future demand trend. An origin-destination traffic model was used to produce different scenarios with- and without-the-project up to 2048. Different assumptions of annual traffic growth were adopted in order to identify more optimistic or pessimistic scenarios. The traffic intensity recorded during the first year of project operation indicates that those estimates were generally accurate and, hence, that the project layout eventually implemented was justified.

As to the forecasting capacity of the project implementation time and cost, it is difficult to determine to what extent the cost overrun and delays occurred during the construction phase were imputable to excessive optimism ex-ante, or rather to the latest change in the project design. For sure the decision to enlarge the road as compared to the original idea determined extra construction cost. Also, as admitted by the Ministry, initial timetables are hard to comply with and time rescheduling for project of this size is very common. However, since the project dossier was never revised and cost estimates recalculated, it is not possible to make a proper comparison between ex-ante estimates and actual implementation costs and dates.

Expropriation cost estimates are a partially different matter. In principle they had to be already sized so as to ensure having enough space for a possible future enlargement of the project. **The fact that expropriations turned out to cost almost twice as much as the forecasted value (EUR 57 million instead of EUR 33 million) reveals a certain optimism bias in the Ministry's cost forecasting**.

4.5. *PROJECT GOVERNANCE*

Being the new bypass of Malaga a project of national relevance, integrated into a national strategic plan and part of a national and European transport corridor, **the Ministry of Infrastructure had a central and direct role over the project** since its initial conception and design, until its implementation and project management. In Malaga, the Ministry has an office which oversees the implementation of the state road network of Eastern Andalusia. This gave the Ministry a privileged workstation to supervise the construction works. The SEITT was responsible to select the construction companies, prepare the documentation to ask for EU co-financing and verify compliance of expenditures, thus acting as the linking point between the Ministry of Infrastructure and the Managing Authority and formal beneficiary of EU funds.

The only role that the European Commission had on the project was to provide the ERDF grant to cover a share of construction expenditure. It did not make any observations on the project before taking the co-financing decision. The information flow between the Ministry of Infrastructure and the Commission was mediated by the SEITT and the Managing Authority, i.e. the Ministry of Finance. The latter only verified compliance with the applicable legislation and handed over the file to the Commission. Based on information collected through interviews, it seems that neither the Managing Authority nor the European Commission were aware that the project dossier they had in their hands did not provide an updated representation of the project, which reflected the latest decisions that the Ministry of Infrastructure took over the project design. If they had known, the SEITT should have prepared a revised project dossier, with an adjusted project description, cost estimates and CBA.

The Ministry of Infrastructure is also the main actor which guarantees the financial sustainability of operations. It provided national co-financing to the project, covered all additional expropriation and construction cost incurred, and currently supplies financial resources for paying ordinary maintenance. With the exception of EU funds, no other external resources were used, either private or from other national, regional or local public administrations.

The municipality of Malaga was involved to some extent in the project planning phase. It pushed for having the project realised in short time and during the public consultation phase it submitted some minor comments on the project design.

The involvement of the Region was much more limited. Being the A-7 bypass under national responsibility, the Region could not play a key role during the selection process and the project design. The Ministry and the Region did not discuss how the bypass could have been integrated into the local transport network, as shown by the limited coordination with regard to the link with the airport and the industrial area, as well as the connection to the Technological Park.

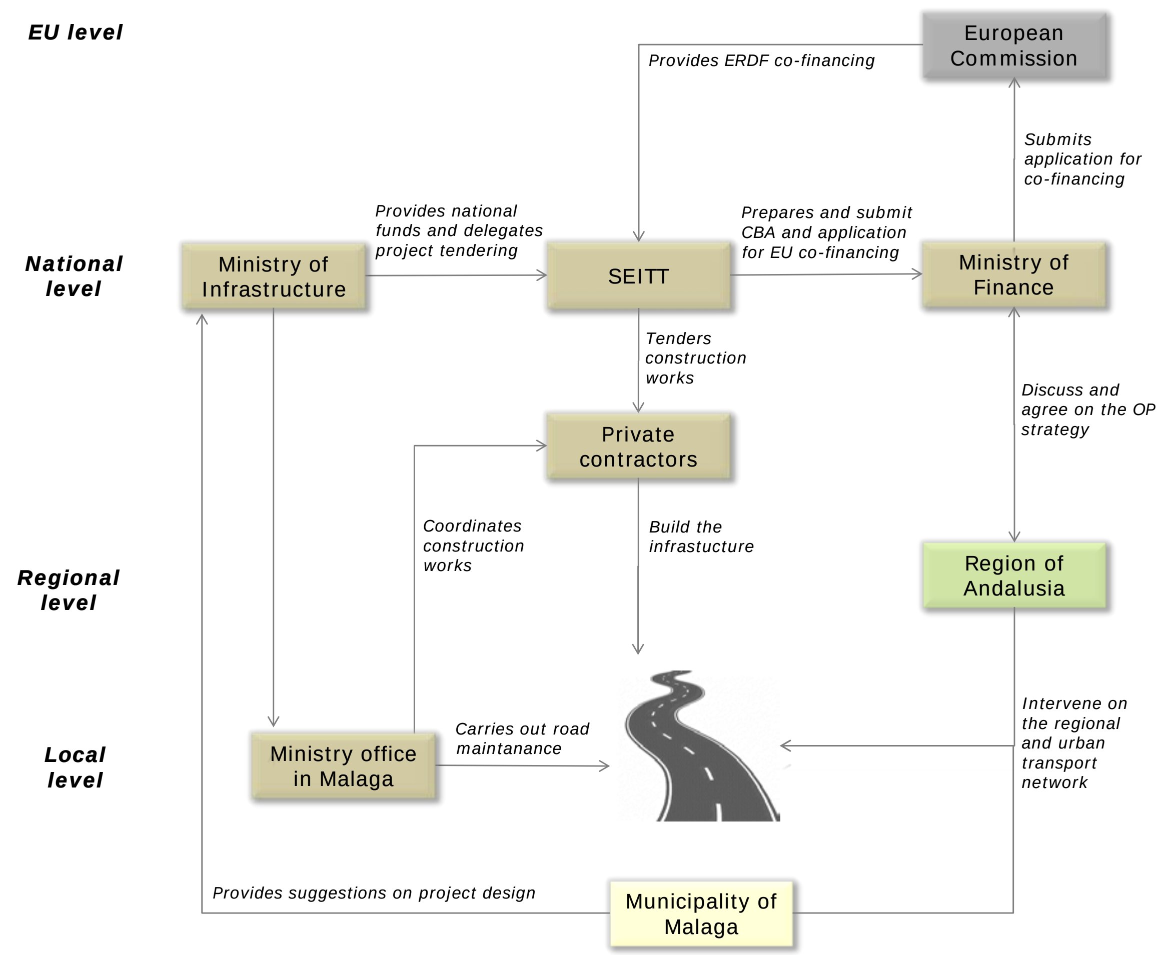
The Ministry always made very clear that the bypass project had to respond to a national strategic objective and to serve primarily long-distance traffic. Improving the local transport network was beyond the project scope and the Ministry's mandate. On the contrary, **it is generally the Region that has direct responsibility over**

investments aimed to upgrade and develop the existing local road network. The Region's more limited budgetary resources, especially in a context of economic crisis, contributed to slow down the implementation of complementary investments that would have brought greater traffic mobility benefits to the local area. Furthermore, the fact that the central government and the Andalusia government in the latest years are ruled by the two opposing political parties of Spain may have contributed to impede a fruitful dialogue between them.

In short, the assessment of the governance system on the project performance is mixed: on one side, **the predominantly top-down decision process positively contributed to the performance of the bypass project, by ensuring fast decision-making and smooth project implementation**; on the other side, insufficient dialogue and coordination between the Region and the Ministry prevented from effectively planning the additional investments needed to upgrade the local road network and, therefore, constrained the project's potential to improve the service conditions for local users.

The project governance structure, with the different actors involved during the project cycle and their respective role over it, is summarised in the Figure below.

Figure 18. Project governance structure



Source: Authors

4.6. *MANAGERIAL CAPACITY*

It has been almost ten years since the project entered the construction phase and six years since it started being operational. During this time, **no unexpected technical issues emerged and the project is today providing the service that it was planned to**. Good forecasting capacity and adequate project design proven by the Ministry of Infrastructure in the planning phase were essential to ensure the project positive performance.

No particular problems have emerged and affected so far the project management. All interviewed actors at local level maintained that the road's pavement is of very good quality and that maintenance is properly done.

The only event that was originally programmed but that eventually did not happen is the implementation of the Metropolitan Distributor Road of Malaga which would have also connected the bypass to the airport. When the economic crisis came and the Region decided to suspend the project, after the tender had already been launched and the project commissioned, the Ministry completed the bypass construction anyway and according to the original design. The A-7 exit to the airport was still constructed, because in any case it coincided with the connection with the A-7052 road to Alhaurín de la Torre. The two roads are connected by means of large roundabout, to which the Metropolitan Distributor Road was planned to be linked too.

Since the lack of a direct access to the airport would have limited to benefits generated by the project, the Ministry of Infrastructure decided to step in and take responsibility for the 1.6 km segment linking the bypass to the airport. **The way how the Ministry reacted to an event which was out of its control in order to make sure that the A-7 bypass fully delivered its intended service testifies to the its good managerial capacity**.

At the same time, some of the interviewed stakeholders question whether separating the Distributor Road and the North access in two different projects was a good idea. When the Distributor Road will be eventually built, this will run next to the bypass and the connecting road to the airport, and will be linked to the A-7 at the same roundabout. The reason why there should be two separate and parallel roads in a very limited space is not clear or agreed on by some interviewees. Even if it is probably true that longer time and more efforts would have been needed in order for the Ministry and the Region to reach a shared solution, **better coordination may have led to the best, although not the easiest, solution**.

4.7. *PROJECT BEHAVIORAL PATTERN*

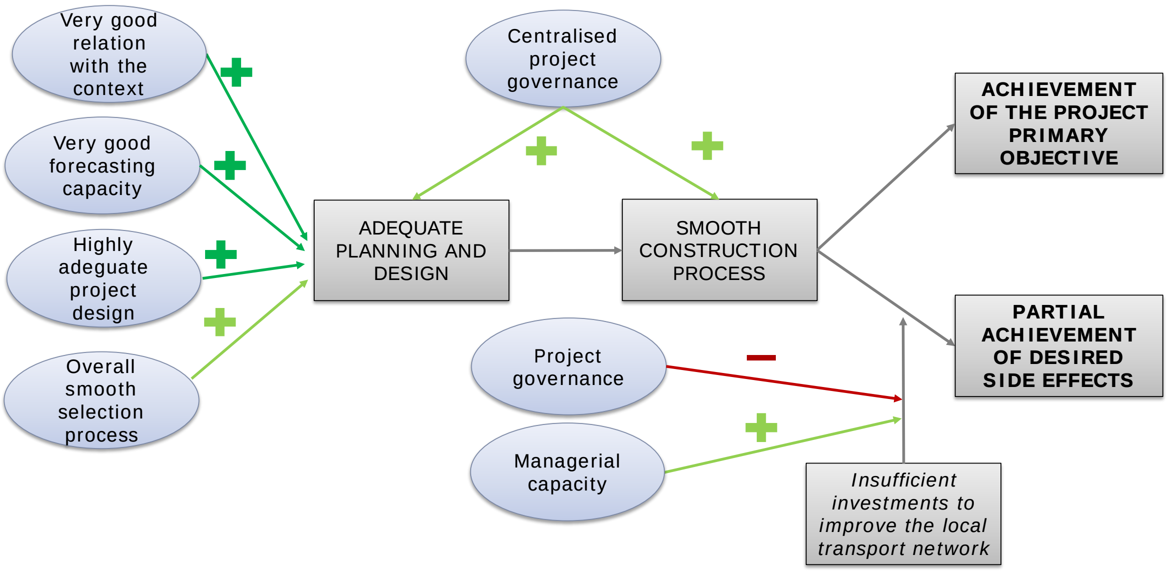
This section puts together the different determinants of project performance presented in the previous sections and discusses their interlinkages and dynamic impact on the project life cycle.

