

Ajuntament de
Barcelona



DATA CITY

Barcelona [Season 1]

Build together The
Cities of Tomorrow

through
Public-Private Collaboration,
Data & Technology

2018-2019

#2 Challenge

Reduce traffic congestion and air pollution at the access to the city of Barcelona

What model of management for high capacity roads for which impact on the city of Barcelona ?

// CONTEXT

Cities throughout the world are faced with the challenge of reducing traffic congestion due to its considerable impact on public health.

The City of Barcelona set the ambitious objective of reducing by 21% the use of private vehicles in the city by 2024. At the same time, some of the main toll-roads concessions in Catalonia will come to an end by 2021.

Debate is opened regarding which new management model for high capacity roads to opt for. Two main models are being implemented throughout Europe:

1. **Time-based payment system or “vignette”**
elimination of all toll roads and implementation of an annual tax paid by all users of private vehicles allowing them to access high capacity roads.
2. **Distance-based payment**
scenario under which the user pays an amount depending on the distance travelled on the high capacity road.

// QUESTIONS

The access to Barcelona includes the network high capacity roads but also the network of public transportation entering the city. How would high capacity roads be affected by the different management scenarios and how would it affect commuters's behaviour from municipalities of the Metropolitan Area of Barcelona to Barcelona City?

// TEAM INVOLVED



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// DATASETS GATHERED

Ministry of Development - 2017
Traffic Map

Observatory of Mobility - data on
travel patterns

Mobility Studies - insights on time
value, traffic elasticities, traffic growth
etc.

Abertis Autopistas España - Data on
toll roads management and traffic
entering the city

Instituto Nacional de Estadísticas
Demographic and economic data

Catalan Municipalities - Urban
Mobility Plans & population travel
patterns

// SIMULATION OBJECTIVES

The objective of this study is to analyse the
impact of both management models on:

1. Traffic conditions in high capacity roads

Specifically looking at the impact on the
following indicators:

1. Level of Service
2. Traffic (IMD)
3. Travel times or Delays
4. Emissions
5. Accidentality

2. Commuters' choice of transportation mode to enter Barcelona

The study focused on assessing the change
of transportation mode by commuters
travelling from six municipalities of the
Metropolitan area to Barcelona, in both
scenarios.

// OUTCOMES AND KEY RESULTS

1.

KNOWING THE ORIGIN OF COMMUTERS ENTERING BARCELONA

The data brought by Abertis enabled to understand where private vehicles entering the city came from. Combined with various public data and previous works, it enabled to model the different management scenarios.

2.

KNOWING THE IMPACT OF BOTH MANAGEMENT MODELS OF HIGH CAPACITY ROADS ON THE ACCESS TO THE CITY

Both management models for high capacity roads have distinct and opposite impact on congestion, environment and accidents. The suppression of all toll roads combined with an annual tax would increase the number of vehicles entering the city, would require defining an immediate action plan to counteract the negative effects of congestion, environment, accidents, while the implementation of a payment per distance system would enhance the use of public transportation which current infrastructure could not absorb.

3.

KNOWING THE PROPORTION OF COMMUTERS TRANSITING FROM PRIVATE VEHICLES TO PUBLIC TRANSPORTATION TO ENTER THE CITY

The implementation of tolls in specific tariff zones could have positive environmental and public health impact but will also mean an increase by up to 24% of public transportation use (depending on the municipality) which cannot be absorbed by the current public transportation scheme. This scenario will require immediate action from the Metropolitan Area and the city to reinforce public transportation network connecting to Barcelona in most urgent municipalities.

#2 Challenge

Executive Summary

// Assess the impact of management models on the level of service, traffic conditions, delay, emissions & accidents of high capacity roads accessing the city

1. Comparative scenarios of management models for high capacity roads

Situation Actual

Scenario 0

Current situation of access to the city of Barcelona from high capacity roads of the Metropolitan Area of Barcelona (AMB).

