



Intermodal passenger transport in Spanish high-speed rail stations

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Abstract

This paper analyses the intermodality of different high-speed rail stations, establishing the mode of access and dispersion of travellers, and their complementarity with other modes of transport, with special attention to the rail-plane link in Madrid and Barcelona.

In order to carry out this analysis, we have studied the intermodality of travellers from the stations of Madrid Puerta de Atocha and Madrid-Chamartín, Barcelona Sants, Zaragoza Delicias, Málaga María Zambrano, Córdoba Central, Santiago de Compostela Alicante, Girona, Ourense and Jerez de la Frontera. The 9 first among the 15 with highest demand for AV (more than 1 million pax).

Keywords: intermodality, stations, high-speed rail, etc....

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1. The stations analysed within the high speed network

1.1 Introduction

With the objective of deepening aspects related to intermodality in different typologies of High Speed stations, where basically one can find a nearby bus station, but also to know how is affected intermodality by the typology of services offered or the size of Cities or even by its location within the city, a study has recently been launched in Adif Alta Velocidad in order to show some conclusions on this important issue in today's large transport nodes

1.2 Railway services of the study stations

The majority of the stations in the study move around 900 trains per week, with maximums of almost 1,700 in Madrid-Puerta de Atocha and minimum values in Orense (300) and Jerez (200). The following table shows the main characteristics of railway operation for the period 2014 -2015.

Table 1. Annual passengers and weekly trains by station		
	Passengers (mill)	Week trains
Madrid-Pta de Atocha	18	1.670
Barcelona-Sants	10	950
Madrid-Chamartín AV	4,21	508
Madrid-Chamartín Conv	1,36	451
Madrid-Chamartín	5,57	959
Zaragoza AV	2,7	498
Zaragoza Regionales	0,54	341
Zaragoza-Delicias	3,24	839
Málaga AV	2,4	276
Málaga Conv	0,4	88
Málaga-M. Zambrano	2,8	364
Córdoba AV	2,24	611
Córdoba Conv.	0,98	284
Córdoba	3,22	895
Alicante AV	1,98	235
Alicante Conv	0,28	73
Alicante Terminal	2,26	308
Girona AV	0,90	203
Girona Conv.	2,00	379
Girona	2,9	582
Ourense AV	0,77	226
Ourense Conv	0,09	104
Ourense	0,86	330
Santiago de Compostela	1,97	NA
Jerez de la Frontera	0,59	213

With this first perspective of the weight of each one of the stations, the main results of the study are described below.

2. Accessibility to stations. Aggregate results

The first approximation to the results, shown in the next graph, clearly shows a different behaviour according to HS services or conventional services.

For Great cities:

- Madrid and Barcelona: great influence of public transport, Metro and Rail (> 35%)
- The previous ones, plus Zaragoza, Málaga and Alicante show car preponderance (> 58%), highlighting for HS services (\approx 25-35 % taxi)
- Ourense and Córdoba an intermediate situation, walking access is increasing but cars are the main mode > 50% (\approx 20-10% taxi)