The project is considered overall successful inasmuch it achieved its intended primary objective, i.e. favouring long-distance traffic in the area of Malaga. This positive outcome strongly depends on the high appropriateness of the project to the context in which it was embedded and to existing needs, as well as good forecasting capacity and project design proven by the Ministry of Infrastructure. The high centralisation of the project governance was instrumental to produce an adequate project design and a fast selection process and project implementation.

When considering the side objectives of the project, i.e. reduced travel time for local users and improved connection to the suburban areas of Malaga, the final assessment is less straightforward. Even if it is true that, with the implementation of this project, the Ministry was mainly targeting long-distance traffic, the expectations by the local population that the new bypass would have also improved the mobility conditions in the metropolitan area of Malaga were legitimate and could not be put aside. The lack of sufficient and timely complementary investments, especially by the Region, allowed these side effects to be only partially achieved. Good managerial capacity was proven by the Ministry of Infrastructure to remedy at least to the missing link between the bypass and the airport, when it was clear that the Region would have not implemented it in short time. However, closer cooperation and shared goals between the Region and the Ministry would have helped them find the best solution to address the local population needs. **The project governance, therefore, plays at the same time a positive and negative effect on the project**.

This assessment is summarised in the following figure, which outlines the "behavioural" path of new west bypass of Malaga over its life time. Following the analytical methodology detailed in the First Interim Report of this evaluation study, 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 dark green indicate factors that had a stronger influence on the project, arrows in light green instead indicate factors that had a positive but less strong influence. Red arrows and the '-' sign indicate a negative influence of the determinant factor on the project.

Figure 19. Behavioural pattern of the new west bypass road of Malaga: blurred star



Source: Authors

On the basis of the assessment previously presented, the project cannot be considered completely successful and, hence, cannot be labelled as “bright start”. **Since the poor coordination between the regional and national authorities partially clouded the fulfilment of all the expected objectives, it is preferred to label the project as a “blurred star”**.

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 hereafter along a set of four evaluation criteria: project relevance and coherence, project effectiveness, project efficiency and EU added value.

5.1. *PROJECT RELEVANCE AND COHERENCE*

The project was highly relevant in the context where it was implemented and matched a real and urgent need, providing a long-term solution to the serious traffic movement problems that were affecting both long-distance and local users crossing the metropolitan area of Malaga. Since the project was designed in order to enable it to face the higher and higher traffic intensity that is forecasted in the next years, the project is expected to remain relevant also in the future.

The project was coherent with the strategic priorities set at European and national level but also with objectives of sustainable development at regional and local level. It represented a necessary and important step to improve long-distance light and heavy transport services along the Mediterranean route. In this respect, the project was fully coherent with the European strategy for quality and sustainable EU-wide motorway corridors, the national strategy set in the PEIT, and with other interventions carried out in the same period by the Ministry of Infrastructure to improve the Spanish national transport network.

At the same time, the bypass was in line with the regional and municipality goals of equipping the city of Malaga of improved transport infrastructures that could accompany and sustain the strong economic development of the Malaga province. For these objectives to be achieved, it is clear that the new bypass road was necessary, but could not be sufficient. **Additional investments should be put in place, following a more comprehensive and integrated transport and economic development strategy agreed by national, regional and municipal institutions**.

This need is evident when considering the emblematic case of the Technological Park of Andalusia. The Park's strategic importance not only for the city, but for the entire region and country is well acknowledged. The Park is expected to significantly enlarge its capacity in the next few years but this would require better accessibility to it. During the public consultation on the bypass project, the Park advocated for the creation of a new direct connection with the bypass. The Ministry at that time did not assume any responsibility arguing that the improvement of the local road network was up to the Region. Furthermore, the Ministry underlined that "its goal was to provide a public service, mainly for long-distance traffic, which was in contrast with the interests expressed by a private institution, like the Park".[43] On the other side, the Region did not commit to realise any new road, mainly due to financial constraints. The recent decision to enlarge part of the already existing connecting road will provide limited and short-term benefits. The lack of a shared commitment between the State and the

[43] Source: interviews.

Region to guarantee the competitiveness and future growth of the Park prevented from reaching so far a long-term and satisfactory solution to the Park's needs.

5.2. *PROJECT EFFECTIVENESS*

The project achieved its objective as stated in the application for Cohesion policy support, i.e. improving the service conditions of motorways in the area nearby the city of Malaga. Some alternative options for the road's route were formulated and the selected one turned out to be the best one from technical, financial and environmental point of view.

The main socio-economic benefits produced by the project were quantified and valued in the ex-post CBA (see Annex II for details). Against a total investment cost of EUR 467 million and approximate EUR 87 million[44] for annual operation and maintenance until the assumed last year of the project time horizon (2036), **the project produces a net socio-economic contribution to society measured by the economic net present value, of EUR 600.5 Million**. The internal rate of return is equal to 7.61%. The benefit from travel time saving is the largest benefit of the project, as also expected ex-ante and consistently with the project's objective. Other minor benefits related to the reduction of traffic noise in the urban area, thanks to the deviation of vehicles from the previously existing road crossing the city, to the new west bypass, and vehicle operating cost saving, thanks to improved traffic flow. The project generated other externalities on safety and the environment with a mixed effect, even if marginal, on project performance.

The large amount of funds allocated by the Ministry allowed to implement a more costly and larger project than initially envisaged, which eventually was key for its positive performance in the long term. If the Ministry did not face any problem of fund availability, the Region instead had to deal with significant financial constraints, further emphasised by the economic crisis. Limited funds availability for transport infrastructure limited the Region's capacity to put in place complementary interventions on the regional road network, which, although being out of the scope of the Malaga bypass major project, could have contributed to address the accessibility and travel time problems in Malaga and its neighbouring towns.

As a matter of fact, **the project has great potential to sustain the local economic development of Malaga and its province in the long run**. It has already produced some positive wider benefits thanks to improved accessibility to the industrial and technological areas localised nearby the new bypass. By improving connection between the city and the population living in the interior areas, the project has also reinforced territorial cohesion. These side and not measurable effects, however, could be much more important if the local road network providing access to the bypass is substantially improved. **The Region's funding problems, together with weak coordination between the regional and national authorities, may jeopardise the attainment of long-term economic development benefits**.

[44] Present real values at 2017 terms, excluding VAT.

5.3. *PROJECT EFFICIENCY*

The project implementation suffered from some delays and cost overruns. The project construction lasted 25 months more than what envisaged in the project dossier. The delay was at least partially due to the modification of the project design but also to an external and unforeseeable event, the river flood. As to the cost overrun, they concerned the construction and expropriation investment costs, which turned out to be respectively 34% and 73% higher than the official preliminary estimates included in the project dossier submitted to the European Commission. In total, the project investment realised between 2006 and 2012 amounted to EUR 528 million against an ex-ante forecast of around EUR 376 million[45] (both figures are expressed in nominal terms, including VAT). The main reason for such variation is the last modification of the project design which enlarged the bypass from 2-3 to 3-4 lanes. Since the official cost estimates included in the project dossier were not revised accordingly, but construction works started right away, **it is not possible to make a proper comparison between ex-ante and ex-post project cost for exactly the same project features**.

For the same reason, any comparison between the ex-ante and ex-post CBA results would be inaccurate. In general terms, both the two analyses indicate that the project was worth being implemented from a socio-economic view point, and that travel time saving was the main benefit produced by the new west bypass. No other comparison between the two analyses can be made due to a lack of sufficient details and justification of many of the underlying assumptions and hypotheses in the ex-ante CBA.

Even if the project was more costly than originally expected, the decision to build a larger road since the beginning eventually entailed lower public resources to be spent, as compared to the hypothesis of upgrading the infrastructure in a subsequent moment, when the project was already in operation. In fact, the Ministry considered that implementing the fourth lane from the very beginning would have been financially and technically more convenient.

The average cost per kilometre of the bypass was approximately of EUR 17.5 Million for a 2-3 lanes road. After the design modification, the project cost raised to about EUR 24 Million per kilometre. This average investment cost is in line with the average cost of other investment recently made by the Ministry of Infrastructure on other sections of the A-7 Mediterranean motorway. The table below illustrates some examples in the province of Granada. The average cost of the Malaga bypass is overall in line with the average cost per kilometre for other motorway sections. If considering that the Malaga bypass has four lanes per carriageway, and the other sections in the province of Granada only two, the Malaga major projects can be regarded as cost-effective.

[45] Source: project dossier prepared by SEIT.

Table 9. Investment cost of different sections of the A-7 Mediterranean motorway

Section	Lenght (km)	Construction (MEUR)	Project design (MEUR)	Monitoring and control (MEUR)	Expropriation (MEUR)	Total investment (MEUR)	Average cost (MEUR per Km)
New West Bypass of Malaga	21.4	453.40	6.40	11.50	57.00	528.30	24.7
Taramay-Lobres	7.8	171.1	1.9	2.9	33.6	209.5	26.9
Lobres-Guadalfeo	2.3	25.8	0.6	1.3	9.1	36.8	16.0
La Gorgoracha-El Puntalón	6	109.8	1.7	3.7	37.6	152.8	25.5
El Puntalón-Carchuna	6.1	115.5	1.4	2.3	53	172.2	28.2
Carchuna-Castell de Ferro	10.2	118.1	1.8	2.4	42.3	164.6	16.1
Polopos-Albuñol	14.9	247.6	2.8	3.3	100.9	354.6	23.8
TOTAL	**47.3**	**787.9**	**10.2**	**15.9**	**276.5**	**1,090.5**	**23.1**

Source: Ministry of Infrastructure data provided upon request.

The financial sustainability of the project during the project investment was guaranteed by the funds provided by the Ministry. **The Ministry itself is responsible to ensure the project financial sustainability over its entire life time**. Since the bypass was expected to be largely used also by local population, the possibility to put a toll on it was soon discarded, as it would have discouraged local users from taking it.

In the original project design, when the bypass project was merged with the (tolled) AP-46 motorway project, it was considered the possibility to give to the concessionaire firm the control also over the bypass and make sure that the revenues raised from the AP-46 motorway covered the cost of the bypass too. Then, judging that the revenues would have not be sufficient to recover from the construction cost of both the motorway sections, the Ministry preferred to split the two projects and to keep the bypass under public responsibility. Today the AP-46 motorway is among the most costly for users and the most profitable in Spain.[46] Given the sustainability problems that many Public-Private Partnership motorways faced since the Nineties due to manifold reasons (Engel et al., 2016), and the subsequent renegotiation of most of the contracts, all interviewees agreed that **putting the bypass under public control and leaving it free to all users was the right and least risky decision to take to guarantee the long-term sustainability of the project**.

5.4. *EU ADDED VALUE*

The European Commission contributed to the investment project by providing a grant of EUR 234 million in nominal terms (EUR 251 million, at 2017 value). The grant was estimated as 80%[47] of the project construction cost as presented in the project dossier. Since the project dossier was not revised after the decision to modify the project design and therefore to increase the cost, in fact **the EU grant covered 63% of the construction costs actually incurred, and 54% of the total investment costs**.

[46] Source: interviews and press review (e.g. http://www.elperiodico.com/es/motor/noticias/trending/las-10-autopistas-mas-caras-de-espana-6187694).

[47] After the decision of increasing the co-financing rate of the OP.

The application for EU co-financing was submitted by the national Managing Authority when the road had already started being constructed. On the basis of information provided by the Managing Authority, the Commission took the co-financing decision without any further exchange of information with the national counterpart and without making any observation on the project.