Annual Fee & no toll roads

Scenario 1

Implementation of an annual fee for the possession of a private vehicle enabling the use of all high capacity roads of the AMB.

Pay per distance

Scenario 2

Definition of the price per use enabling to reach the acceptable Service Level (C) in all high capacity roads of the AMB.

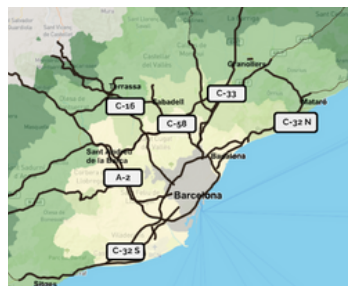
2. Simulation model

CIMA created a travel choice model based on the minimization of the Generalized Cost for the use of high capacity roads. Travel choice models are widely used in transport modeling to estimate the demand and mostly known as *logit* model. Parameters were defined for the simulation of the Generalized Cost under each scenario to assess how it would impact the demand, meaning the amount of vehicles in high capacity roads.

3. Geographical scope of the study

The geographical scope of the study was delimited as follows:

- **6 corridors** to the city
- **23 roads** to the city
- **53 sections & control points**
- **4 areas** coinciding with the tariff zones for public transportation applied by the Metropolitan Transport Authority



4. Impact of each scenarios on predefined indicators

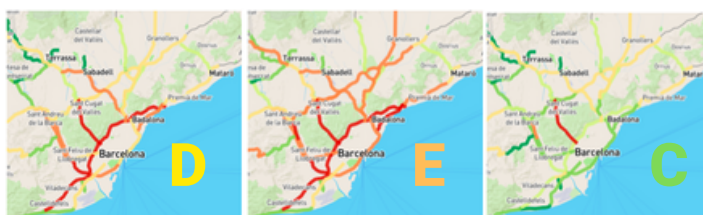
1. Impact on level of Service

The level of service is a qualitative parameter that represents the traffic conditions on the road (speed, travel time, interruptions, comfort, safety, etc). It varies from A (free speed without obstacles) to F (the path is saturated). C is considered the acceptable level and minimum target in the section. The results below show the average level of service and traffic congestion throughout the geographical area under each scenario.

Scenario Actual

Scenario 1

Scenario 2



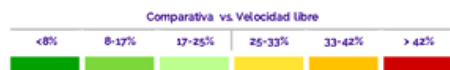
2. Impact on travel times

The increase of travel time or "delays" is a parameter that represents the time of travel with respect to ideal conditions. It is calculated comparing the free speed with the real speed. Results below show that scenario 1 would increase travel times on high capacity roads accessing the city of Barcelona by an average of 30% while scenario 2 would enable a reduction of time travels by up to 60% (check legend don't match).

Scenario Actual

Scenario 1

Scenario 2



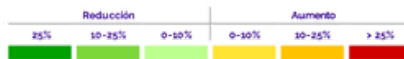
3. Impact on emissions

Represents the polluting emissions generated by the vehicles present in high capacity roads in the different scenarios. Results show Scenario 1 would increase emissions by an average of 17% while scenario 2 would enable a decrease of an 18% of emissions.

Scenario 1



Scenario 2



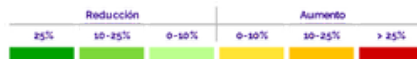
4. Impact on accidentality

Accidentality represents the accident rate on high capacity roads. The hazard index (IP) is used as the measurement parameter and represents the number of accidents with victims in each section in relation to its IMD and length.

Scenario 1



Scenario 2



// CONCLUSIONS

From the analysis of the statistical data of the main mobility indicators, a simulation model has been created highlighting the consequences that both management models of high capacity roads would imply. Both the congestion, as well as the environment and accident indicators will be increased by the suppression of toll roads in comparison to the current situation, aggravating the quality of life and the welfare of the citizens of the AMB. The main results show an increase of 18% in private vehicle traffic and 35% travel times, increase by around 17% of emissions and accident rates by 31%.