The project has contributed to produce benefits at EU level, by reducing the travel time for long-distance traffic along the Mediterranean motorway and improving the connection to the Malaga International Airport. However, on the basis of information collected and interviews carried out, **there is no evidence demonstrating a value added of the EU spending on the Malaga bypass project**. The positive net benefits produced by the project are not sufficient to prove the added value of EU spending. At the same time, it is not possible to argue that the EU provided a direct contribution to the project effectiveness and efficiency and not even to its financial sustainability, since the project was not facing particular financing problems or risks when the application for EU co-financing was submitted.

Even if it is true that the project covers a section of a European road (the E-15) and was therefore also aimed to contribute to EU-wide long-distance mobility objectives, the project conception, design and implementation were mostly driven by national interests. Given the great relevance of the project for both national and local objectives, as well as the urgent need for its implementation, it is reasonable to assume that the new west bypass of Malaga would have been implemented even without the EU grant. In principle, **it is possible to assume that the availability of EU funds may have produced an additionality effect on national expenditure for other projects, but this cannot be ascertained in the context of this case study**.

In the future, the Commission could stimulate the dialogue between the Spanish institutions and encourage them to adopt a more integrated and concerted transport investment plan, in line with regional and local development goals. Even if the division of responsibilities between the Region and the Ministry over the investment in the transport network is clear, and in no case the Ministry could finance the improvement of regional and local roads, stronger dialogue during the planning and design phase between stakeholders at different institutional levels would be extremely valuable. For instance, given the strategic priority given to the development of the ICT sector in the region, also stressed by the Smart Specialisation Strategy of Andalusia, there would be large scope and reason for multi-level cooperation in order to reach a satisfactory solution to the problem of accessibility to the Technological Park of Andalusia, which may in fact hamper the future development of the Park.

5.5. *FINAL ASSESSMENT*

The following table summarises the final assessment of the project along the four evaluation criteria previously discussed. Overall, **the new west bypass of Malaga represents a good example of a project characterised by no major controversies**, thanks to its high relevance and coherence with the needs and objectives stated at different level, from local to national and European.

Even if with some delays in the construction phase, the project implementation proceeded smoothly. **The good forecasting and design capacity proved by the**

Ministry of Infrastructure ensured that the project was highly effective and desirable from a socio-economic point of view, and also efficient in the use of public resources.

Even if the project is of EU interest, because it concerns a section of a European route, national and local interests on this project were largely prevailing. For this reason, the project was conceived and implemented more as a Spanish major project, rather than a European one, and it would have likely been implemented even without the Community contribution. The EU added value on this project is therefore very limited, but some additionality effects could have been produced on the national public expenditure. **The European Commission could play a larger and perhaps decisive role** in facilitating coordination between local, regional and national authorities and fostering the development of a common and integrated strategy for transport and economic development in Malaga, so as to maximise the long-term benefits produced by the major project.

Table 10. 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 with some delay with respect to the projected time schedule. It turned out to be the best option among all feasible alternatives. Additional complementary interventions would be needed to maximize the project effectiveness.	3
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?	The project was cost effective but no precise comparison between ex-ante and ex-post CBA can be made.	3
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?	Since the project improved a section of a European motorway, the project contributed to EU-wide long-distance transport. Overall the EU added value on this project was very limited.	1

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

6. CONCLUSIONS AND LESSONS LEARNED

The ex-post evaluation of the major project relating to the construction of the new west bypass road of Malaga supports the conclusion that **the project was the right initiative to implement** to provide a better service for both long-distance travel and local users crossing the metropolitan area of Malaga. The results of the ex-post CBA confirm that the project is adding value to the EU, thanks to travel time savings generated over its entire life time.

This case study gives the opportunity to draw important lessons of more general relevance.

- **A project which has a good start, is more likely to perform well during its life time**. In the case of Malaga, the project appropriateness to the context and relevance to the objectives at local, regional and national level, along with the capacity to accurately forecast future traffic flows and design the project accordingly, were key for the project positive performance. They are all determinant factors that had a role in the initial phase of the project lifetime, but were essential to pave the way for the project future success.
- **Implementing a major project requires long time, thus it is important that the project adapts to the ongoing context evolution**. In spite of the urgency and the convergence of interests around the Malaga bypass project, it took more than ten years to get the project done.[48] This is the normal time span needed to programme and implement a major project of this nature, including the consultation phase, the environmental impact assessment and project design. Because of this, initial forecasts and project designs should be revised, fine-tuned and further specified as time goes by, in order to make sure that the project maintains its appropriateness to the context features and is potential to address present and future needs.
- **If implementing a major infrastructure project can be relatively easier when all the necessary conditions are in place, it is more challenging to ensure that the project effectively contributes to wider economic growth**. The major transport project can have a pivotal role in promoting more ambitious wider economic development and territorial cohesion goals only if it is integrated into a comprehensive development strategy. Even when the transport project is meant to target primarily long-distance users, as in the case of the Malaga bypass project, the possible opportunities that it may produce at the local level should not be disregarded or underestimated. These objectives should instead been incorporated in the project since the beginning and appropriate measures should be taken to maximise the positive spillovers of the project on the local and regional economy.
- To this end, strong cooperation between different institutional levels is a prerequisite. Centralised, **top-down project management** can be determinant to ensure a fast decision process and project implementation. This however **may limit the capacity to cooperate and exploit the synergies** with other authorities for the implementation of complementary interventions contributing to the same objective. The European Commission could play a role in this respect by

[48] From the initial conception to the start of operations.

facilitating dialogue between stakeholders and fostering the integration of transport objectives into broader economic development strategies.

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[49].

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.

49 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 11. 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 provide 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)[50]. 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)[51]. 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.

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

50 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

51 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.

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 12. 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 13. 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 division of responsibilities, bad incentive schemes).

Source: Authors

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 New West Bypass of Malaga, undertaken to assess the performance of the project in a quantitative way. The methodology applied is in line with 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, assumptions 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 New West Bypass of Malaga (A-7). The project had the objective of improving the road service conditions in the Malaga metropolitan area, particularly by relieving traffic from the existing MA-20 motorway. The project consisted of the construction of a greenfield 21.4 km road surrounding the city of Malaga, from the district of Ciudad Jardín (North-East of Malaga) to the city of Torremolins (South). The bypass is a section of the A-7/E-15 Mediterranean motorway, running from Algeciras to the French border, and continuing thereafter up to Scotland.

  The project implementation started in 2006, even though preliminary feasibility studies began as early as 1997.[52] The bypass road is composed of four sections, two of which were opened to traffic at the end of 2010 and two at the end of 2011. Construction works were completed at the beginning of 2012. The table below provides a schematic timeline.

Table 14. Synthesis of the interventions

ACTIVITY	IMPLEMENTATION PERIOD
Preparatory phase (design, documentation, feasibility study)	1998-2006
Land acquisition	2006-2007
Construction Works	2007-2012
Start of Operational Phase	Section 3 and 4: December 2010 Section 1 and 2: October 2011

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, including the construction years. Accordingly, the timeframe for the project's evaluation runs from 2006, when the first capital expenditure for land expropriation occurred, to 2035. A mix of historical data from 2006 to 2016[53] (covering 11 years) and forecasts from 2017 to 2035 (covering 19 years) was used.

[52] The very first preliminary and feasibility studies were launched in 1997. The actual project was drafted around 2006 and then modified in 2008. In light of this, all costs occurred before 2006 are considered as sunk costs and thus not included in the CBA.
[53] Data on traffic and accidents are available up to 2015. Financial data on operating costs are available since 2012.

- *Constant prices and discount rates*
  In line with the guidelines of the First Interim Report, the CBA was performed at constant prices. Historical data were 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 to projections from 2017 onwards, they were estimated in real terms (no inflation was considered).
  Consistently with the choice of using constant prices, financial and social discount rates were expressed in real terms. Specifically, inflows and outflows of financial analysis – for both the backward and forward periods of analysis – were discounted and capitalised using a 4% real rate, as suggested in the EC CBA Guide (2014). Regarding the economic analysis, a real backward social discount rate of 2.88% and a real forward social discount rate of 3.22%, specifically calculated for Andalusia (see the First Interim Report for the calculation), were adopted.

- *Without the project scenario*
  Before the implementation of the project, the MA-20 was the only western orbital road available to serve both long-distance and metropolitan traffic in Malaga. The reference scenario for the CBA (without-the-project scenario) was considered as the "Business as usual" (BAU) scenario, where the MA-20 would have continued operating until reaching its full capacity (200,000 vehicles per day). The same counterfactual scenario was assumed in the ex-ante CBA carried out by SEITT (2006). Further explanation on how this assumption was reflected in the CBA is provided in section II.2.

- *Data sources*
  Historical traffic data (1993-2015) were provided by the Ministry of Infrastructure. Financial data (capital expenditure and operating expenditure) were provided by the same Ministry, which oversees maintenance and management of the project during its entire life horizon.

- *Technical features*
  The project consists of a 21.4 km long motorway. The A-7 road has four lanes per carriageway in three sections, and three lanes per carriageway in the fourth section. The general speed limit is 100 km/h, even though it is raised to 120 km/h in some sections. The project includes 9 viaducts, 12 overpasses, and one 1,250 metre long tunnel.

Table 15. Technical features

A-7 SECTION	LENGHT(KM)	LANES PER CARRIAGEWAY
Section 1: Motorway AP-7 -Intersection MA-417	6	4
Section 2: Intersection MA-417 - Highway A-357	3.9	4
Section 3: Highway A-357 - Intersection A-7075	5	4
Section 4: Intersection A-7075 - Highway A-7	6.5	3

Source: Authors

A II.2 Future scenario

In order to assess the future project performance, hypotheses were made regarding the future trends of variables. Most of the variables composing the analysis are linked to the project demand, i.e. the number of vehicles running on the A-7 bypass.

Since travel time savings and other benefits are expected to occur for both users of the new A-7 bypass and vehicles that continue using the MA-20 road after the project implementation, the traffic evolution was estimated for both the MA-20 and the A-7 in the project scenario, and for the MA-20 also in the counterfactual scenario.

The demand up to the end of the project time horizon was forecasted by taking into account the historical trends observed, but also the traffic scenarios modelled by the Ministry of Infrastructure in the ex-ante feasibility study (2006). Data on traffic were quantified in terms of yearly average traffic intensity (number of vehicles per day). For the past years, these data were provided by traffic counting stations located throughout the routes of MA-20 and A-7. The figure below shows the location of counting stations.

Figure 20. Map of traffic counting stations on the MA-20 and A-7 bypass

Source: Authors (via Google Maps)

Demand for the A-7 bypass

Historical data on the A-7 are available since its opening in 2011 until 2015. The future average annual growth rate of the total number of vehicles is assumed to remain constant for the entire time period, growing at the average annual rate recorded during the 2011-2015 period in each section of the road. As an average of the four sections, the future traffic daily intensity is expected to grow at nearly 3.59% per year.

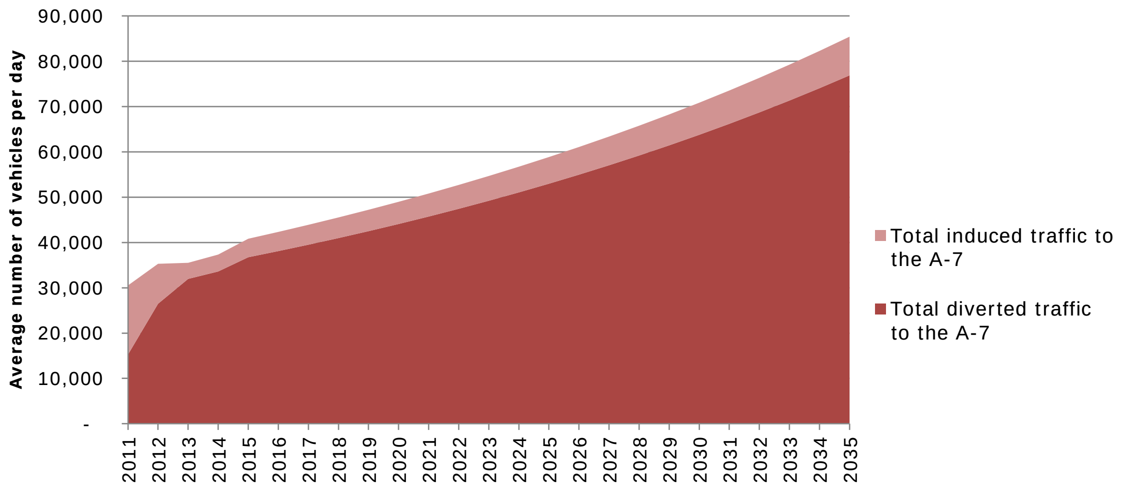
At these growth rates, by the end of the time horizon the average traffic daily intensity is expected to reach 85 thousand vehicles, with a maximum of 143 thousand vehicles on road's Section 2 and a minimum of 51 thousand on Section 1. These figures are overall in line with the traffic scenarios developed ex-ante by the Ministry of Infrastructure. The share of heavy traffic over the total number of vehicles is expected to grow until 10% and then to stabilise, in line with predictions made ex-ante.

Table 16. Traffic on the A-7 New West Bypass: Historical (2011-2015) and Forecasted (2016 -2035) data by type of vehicle

Section and counting station	Type of Vehicles	Historical average traffic daily intensity (vehicles)					Future average annual growth rate (%)
		2011	2012	2013	2014	2015	2016-2035
1 - P.K. 226	Light	29,130	27,208	27,530	28,886	31,213	2.06%
	Heavy	2,098	2,114	2,162	2,361	2,672	
1 - P.K. 228	Light	37,446	36,287	36,827	38,647	41,868	3.44%
	Heavy	1,824	2,108	2,508	2,740	3,092	
2 - P.K. 231	Light	45,352	45,336	47,320	49,888	53,741	4.69%
	Heavy	2,349	2,703	2,891	2,605	3,548	
3 - P.K. 235	Light	13,356	32,680	30,436	32,508	36,008	3.61%
	Heavy	1,442	2,824	2,770	2,877	3,484	
4 - P.K. 239	Light	17,831	22,487	23,250	24,255	26,435	4.15%
	Heavy[54]	1,802	2,771	1,897	1,924	2,097	

Source: Ministry of Infrastructure data for the 2011-2015 period. Own assumptions for 2016-2035 period.

Figure 21. Total (light and heavy) traffic trend on the A-7



Source: Authors based on Ministry of Infrastructure data (for the 2011-2015 period) and own assumptions (2016-2035)

Most of traffic on the A-7 is deviated from the MA-20 road. In the first two operating years (2011-2012), some induced traffic is estimated on the A-7, respectively at 50% and 25% of total vehicles (both light and heavy). This growth can be imputed to sort of “novelty effect” of the A-7 project, but also to a higher number of people that start using the A-7 thanks to the improved road service conditions. The share of induced traffic over the total number of vehicles is expected to be lower during the rest of the time horizon, at around 10%.

[54] Available historical data on the heavy vehicles traffic as measured by the P.K. 239 counting station in the 2011-2015 period follows a different trend than the rest of the road's sections. No information is available to understand the determinants for such a trend. Since there is no reason to believe that the number of heavy vehicles will decrease along this section, it was assumed a future positive growth rate for heavy vehicles in this section too.

Demand for the MA-20 road (with-the-project scenario)

The forecasted traffic for MA-20 is estimated by considering the historical average daily intensity on the road since 1993 and assuming the average annual growth rate for the future year. Future projections are made by considering the total maximum capacity of the road (i.e. around 200 thousand vehicles per day) and traffic scenario modelled by the Ministry of Infrastructure before the project implementation. On average, the future traffic daily intensity on the MA-20 is expected to grow at 2.7% per year. The share of heavy vehicles on the MA-20 is expected to remain constant at 4%.

By the end of the time horizon of the analysis (2035), an average daily traffic intensity of around 136 thousand vehicles is expected on the MA-20, with a peak of nearly 180 thousand vehicles in the mid-section, and a minimum of 90 thousand in the southern section. This means that by 2035 the MA-20 will reach the same level of traffic than before the implementation of the A-7 bypass.

Table 17. Traffic trend on MA-20 – With the Project scenario: Historical (2011-2015) and Forecasted (2016-2035) data by type of vehicle

Counting station	Type of Vehicles	Historical average daily intensity (vehicles)					Future average annual growth rate (%)	
		2011	2012	2013	2014	2015	2016-2026	2027-2035
P.K. 1.9	Light	81,072	66,554	64,392	70,019	73,016	4.23%	2.54%
	Heavy	3,330	2,577	1,841	2,024	2,201	-4.28%*	-2.57%
P.K. 6.9	Light	169,001	153,295	137,824	138,572	139,653	0.86%	0.52%
	Heavy	8,428	6,121	3,655	3,982	4,036	6.70%	4.02%
P.K. 11.4	Light	71,834	58,623	58,663	58,905	61,465	2.09%	1.25%
	Heavy	5,171	3,780	3,856	3,955	3,846	0.79%	0.47%

Source: Ministry of Infrastructure data for the 2011-2015 period. Own assumptions for 2016-2035 period
**Heavy traffic in the P.K 1.9 section is assumed to decrease in line with historical data.*

Demand for the MA-20 road (without-the-project scenario)

The Business-As-Usual scenario that was adopted as counterfactual scenario corresponds to the hypothetical world where the new west bypass (A-7) was not implemented and all traffic continued to be served by the MA-20. Since the project caused a traffic diversion from the MA-20 to the new A-7, the traffic on the MA-20 in the *without-the-project* scenario was estimated as the sum of the traffic on MA-20 and A-7 under the project scenario minus the induced traffic.[55]

Traffic on MA-20 *without-the-project* =

Traffic diverted to A-7 *with-the-project* + Traffic on MA-20 *with-the-project*

[55] Since the demand on both roads is estimated for each road's section, the traffic intensity measured by the three counting stations on the MA-20 was summed to three counting stations on the A-7. In particular:

- traffic in the first (south) section of the MA-20 measured by the counting station P.K. 1.9 is summed to traffic of the first section of the A-7 road, measured by the counting station P.K. 226;
- traffic in the mid-section of the MA-20 (P.K. 6.9) is summed to traffic in the second section of the A-7 (P.K. 231);
- traffic in the last (north) section of the MA-20 (P.K. 11.4) is summed to traffic in the fourth section of the A-7 (P.K. 239).

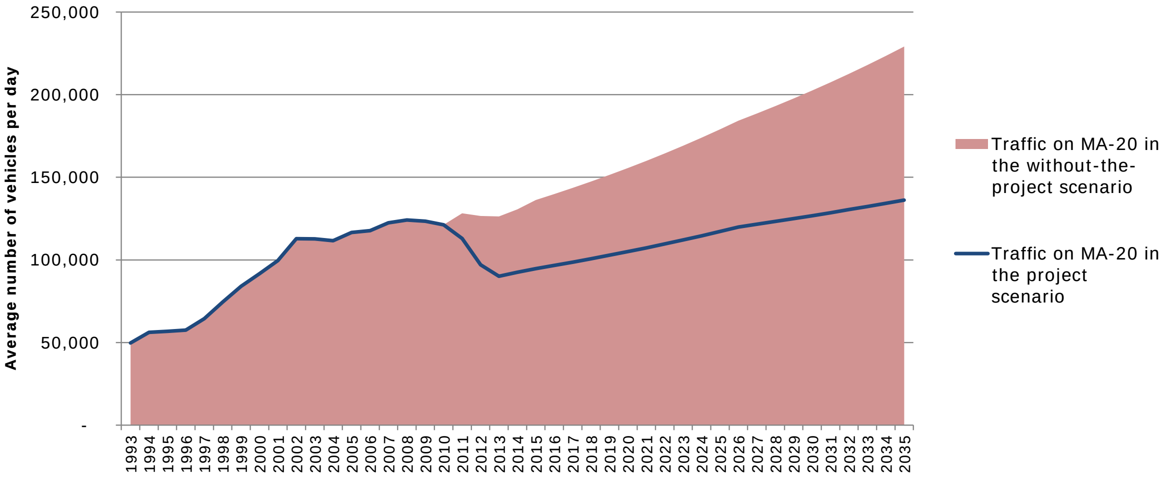
At the end of the considered time horizon, the average traffic daily intensity on the three sections of the MA-20 is assumed to reach around 230 thousand vehicles, with the maximum volume in its mid-section, in the city centre. These projections are overall in line with the ex-ante forecasts made by the Ministry of Infrastructure. From a technical point of view, this means that the MA-20 would operate beyond its nominal capacity. This is a working assumptions made to incorporate in the analysis a congestion effect that, in the without-the-project scenario, would not only lead to the collapse of the MA-20, but would also spread to other roads in Malaga. Having no access to the transport network model for the area of Malaga, the analysis here was simplified to a two-arc system (A-7 and MA-20) and the no-project capacity limit was set beyond 200 thousand vehicles.

Table 18. Average daily intensity of vehicles on MA-20 without the project in selected years and by type of vehicle

Counting station	Type of Vehicles	Average daily intensity (vehicles)					
		2011	2015	2020	2025	2030	2035
P.K. 1.9	Light	95,384	107,084	129,885	158,436	185,060	213,976
	Heavy	4,282	4,882	5,807	6,500	7,316	8,389
P.K. 6.9	Light	183,313	188,020	205,266	226,568	250,216	278,374
	Heavy	9,380	6,717	9,620	12,796	15,729	19,051
P.K. 11.4	Light	86,146	95,533	108,214	123,500	138,812	155,927
	Heavy	6,123	6,527	8,039	9,240	10,363	11,689

Source: Authors

Figure 22. Total (light and heavy) traffic trend on the MA-20 with and without-the-project



Source: Authors based on Ministry of Infrastructure data (for the 2011-2015 period) and own assumptions (2016-2035)

A II.3 Financial Analysis

Investment cost

Updated data on investment costs were provided by the Ministry of Infrastructure, broken down by road section, year and type of cost. The table below shows the construction costs, expressed in nominal value, for each section of the project. Section 1 and 2, which respectively include a tunnel and a large viaduct over the Guadalhorce River, made up to 65% of total construction costs.

Table 19. Construction cost breakdown by A-7 section, excluding expropriation, design and monitor and control costs (EUR)

A-7 SECTION	NOMINAL VALUE (EUR)[56]	% OF TOTAL CONSTRUCTION COSTS
Section 1: Motorway AP-7 -Intersection MA-417	125,554,300	33%
Section 2: Intersection MA-417 - Highway A-357	120,506,749	32%
Section 3: Highway A-357 - Intersection A-7075	99,255,928	26%
Section 4: Intersection A-7075 - Highway A-7	97,065,385	26%
TOTAL	**375,163,355**	**100%**

Source: Ministry of Infrastructure

The next table provides the breakdown of the investment cost by cost type[57] and shows the financial cost of the investment expressed in 2017 Euro net of VAT[58].

Table 20. Investment cost breakdown by project component (EUR)

INVESTMENT COST ITEM	NOMINAL VALUE (EUR)	PRESENT VALUE (EUR 2017)
Construction	375,163,355	395,741,771
Expropriation	47,851,097	55,131,782
Design	5,357,185	6,172,296
Monitor and control	9,547,865	10,071,583
Total	**437,919,503**	**467,117,433**

Source: Ministry of Infrastructure for investment cost expressed in nominal terms; Own calculation of investment cost expressed in real terms at 2017 present value.