The scenarios based on distance pricing (installation of collection gantries in two tariff zones within the metropolitan area) would on the other hand improve the congestion levels and significantly reduce the indexes related to the air quality and the danger with respect to the current scenario. The model estimates a reduction of 27% in the use of private vehicles with a consequent decrease in travel times, valued at 64%. The emissions could be reduced by 18% and the accident rate would fall by around 16%.

//Assess the impact of both management models on the commuters' election of transportation mode to enter the city of Barcelona

The study conducted by Mosaic Factor focused on commuters' behavioural change under both scenarios. Combining public data of 6 specific municipalities with the results of CIMA, Mosaic Factor built a predictive model to enabling to assess the proportion of people who would, in each scenario, use private vehicles or public transportation to enter the City.

1. Scope of work

There are **165 municipalities** among the **4 tariff zones of public transport network** by the Metropolitan Transport Authority, surrounding the city of Barcelona. One municipality by corridors of access to the city was identified and selected as preliminary scope of work:

- Corredor C-32 Sur – Castelldefels
- Corredor A-2 – Sant Andreu de la Barca
- Corredor C-16 – Terrassa
- Corredor C-58 – Sabadell
- Corredor C-33 – Montcada i Reixac
- Corredor C-32 Norte – Mataró



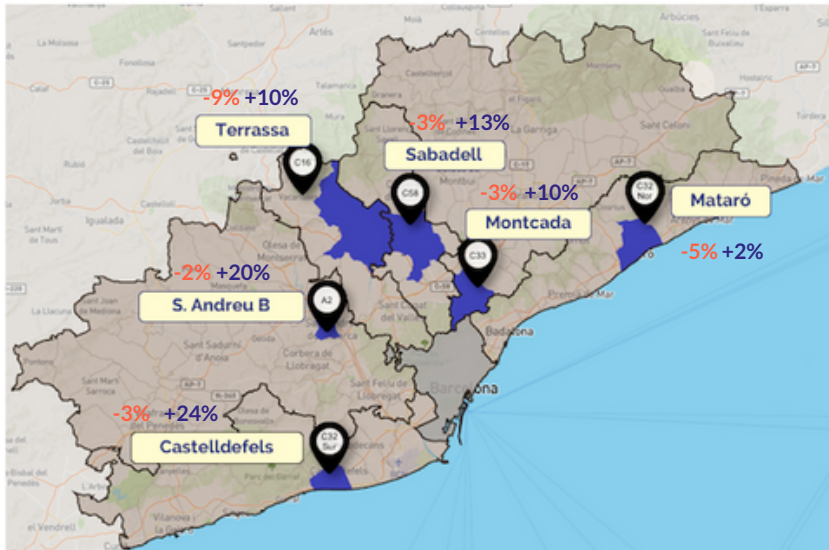
**6 municipalities
representing 20%
metropolitan area's
total population**

2. Simulation model

This model is fed by a set of data both at a socioeconomic and mobility level and applied to a predefined set of municipalities. This model allows to know for a given scenario the number of journeys made in public transport originating in a municipality in direction to Barcelona. Said model determines the average user's choice of travel model based on the Generalized Cost.

3. Variation in public transportation use from municipalities of AMB to Barcelona

Scenario 1 ● Scenario 2 ●



// CONCLUSIONS

The decision to be taken regarding the management of high capacity roads in Catalonia will have an immediate and relevant impact on critical matters for the city and its metropolitan area.

A possible elimination of tolls in the high capacity roads would require defining an immediate action plan to counteract the negative effects of congestion, environment, accidents.

The implementation of tolls in specific tariff zones could have positive environmental and public health impact but will also mean an increase by up to 24% of public transportation use (depending on the municipality) which cannot be absorbed by the current public transportation scheme. This scenario will require immediate action from the Metropolitan Area and the city to reinforce public transportation network connecting to Barcelona.