Residual value

No relevant information concerning the possible residual value of the project was provided by the consulted stakeholders. The residual value of was therefore conservatively assumed at 10% of total construction costs.

Operating & Maintenance costs

The Ministry of Infrastructure provided data on the operating costs for both the A-7 and MA-20 roads over the 2011-2017 period. The table below shows the figures provided by the Ministry, net of VAT.

[56] Net of VAT.

[57] Due to lack of data on labour cost, this is assumed to be 40% of construction cost and 100% of design, control and monitoring cost.

[58] The VAT rate changed throughout the investment phase. It was set to 16% until 2010, then it increased to 18% in the period 2010-2012. Finally, in 2012, it was further increased to 21%.

Table 21. Operating costs net of VAT (EUR) – historical data (2011-2017)

ROAD	2011	2012	2013	2014	2015	2016	2017
MA20	321,813	310,040	310,040	430,290	360,751	360,751	360,751
A7	191,266	184,269	184,269	255,738	214,408	214,408	214,408

Source: Ministry of Infrastructure

A 12% increase on O&M costs on both roads is recorded between 2011 and 2017.[59] It is assumed that, in the project scenario, the same growth trend will remain in the future years. In the without-the-project scenario, it is assumed that maintenance cost will increase by a higher rate, due to faster deterioration of asphalt caused by higher traffic intensity. The assumption is that, starting from year 2021, O&M cost for the MA-20 in the without-the-project scenario are 20% higher every year than the O&M cost for the MA-20 in the project scenario.

Replacement costs

In line with the assumption included in the ex-ante CBA, some replacement costs for the renewal of the road surface will be incurred in the middle of project operational phase, i.e. year 2022. Replacement cost are assumed to be 20% of the initial construction cost.[60]

Operating revenues

As the road is not tolled, no operating revenue was forecasted.

Project's Financial Performance

Since the project is non-revenue generating, on a financial basis the project profitability is negative. The Financial Net Present Value (FNPV) on the investment is equal to EUR –691 million (at a 4% real discount rate), with an internal rate of return of -11%. The Financial Net Present Value on national capital is also negative, equal to EUR -354 million and with the internal rate of return on capital of -10%. These negative values confirm that the project would have not been profitable for a private investor.

The results of the project financial performance are presented in tables below.

Table 22. Financial performance indicators of the project (present value, 2017 prices)

INDICATOR	EUR
FNPV/C	-691,060,541
FRR/C	-11%
FNPV/K	-354,276,891
FRR/K	-10%

Source: Authors

[59] The total value of operating cost is assumed to be made by approximately 40% of labour, 30% of materials and 30% of energy costs.

[60] The total value of replacement cost is assumed to be made by approximately 30% of labour, 40% of materials and 30% of energy costs.

Financial Sustainability

The A-7 bypass road is managed and operated by the Ministry of Infrastructure. The Ministry periodically contracts out the maintenance to private operators, which are selected through competitive tendering. With the exception of the EU grant, no other sources of financing were mobilised to cover the project investment, O&M and replacement costs.

According to the ex-ante financing decision, the EU grant was expected to be allocated by 17% in year 2007, 33% in 2008 and 2009, and 17% in 2010. Given the implementation delays recorded by the project, we have allocated the grant over the 2008-2011 period without changing the allocation shares over the four year period.

The Ministry of Infrastructure is responsible to guarantee the project financial sustainability over its entire life time. As discussed in the case study, the possibility to introduce a toll on the motorway was discarded because it would have discouraged local users from using the new road. Therefore the State budget is expected to ensure coverage of the project O&M and replacement cost in the long-term. Although there is no evidence to support this commitment (e.g. no specific financing plan was produced for this road), given the sustainability problems that many Public-Private Partnership motorways faced since the Nineties in Spain due to manifold reasons, and the subsequent renegotiation of most of the contracts (Engel et al., 2016), all interviewees agreed that putting the bypass motorway under public control was the least risky decision to guarantee the long-term sustainability of the project.

Table 23. Financial return on investment (EUR)

		PRESENT VALUE	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	**Operational income**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1.1	Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	**CAPEX**	**703,411,230**	**61,304,078**	**14,262,931**	**61,183,853**	**151,897,383**	**84,858,793**	**48,167,388**	**45,443,006**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2.1	Construction	530,481,545	0	13,908,950	59,665,376	148,127,554	82,752,745	46,971,957	44,315,189	0	0	0	0	0	0	0	0
2.2	Expropriation	84,872,846	55,131,782	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.3	Design	9,501,966	6,172,296	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.4	Monitor and control	13,500,696	0	353,981	1,518,477	3,769,830	2,106,048	1,195,431	1,127,817	0	0	0	0	0	0	0	0
2.5	Replacement cost	65,054,178	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	**OPEX**	**7,184,237**	**0**	**0**	**0**	**0**	**0**	**339,008**	**303,088**	**291,262**	**416,627**	**363,038**	**365,908**	**367,058**	**367,058**	**367,058**	**367,058**
3.1	Incremental O&M cost	7,184,237	0	0	0	0	0	339,008	303,088	291,262	416,627	363,038	365,908	367,058	367,058	367,058	367,058
4	**Residual value**	**- 19,534,927**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5	**Total (1-2-3-4)**	**- 691,060,541**	**- 61,304,078**	**- 14,262,931**	**- 61,183,853**	**- 151,897,383**	**- 84,858,793**	**- 48,506,396**	**- 45,746,094**	**- 291,262**	**- 416,627**	**- 363,038**	**- 365,908**	**- 367,058**	**- 367,058**	**- 367,058**	**- 367,058**

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	**Operational income**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1.1	Revenues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	**CAPEX**	**0**	**79,148,354**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2.1	Construction	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.2	Expropriation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.3	Design	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.4	Monitor and control	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.5	Replacement cost	0	79,148,354	0	0	0	0	0	0	0	0	0	0	0	0	0
3	**OPEX**	**428,018**	**345,513**	**345,513**	**345,513**	**345,513**	**345,513**	**345,513**	**392,365**	**316,733**	**316,733**	**316,733**	**316,733**	**316,733**	**316,733**	**345,885**
3.1	Incremental O&M cost	428,018	345,513	345,513	345,513	345,513	345,513	345,513	392,365	316,733	316,733	316,733	316,733	316,733	316,733	345,885
4	**Residual value**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**39,574,177**
5	**Total (1-2-3-4)**	**-428,018**	**- 79,493,867**	**- 345,513**	**- 345,513**	**- 345,513**	**- 345,513**	**- 345,513**	**- 392,365**	**- 316,733**	**- 316,733**	**- 316,733**	**- 316,733**	**- 316,733**	**- 316,733**	**39,228,292**

Source: Authors

Table 24. Financial return on national capital (EUR)

		PRESENT VALUE	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	**Inflow**	**19,534,927**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1.1	Residual value	19,534,927	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
2	**Outflow**	**373,811,818**	**61,304,078**	**14,262,931**	**17,740,571**	**67,377,380**	**3,667,628**	**6,655,279**	**45,759,484**	**309,061**	**423,010**	**358,230**	**360,030**	**360,751**	**360,751**	**360,751**	**360,751**
2.1	National contribution to CAPEX	366,109,383	61,304,078	14,262,931	17,740,571	67,377,380	3,667,628	6,316,271	45,443,006	0	0	0	0	0	0	0	0
2.2	National contribution to OPEX	7,702,435	0	0	0	0	0	339,008	316,478	309,061	423,010	358,230	360,030	360,751	360,751	360,751	360,751
3	**TOTAL (1-2)**	**- 354,276,891**	**- 61,304,078**	**- 14,262,931**	**- 17,740,571**	**- 67,377,380**	**- 3,667,628**	**- 6,655,279**	**- 45,759,484**	**- 309,061**	**- 423,010**	**- 358,230**	**- 360,030**	**- 360,751**	**- 360,751**	**- 360,751**	**- 360,751**

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	**Inflow**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**39,574,177**
1.1	Residual value	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	39,574,177
2	**Outflow**	**461,568**	**79,148,354**	**372,596**	**372,596**	**372,596**	**372,596**	**372,596**	**476,723**	**384,829**	**384,829**	**384,829**	**384,829**	**384,829**	**384,829**	**492,375**
2.1	National contribution to CAPEX	0	79,148,354	0	0	0	0	0	0	0	0	0	0	0	0	0
2.2	National contribution to OPEX	461,568	372,596	372,596	372,596	372,596	372,596	372,596	476,723	384,829	384,829	384,829	384,829	384,829	384,829	492,375
3	**TOTAL (1-2)**	**- 461,568**	**- 79,520,950**	**- 372,596**	**- 372,596**	**- 372,596**	**- 372,596**	**- 372,596**	**- 476,723**	**- 384,829**	**- 384,829**	**- 384,829**	**- 384,829**	**- 384,829**	**- 384,829**	**39,081,802**

Source: Authors

Table 25. Financial sustainability of the project (EUR)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
EU grant	0	0	43,443,282	84,520,004	81,191,166	41,851,117	0	0	0	0	0	0	0	0	0
National contribution to CAPEX	61,304,078	14,262,931	17,740,571	67,377,380	3,667,628	6,316,271	45,443,006	0	0	0	0	0	0	0	0
National contribution to OPEX	0	0	0	0	0	339,008	316,478	309,061	423,010	358,230	360,030	360,751	360,751	360,751	360,751
Total inflows	**61,304,078**	**14,262,931**	**61,183,853**	**151,897,383**	**84,858,793**	**48,506,396**	**45,759,484**	**309,061**	**423,010**	**358,230**	**360,030**	**360,751**	**360,751**	**360,751**	**360,751**
CAPEX	61,304,078	14,262,931	61,183,853	151,897,383	84,858,793	48,167,388	45,443,006	0	0	0	0	0	0	0	0
OPEX	0	0	0	0	0	339,008	316,478	309,061	423,010	358,230	360,030	360,751	360,751	360,751	360,751
Total outflows	**61,304,078**	**14,262,931**	**61,183,853**	**151,897,383**	**84,858,793**	**48,506,396**	**45,759,484**	**309,061**	**423,010**	**358,230**	**360,030**	**360,751**	**360,751**	**360,751**	**360,751**
Net cash flow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cumulated net cash flow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
EU grant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
National contribution to CAPEX	0	79,148,354	0	0	0	0	0	0	0	0	0	0	0	0	0
National contribution to OPEX	461,568	372,596	372,596	372,596	372,596	372,596	372,596	476,723	384,829	384,829	384,829	384,829	384,829	384,829	492,375
Total inflows	**461,568**	**79,520,950**	**372,596**	**372,596**	**372,596**	**372,596**	**372,596**	**476,723**	**384,829**	**384,829**	**384,829**	**384,829**	**384,829**	**384,829**	**492,375**
CAPEX	0	79,148,354	0	0	0	0	0	0	0	0	0	0	0	0	0
OPEX	461,568	372,596	372,596	372,596	372,596	372,596	372,596	476,723	384,829	384,829	384,829	384,829	384,829	384,829	492,375
Total outflows	**461,568**	**79,520,950**	**372,596**	**372,596**	**372,596**	**372,596**	**372,596**	**476,723**	**384,829**	**384,829**	**384,829**	**384,829**	**384,829**	**384,829**	**492,375**
Net cash flow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cumulated net cash flow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Source: Authors

A II.4 Economic Analysis

From market to accounting prices

In line with the EC CBA Guide (2014), the social opportunity cost of the project's inputs and outputs were considered in the economic analysis. For this purpose, market prices have been converted into accounting prices by using appropriate conversion factors.

As to labour, the backward and forward shadow wages which were provided by the First Interim Report[61] and specifically estimated for the Andalusia region were adopted to correct past and future value of labour costs. The assumed share of labour cost over the construction, O&M and replacement costs are mentioned in the previous sections.

A guidance document for the implementation of CBA for Spanish project is available (Ministry of Infrastructure and Ministry of Environment Affairs, 2010), but it does not provide specific conversion factors to apply when assessing the socio-economic value of projects' cost items. Thus a conversion factor equal to 1 was assumed for all items other than labour. The Table below summarises the conversion factors applied for each cost item.

Table 26. Conversion factors for CBA inputs

ITEM	CONVERSION FACTOR	SOURCE
Labour cost under investment costs and operating costs	0.85 backwards 0.58 forwards	Conversion factors for labour as reported in the First Interim Report, Volume I
Land acquisition	1	Own assumption
Materials under both operating and investment costs	1	Own assumption
Energy/Fuel costs under operating costs	1	Own assumption
Residual value	1	Own assumption

Source: Authors based on cited sources

Project's effects

The main effects generated by the implementation of the project and monetised in the CBA are distinguished into:

- Change in consumer surplus, represented by:
  - time savings for both A-7 and MA-20 users;
  - change in operating costs savings for both A-7 and MA-20 users.
- Environmental externalities:
  - change in local air pollution;
  - change in GHG emissions;
- Quality of life effects
  - change in traffic noise;
  - change in the number of road accidents.

The socio-economic value of each of these effects is summarised in the Figure below. As the Figure shows, not all these impacts represent positive benefits of the project.

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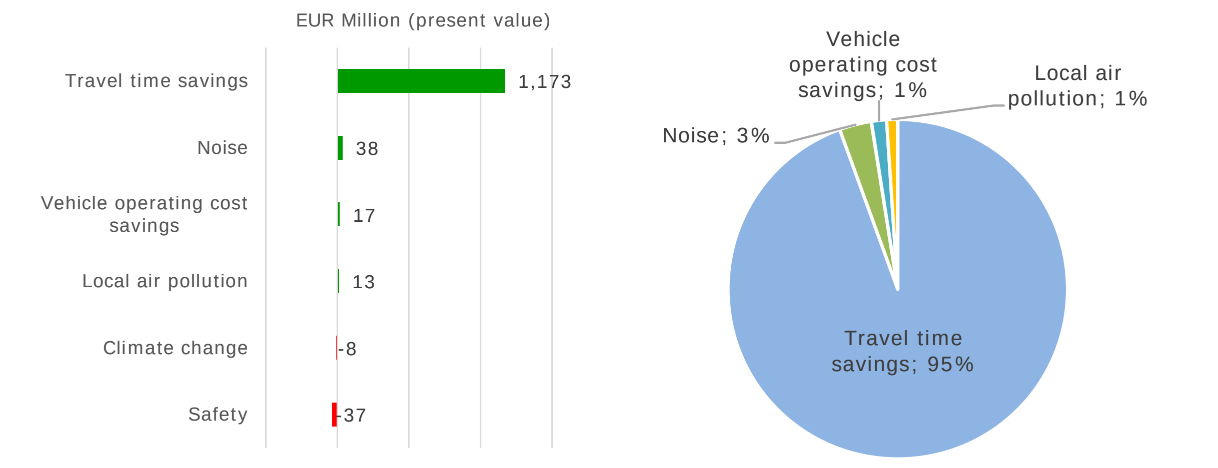
[61] See Annex III, page 76.

Figure 23. Present value of the project socio-economic effects (EUR million, 2017 prices) and share of each benefits on the total



Source: Authors

Travel time savings are the main project benefit, making up to 95% of the whole project's benefits. This is consistent with the project objective, namely improving traffic conditions in Malaga by diverting traffic from the highly congested MA-20 to the A-7. Savings in vehicle operating costs are a positive, but marginal, benefit of the project. The diversion of vehicles away from the MA-20 to the A-7 produced the benefit of reducing noise and air pollution in the urban area. The CBA reveals that the project produces a negative, even if marginal, effect on users' safety and climate change, because of an increase in GHG emissions due to induced traffic.

As discussed in the case study (Section 3.2), the project has also contributed to produce some agglomeration economies through the increase of labour density in the industrial area of Malaga. In line with the CBA practice (EC Guide 2014; EIB 2013, OECD/International Transport Forum 2008, 2016), the analysis does not incorporate these wider economic effects for the industrial areas nearby Malaga.[62]

The CBA also ignore the environmental impact in terms of land taken, barrier effects and aesthetic impact on the mountain landscape. Actually, in spite of the big size of the infrastructure, these effects were not perceived as particularly significant by any of the stakeholders interviewed.

In what follows the way how each effect was quantified and value is presented.

Time savings

Thanks to the implementation of the project, part of the traffic originally served by the MA-20 was diverted to the A-7. This led to travel time savings for users of both roads. On the one side, congestion on the MA-20 was reduced, benefiting the traffic which continues using the MA20; on the other side, vehicles using the A-7, given the road's higher capacity, are not likely to suffer from any significant congestion problem during the entire project life.

[62] Wider economic impacts arise from market imperfections and may affect industrial areas nearby the transport project implementation in terms of return to scale, agglomeration, thickening of labour market, market power, firms' and households' behavioural adaptations to changes in transport costs, and so on so forth (OECD/ ITF, 2008).

It is assumed that the total traffic in the metropolitan area of Malaga is composed by 50% of commuters' trips, 25% business trips and 25% leisure trips.

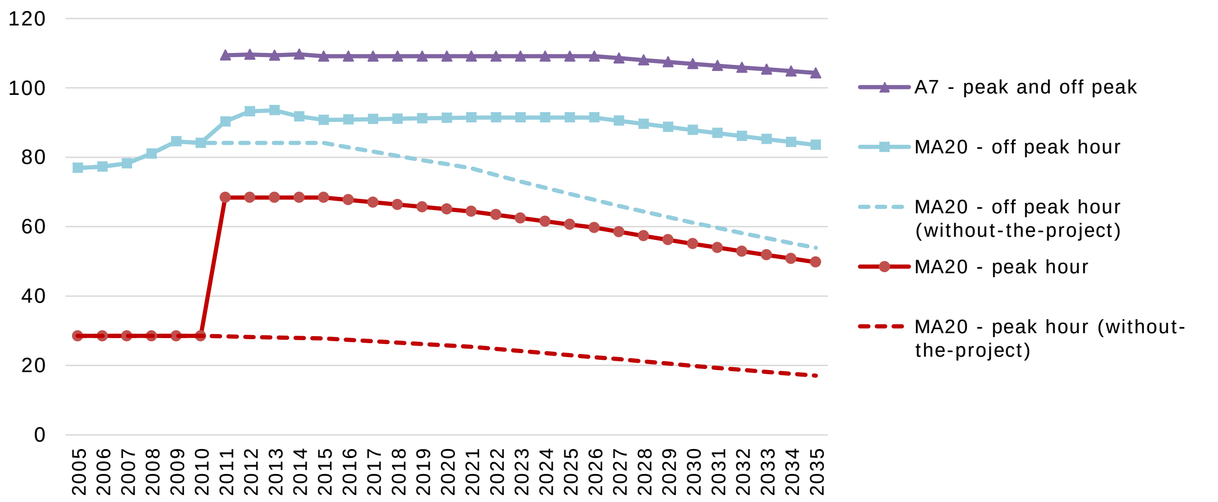
Travel time for both MA-20 and A-7 users was estimated at peak and off-peak hours in different sections of the roads, so as to take into account that congestion before the project implementation was concentrated during peak hours and in the mid-section of the MA20, while traffic was generally more fluid during the rest of the day and in the first and last sections of the MA-20. Peak hours are supposed to last four hours per day (7am-9am; 5pm-7pm).

On the basis of interviews[63] and historical data on traffic and average speed, the average speed of light and heavy vehicles and corresponding travel time during peak hours were estimated, for both the A-7 and the MA-20 in the project and counterfactual scenario. In particular, it was considered that:

- The greatest travel time saving is produced for vehicles using the MA-20 mid-section during the peak hours. They save on average 14 minutes after the project implementation.
- Traffic diverted from the MA-20 to the A-7 also enjoyed some travel time savings compared to the situation before the project. They save 10 minutes to travel from north to south of Malaga along the A-7 as compared to the counterfactual scenario. The time saving is lower than for MA-20 users, due to the longer length of the A-7.
- The average speed is expected to progressively decrease as traffic intensity increases on the A-7 and the MA-20. Average speed on the MA-20 decreases faster because the road has more limited capacity than the A-7 and, thus, tends to congestion before than the A-7.
- During off-peak hours, the time savings for users of the MA20 of A-7 are negligible in the first years of the project time horizon. However, as traffic intensity on the MA-20 in the project and without-the-project scenarios increases, the average speed on the off-peak day starts decreasing too. This is to say that, in the future, congestion on the MA-20 will occur not only during the peak hours, but also in other hours of the day.

[63] According to qualified interviews, the travel time saving on the MA-20 after the implementation of the project is around 14 minutes. Data on average speed for 2015 (in the project scenario) were provided by the Ministry of Infrastructure.

Figure 24. Average speed on the A-7 and the MA-20 (with and without-the-project, peak and off-peak)



Source: Own elaboration and assumptions based on Ministry of Infrastructure data

Note: Average speed is computed as a weighted average of the speed of light and heavy vehicles.

Travel time savings were multiplied by the number of vehicles during peak and off-peak hours in the different sections of the roads. By relying on the detailed data on vehicle intensity per hour provided by the Ministry of Infrastructure, it was estimated that the peak hour share (i.e. the number of vehicles during peak hours compared with the daily average intensity) is 20% for light vehicles and 10% for heavy vehicles.

The so-called “rule of half” approach was applied to estimate the travel time savings for induced traffic.

In line with the methodology described in the First Interim Report, time savings were monetised as person-hours saved multiplied by the unit cost of time for Spain for different travel purposes (commuting, business, and other). An occupancy rate of 1.2 was applied to light vehicles. As to heavy vehicles, monetisation is based on hours saved multiplied by tons of freight. Unit value of time for freight traffic was provided by the Fist Interim Report. An average load factor of 16 tons was assumed.

Travel time savings are valued EUR 1,173 million and represent 95% of the total project benefits.

Trip cost savings

A benefit in trip cost savings resulted from the difference in Vehicles Operating Costs (VOC) in the project and without-the-project scenarios. The relatively short length of the A-7 and MA-20 roads allows considering fuel costs as the main VOC component.

The fuel consumption cost for light vehicle running along the A-7 or the MA-20 was estimated.[64] This is EUR 1.14 and EUR 1.88 per vehicle travelling respectively on the 11.4 km MA-20 and 21.4 km A-7. In line with the European Commission report “Analysis of operating cost in the EU and the US” *(2006)*, VOCs for heavy vehicles are assumed to be twice as much the light vehicles’ VOCs.

Since traffic is expected to be much more congested in the without-the-project scenario, thus leading to higher fuel costs, unit VOCs in the counterfactual scenario are assumed to

[64] Source: https://www.viamichelin.it/web/Itinerari.

be the same as for the MA-20 in the project scenario, and 50% higher starting from year 2026.

The sum of VOCs for vehicles on the A-7 and the MA-20, net of the VOCs in the without-the-project scenario, was computed. The rule of half was used to estimate VOC benefits for induced traffic on the A7. In total, the project produces a VOC saving valuing EUR 17 million and representing 1% of the total benefits.

Air pollution savings

Changes in air pollution emissions (including PM 2.5, NOX, NMVOC) that are directly imputable to the project were quantified and valued in economic terms. The volume of emissions produced by vehicles using the A-7 and MA-20 was quantified by relying on EMEP/ EEA (2017) data of volumes of emissions per vehicle kilometres, for different types of vehicles. The average volume of emissions for light (passenger and commercial) and heavy vehicles was computed.[65]

The unit costs of emissions provided by the First Interim Report were used to attach a monetary value to air pollutants. It is important to notice that the unit economic value of PM 2.5 in an urban area is higher than the value of emission in a suburban area.

Table 27. Assumed volumes and economic value of air emissions

		PM 2.5	NOX	NMVOC
Volume of emissions	light vehicles	0.03 g/vkm	0.75 g/vkm	0.37 g/vkm
	heavy vehicles	0.13 g/vkm	5.63 g/vkm	2.74 g/vkm
Unit shadow prices		Suburban: 54,053 EUR/ton Urban: 213,394 EUR/ton	565 EUR/ton	1,207 EUR/ton

Source: Own elaboration based on EMEP/EEA (2010) for the emissions volume; First Interim Report for the unit shadow prices.

These unit values were applied to the sum of emissions produced by vehicles on the MA-20 and A-7 roads, net of the emissions produced in the without-the-project scenario.

The analysis revels that the project produced an overall reduction of air pollution. This is mainly due to the diversion of a share of traffic from the MA-20 road, crossing the Malaga urban area, to the A-7 bypass, crossing a suburban area and thus causing a reduced environmental cost from PM 2.5. This benefit is valued at EUR 13 million and it represents 1% of the total project benefits.

GHG emissions

The traffic induced by the new A-7 bypass, although not particularly high, produces an increases in CO_2 emissions, which has a negative impact on climate change. By applying the average volume of CO2 emission per light and heavy vehicle kilometre (source: First Interim Report), it was estimated that the project produces around 245 ton throughout its entire time horizon.

The economic value of these emissions was estimated by applying the unit shadow price of CO_2, estimated according to the methodology presented in the First Interim Report. In

[65] Vehicles classified under the “conventional” vehicle class were excluded. This category includes vehicles of pre-1992 production, as well non-regulated vehicles launched prior to 1985.

total, the socio-economic cost from GHG emissions is valued EUR -8 million, not particularly high due to the short length of the road.

Change in the number of collisions and accidents

The Ministry of Infrastructure and the municipality of Malaga provided historical data on the number of accidents on the MA-20 and the A-7 from 2006 to 2017. Historical data show that the risk of incurring in an accident (number of accidents per vehicle kilometre[66]) is slightly higher on the MA-20 than the A-7.

As traffic on the A-7 increases, the number of accidents of any type is expected to increase too. In order to forecast the number of accidents on the A-7 in the future years, it is assumed that the risk of accidents per vehicle kilometre will remain constant during the entire time horizon (hence, the number of accidents increases proportionally with traffic only).

In line with Marchesini and Weijermars (2010), who show that when traffic congestion increases the risk rate of accidents and severe injuries decrease but the rate of slight injuries increase, it is assumed that the risk rate will change on the MA-20 with- and without-the-project, as time goes by. The assumed risk rate by road and type of accident is presented in the table below.

Table 28. Risk rate per one million vehicle kilometres

ROAD	TYPE OF ACCIDENT	2006-2010	2011-2015	2016-2025	2026-2035
A-7	Fatality	-	0.003	→ 0.003	→ 0.003
A-7	Severe Injury	-	0.006	→ 0.006	→ 0.006
A-7	Slight Injury	-	0.085	→ 0.085	→ 0.085
MA-20	Fatality	0.004	→ 0.004	→ 0.004	↓ 0.002
MA-20	Severe Injury	0.009	→ 0.009	→ 0.009	↓ 0.007
MA-20	Slight Injury	0.208	→ 0.208	→ 0.208	↑ 0.212
MA-20 without the project	Fatality	0.004	→ 0.005	↓ 0.003	↓ 0.001
MA-20 without the project	Severe Injury	0.009	→ 0.009	↓ 0.008	↓ 0.006
MA-20 without the project	Slight Injury	0.208	→ 0.208	↑ 0.210	↑ 0.214

Source: Authors.

The applied social costs for accidents (fatalities, sever injuries and slight injuries) are in line with those indicated in the First Interim Report.

The analysis shows that the project has an overall negative impact on the users' safety, valued at EUR -37 million.

Reduction of traffic noise

Diverting traffic away from the MA-20 motorway, crossing the Malaga urban area to the A-7 crossing a suburban and mostly industrial areas produced a reduction of noise externalities.

In line with the Interim Report, noise externalities were quantified by using the unit values per 1000 vehicles kilometres provided by the First Interim Report, differentiated by time of the day (daytime and night time) and vehicles (light and heavy). The volume of traffic on the MA-20 and the A-7 in the project and without-the-project scenarios was

[66] Brevvia et al. (2009).

estimated by assuming reasonable traffic distribution in daytime and night time. Detailed traffic figures provided the Ministry of Infrastructures serves as a basis for calculation.

The overall estimated benefit from noise reduction is valued at EUR 38 million, and represents 3% of the total project benefits.

Project's Economic Performance

The ENPV of the Malaga New West Bypass, computed at a real backward social discount rate of 2.88% and a real forward social discount rate of 3.22%, is positive (EUR 600 million). The EIRR is higher than the social discount rate. The B/C ratio is higher than one. These results confirm that the project was desirable from a socio-economic viewpoint.

The ex-ante CBA carried out by SEITT and attached to the application for EU Co-financing also returned positive, and much higher, results: the ENPV was equal to EUR 4.95 billion, the EIRR was estimated at 46%.[67] While the purpose of the evaluation is not to compare ex-ante and ex-post CBAs and the results of these assessments cannot be easily compared due to different underlying methodological assumptions, the main cause of discrepancy is due to the change in the scope of the project. In both the analyses, however, the most important benefit of the project is referred to the travel time savings for both users of the new bypass motorway and the old MA-20 road.

The results of the economic analysis are presented in the tables below.

Table 29. Economic performance indicators of the project

INDICATOR	EUR
ENPV	600,504,058
B/C	2.25
EIRR	7.61%

Source: Authors

[67] "Estudio de rentabilidad socio-económica de la actuación de la nueva ronda de circunvalación Oeste de Málaga" (November 2008), page 20.

Table 30. Economic return of the project (EUR)

		PRESENTVALUE	2006	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	**CAPEX**	**589,548,455**	**60,378,234**	**13,375,297**	**57,376,159**	**142,444,256**	**79,577,722**	**45,169,756**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1.1	Labour (Construction)	166,305,603	0	4,729,043	20,286,228	50,363,368	28,135,933	15,970,465	0	0	0	0	0	0	0	0
1.2	Labour (Design)	7,169,786	5,246,452	0	0	0	0	0	0	0	0	0	0	0	0	0
1.3	Labour (Monitor & Control)	10,581,147	0	300,884	1,290,706	3,204,355	1,790,141	1,016,116	0	0	0	0	0	0	0	0
1.4	Materials	293,480,475	0	8,345,370	35,799,226	88,876,532	49,651,647	28,183,174	0	0	0	0	0	0	0	0
1.5	Land	75,342,937	55,131,782	0	0	0	0	0	0	0	0	0	0	0	0	0
1.6	Replacement cost - Labour	11,753,626	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.7	Replacement cost - Materials	27,019,830	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.8	Replacement cost - Fuel	20,264,872	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.9	Residual value	-22,369,821	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	**OPEX**	**7,086,659**	**0**	**0**	**0**	**0**	**0**	**0**	**315,211**	**302,912**	**433,292**	**377,560**	**380,544**	**342,098**	**342,098**	**342,098**
2.1	Labour	1,959,981	0	0	0	0	0	115,263	103,050	99,029	141,653	123,433	124,409	85,158	85,158	85,158
2.2	Fuel	2,912,303	0	0	0	0	0	101,703	121,235	116,505	166,651	145,215	146,363	146,823	146,823	146,823
2.3	Materials	2,214,375	0	0	0	0	0	101,703	90,926	87,379	124,988	108,911	109,772	110,118	110,118	110,118
3	**TOTAL SOCIO-ECONOMIC COSTS (1+2)**	**596,257,259**	**596,257,259**	**60,378,234**	**13,375,297**	**57,376,159**	**142,444,256**	**79,577,722**	**45,169,756**	**42,930,133**	**302,912**	**433,292**	**377,560**	**380,544**	**342,098**	**342,098**
4	**TOTAL SOCIO-ECONOMIC BENEFITS**	**1,196,761,318**	**0**	**0**	**0**	**0**	**0**	**25,577,439**	**20,139,390**	**22,137,295**	**24,904,589**	**17,742,222**	**20,662,774**	**24,591,620**	**23,380,616**	**25,416,812**
4.1	Travel time savings	1,173,299,675	0	0	0	0	0	34,820,055	31,715,430	27,771,067	27,449,992	27,241,902	29,217,746	31,308,853	33,533,864	35,905,391
4.2	Vehicle operating cost savings	17,421,965	0	0	0	0	0	-8,975,942	-8,674,766	-7,917,280	-8,297,257	-9,198,729	-9,521,926	-9,860,036	-10,214,540	-10,586,379
4.3	Safety	-36,843,096	0	0	0	0	0	348,353	-3,530,994	873,599	4,278,087	-1,909,721	-712,457	1,389,313	-1,770,204	-1,815,767
4.4	Climate change	-8,310,794	0	0	0	0	0	-681,456.72	-412,977.22	-170,975.94	-184,788.77	-210,237.58	-225,598.59	-241,968.63	-259,453.69	-278,127.50
4.5	Local air pollution	13,114,333	0	0	0	0	0	-170,644	190,424	408,209	428,804	467,436	490,334	514,376	539,702	566,359
4.6	Noise	38,079,234	0	0	0	0	0	237,073	852,274	1,172,677	1,229,752	1,351,571	1,414,675	1,481,083	1,551,249	1,625,336
5	**Total Net Cash Flow (4-3)**	**600,504,058**	**-60,378,234**	**-13,375,297**	**-57,376,159**	**-142,444,256**	**-79,577,722**	**-19,592,317**	**-22,790,743**	**21,834,383**	**24,471,297**	**17,364,663**	**20,282,230**	**24,249,522**	**23,038,518**	**25,074,714**

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	**CAPEX**	**0**	**69,175,662**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1.1	Labour (Construction)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.2	Labour (Design)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.3	Labour (Monitor & Control)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.4	Materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.5	Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.6	Replacement cost - Labour	0	13,771,814	0	0	0	0	0	0	0	0	0	0	0	0	0
1.7	Replacement cost - Materials	0	31,659,342	0	0	0	0	0	0	0	0	0	0	0	0	0
1.8	Replacement cost - Fuel	0	23,744,506	0	0	0	0	0	0	0	0	0	0	0	0	0
1.9	Residual value	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	-39,574,177
2	**OPEX**	**342,098**	**322,018**	**322,018**	**322,018**	**322,018**	**322,018**	**322,018**	**365,684**	**295,195**	**295,195**	**295,195**	**295,195**	**295,195**	**295,195**	**322,365**
2.1	Labour	85,158	80,159	80,159	80,159	80,159	80,159	80,159	91,029	73,482	73,482	73,482	73,482	73,482	73,482	80,245
2.2	Fuel	146,823	138,205	138,205	138,205	138,205	138,205	138,205	156,946	126,693	126,693	126,693	126,693	126,693	126,693	138,354
2.3	Materials	110,118	103,654	103,654	103,654	103,654	103,654	103,654	117,710	95,020	95,020	95,020	95,020	95,020	95,020	103,766
3	**TOTAL SOCIO-ECONOMIC COSTS (1+2)**	**342,098**	**69,497,680**	**322,018**	**322,018**	**322,018**	**322,018**	**322,018**	**365,684**	**295,195**	**295,195**	**295,195**	**295,195**	**295,195**	**295,195**	**- 39,251,812**
4	**TOTAL SOCIO-ECONOMIC BENEFITS**	**29,933,315**	**34,211,275**	**38,821,752**	**43,789,612**	**49,141,599**	**90,183,380**	**95,958,401**	**102,555,734**	**109,612,860**	**117,162,751**	**125,240,852**	**133,885,272**	**143,136,996**	**153,040,110**	**163,642,051**
4.1	Travel time savings	41,140,888	45,736,110	50,672,956	55,976,536	61,673,851	67,793,931	73,102,242	79,214,409	85,767,056	92,792,263	100,324,535	108,400,994	117,061,595	126,349,339	136,310,527
4.2	Vehicle operating cost savings	-11,386,872	-11,738,360	-12,100,927	-12,474,921	-12,860,701	23,094,389	23,551,188	24,025,307	24,517,530	25,028,681	25,559,620	26,111,252	26,684,525	27,280,431	27,900,013
4.3	Safety	-1,911,577	-1,960,201	-2,010,302	-2,061,926	-2,115,123	-3,246,074	-3,337,805	-3,432,655	-3,530,738	-3,632,171	-3,737,077	-3,845,582	-3,957,818	-4,073,923	-4,194,038
4.4	Climate change	-319,409.67	-339,587.53	-360,849.91	-383,252.18	-406,852.51	-431,711.95	-457,894.61	-485,467.82	-514,502.26	-545,072.12	-577,255.32	-611,133.66	-646,793.00	-684,323.49	-723,819.79
4.5	Local air pollution	623,975	652,651	682,654	714,046	746,891	781,257	817,215	854,838	894,204	935,393	978,492	1,023,587	1,070,774	1,120,147	1,171,810
4.6	Noise	1,786,310	1,860,662	1,938,221	2,019,129	2,103,533	2,191,588	2,283,456	2,379,304	2,479,310	2,583,657	2,692,538	2,806,154	2,924,714	3,048,440	3,177,559
5	**TOTAL NET CASH FLOW (4-3)**	**27,254,563**	**-35,286,405**	**38,499,734**	**43,467,594**	**48,819,581**	**89,861,362**	**95,636,383**	**102,190,050**	**109,317,665**	**116,867,556**	**124,945,657**	**133,590,078**	**142,841,801**	**152,744,916**	**202,893,863**

Source: Authors

A II.5 Sensitivity analysis

A sensitivity analysis was carried out on the key variables entering the CBA in order to determine whether they are critical or not. The procedure requires to make them vary one at a time by a

Table 31.

INDEPENDENT VARIABLE	VARIATION (in %) of the economic NPV due to a unit variation of the variable	CRITICALITY JUDGEMENT *
Deterioration factor of OPEX on MA-20 in without-the-project scenario	0%	Not critical
Future average annual growth rate of traffic on A-7 (on all sections)	4%	Critical
Future average annual growth rate of traffic on MA-20 (on all sections)	5%	Critical
Share of business travellers	1%	Not critical
Share of (light and heavy) vehicles during peak hours	11%	Very critical
Future travel speed on MA-20 with project (peak and off peak)	8%	Very critical
Congestion factor of VOC of MA-20 in without-the-project scenario	1%	Not critical
Effect of congestion on risk of light injuries	1%	Not critical
Share of vehicles during the day (light and heavy) on A-7 and MA-20	0%	Not critical
Vehicles emissions of PM2.5, NMVOC and NOX	0%	Not critical

Source: Authors

Note: 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 critical variables resulting from the sensitivity analysis. For the sake of simplicity, it was assumed that the probability distribution of each of these variables is triangular, with 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 analysis was elaborated using the Monte Carlo simulation technique with 10,000 random repetitions. In brief, at each iteration it is randomly extracted a value from the distribution of each of the independent variables. The extracted values are then adopted for computing the ENVP and IRR. Finally, the 10,000 estimated values of ENPV and EIRR 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 604.4 million (slightly higher than the reference case), and that the expected value of the ERR is 7.60% (against a reference case of 7.61%). The probability that the ENPV will become negative and that the ERR will be lower that the SDR adopted in the analysis is nil. However, there is a 50% probability that the two indicators assume a lower value than in the reference case. Hence, the CBA results 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 25. Results of the risk analysis for ENPV (left-hand side) and ERR (right-hand side)

CBA Reference value	
ENPV	600,504,058
ERR	7.61%

Estimated parameters of the distribution

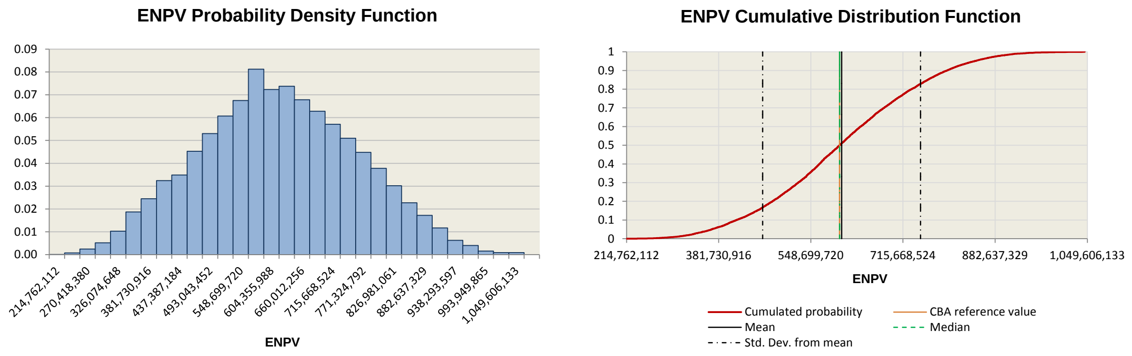
	ENPV	ERR
Mean	604,435,491	7.60%
Median	600,859,944	7.60%
Standard deviation	143,066,600	0.93%
Minimum	214,762,112	4.92%
Maximum	1,049,606,133	10.07%

Estimated probabilities

Pr. ENPV ≤ base value	0.499
Pr. ENPV ≤ 0	0.000
Pr. ERR ≤ base value	0.503
Pr. ERR ≤ Social discount rate	0.000

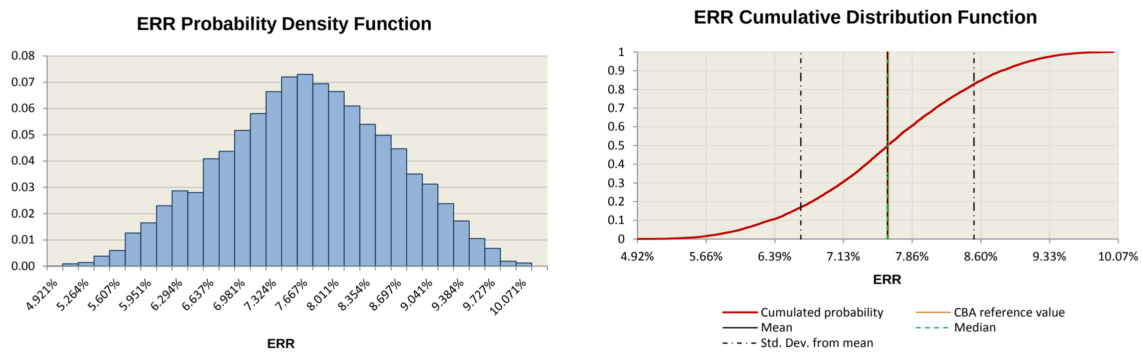
Source: Authors

Figure 26. Probabilistic distribution of the Economic Net Present Value (EUR)



Source: Authors

Figure 27. Probabilistic distribution of the Economic Internal Rate of Return



Source: Authors

ANNEX III. LIST OF INTERVIEWEES

The following table provides details on the 30 stakeholders that have been interviewed as part of the ex-post assessment. The stakeholders have been identified based on the actors 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.

Attention was given to represent different categories of stakeholders, including civil and business associations (Association of Neighbours of Campanillas, the association representing the hotel businessmen, and the association of Industrial and Commercial Zones and Parks of Malaga). One of the main business and logistic centre of the area (Mercamalaga) was also approached and interviewed. Representative people from all the institutional levels (municipality, province, region and State) were interviewed.

NAME	POSITION	AFFILIATION	DATE
Mr. Marian Răduţă	Programme Manager - EU policies / Spain OP Andalucia	DG Regional Policy, European Commission	23/11/2017 and 02/02/2017 (telephone)
Mr. Anatolio Alonso Pardo	Deputy Director	ERDF SPAIN - Treasury (Ministerio de Hacienda)	27/11/2017
Ms. Carmen Martin Moreno	Technical consultant	ERDF SPAIN - Treasury (Ministerio de Hacienda)	27/11/2017
Ms. Margarita Ramos Jado	Transport Engineer	State Company of Terrestrial Infrastructures (Sociedad Estatal de Infrastructuras Terrestres - SEITT)	27/11/2017
Mr. José del Cerro Grau	Head of the State Roads Demarcation in Eastern Andalusia	Ministry of Infrastructure (Ministerio del Fomento)	28/11/2017
Mr. Francisco Javier Pérez Ureña	Head of the Support Unit of the General Directorate of Roads	Ministry of Infrastructure (Ministerio del Fomento)	28/11/2017
Mr. José Menchén Fisac	Chief of Work management and Control, General Subdirectory of Construction Head of the Works Management and Control Are of the General Directorate of Construction	Ministry of Infrastructure (Ministerio del Fomento)	28/11/2017
Mr. José Luis Ruiz Espejo	President	Technological Park of Andalusia (Parque Tecnológico de Andalucía – PTA)	29 /11/2017
	Delegate of the Regional Government in Malaga	Regional Government of Andalusia	29 /11/2017
Mr. Felipe Romera	Director	Technological Park of Andalusia (Parque Tecnológico de Andalucía – PTA)	29 /11/2017
Mr. Juan	Anonymous taxi driver in Malaga		29 /11/2017
Ginés de Rus	Academic expert	Department of Applied Economic Analysis – University of Las Palmas de Gran Canaria	21/12/2017 (telephone)
Carmela Fernandez	President	Association of Neighbours of Campanillas	09/01/2018
Salvador Aranda	Member of the association	Association of Neighbours of	09/01/2018

		Campanillas	
Ricardo Fombuena	Member of the association	Association of Neighbours of Campanillas	09/01/2018
Sergio José Brenes Cobos	Councilor Deputy Spokesperson	Municipality of Malaga	09/01/2018
Rubén Castro Rodrìguez	Deputy Director of Markets and General Services	Mercamálaga	10/01/2018
Francisco Luque López	Head of Customers and Suppliers	Mercamálaga	10/01/2018
Manuel J. Piniella García	Head of the office Roads and Infrastructure	Province of Malaga	10/01/2018
Alfonso Sanchez	Head of the Roads and Infrastructure Office	Regional Government of Andalusia	10/01/2018
Antonio Moreno Jiménez	Technical expert	Regional Government of Andalusia	10/01/2018
Antonio Aranda	General Secreatary	Costa del Sol Hotel Businessmen Association (Asociación de Empresarios Hoteleros de la Costa del Sol - AEHCOS)	11/01/2018
Francisco de la Torres Prados	Major	Municipality of Malaga	11/01/2018
Carlos Conde	Councilor for Economy	Municipality of Malaga	11/01/2018
Francisco Pomares Fuertes	Councilor for Town Planning and Housing	Municipality of Malaga	11/01/2018
José Cardador	Manager of Urbanism	Municipality of Malaga	11/01/2018
Javier Bootello	Head of the Infrastructure Office	Municipality of Malaga	11/01/2018
Pedro Marin Cots	Head of European Programmes and Director of the Urban Environment Observatory (OMAU)	Municipality of Malaga	11/01/2018
José Antonio Domíngo Atencia	Head of the State Highway Unit in Malaga - State Roads Demarcation in Eastern Andalusia	Ministry of Infrastructure (Ministerio del Fomento)	12/01/2018
Juan Alberto Creto	Road Conservation - State Highway Unit in Malaga - State Roads Demarcation in Eastern Andalusia	Ministry of Infrastructure (Ministerio del Fomento)	12/01/2018
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