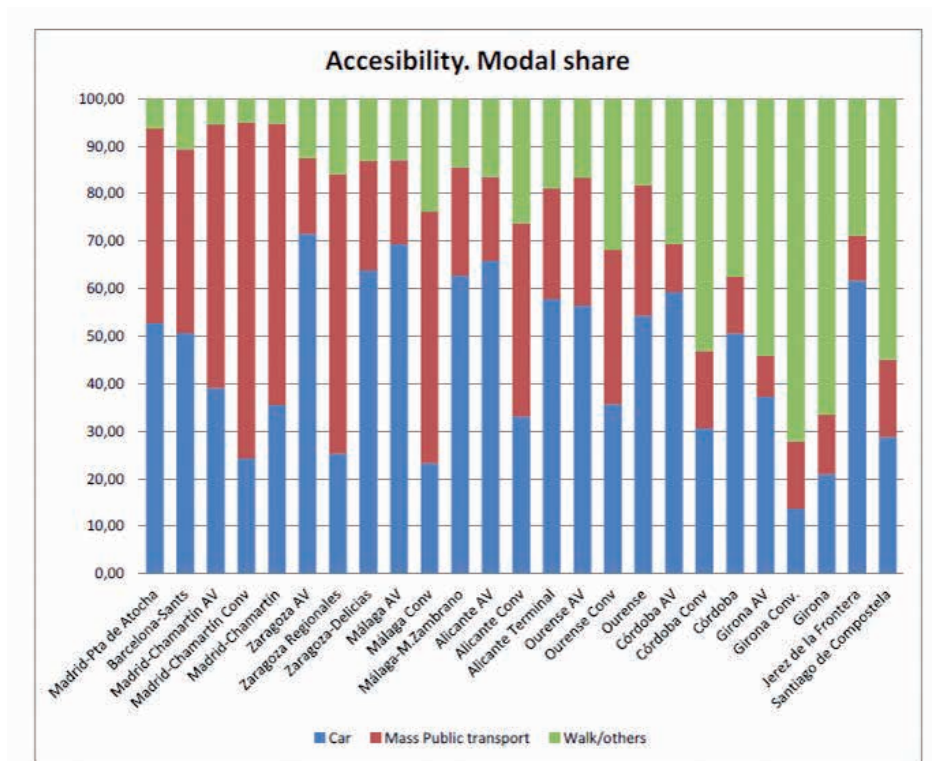


Figure 1. Accessibility to stations. Aggregate results

For Small cities, the results show a great influence of walking access (between 30 and 70%) depending on location

The greater the size of the city the less walking access is, being replaced by mass public transport. (Metro and Rail in Madrid and Barcelona, “Conventional” trains in Zaragoza and Córdoba, tram in Málaga and Alicante and urban bus in the rest).

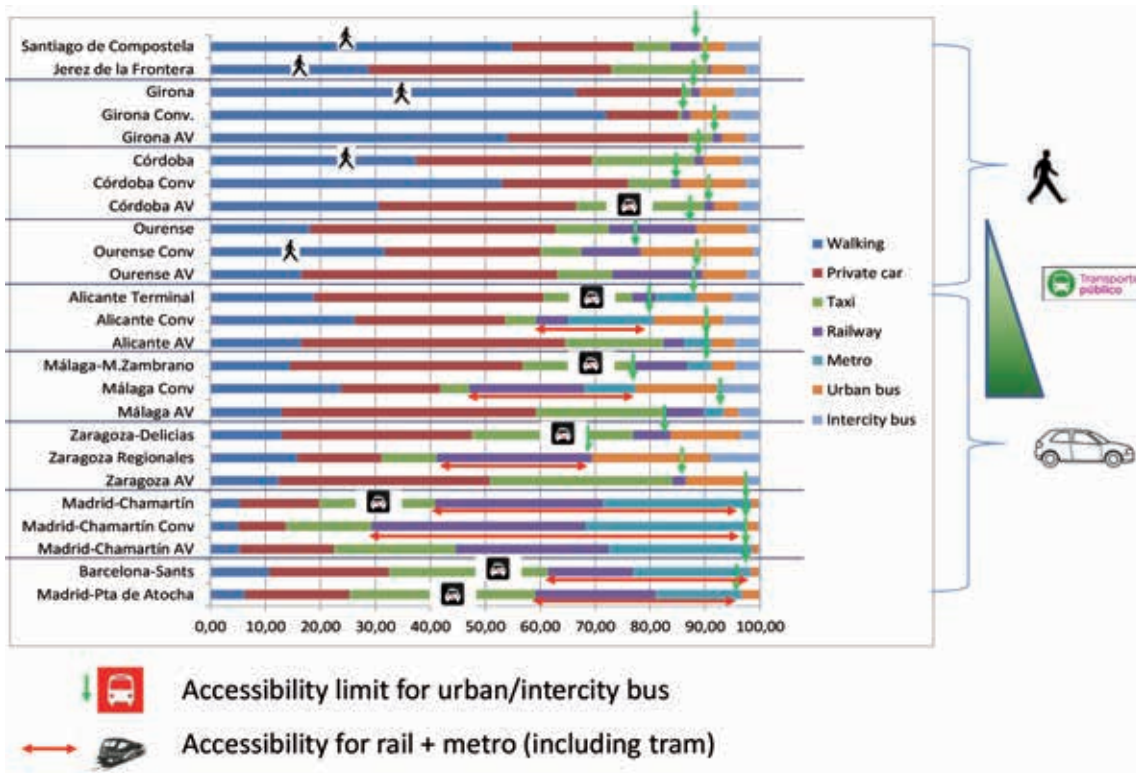


Figure 2. Accessibility to stations. Details

3. Car accessibility

The detailed analysis for “Car”(including taxi) show that this mode has the highest modal share, from 30% up to 70%, with “normal” values between 40-60%. (Fig. 3)

However, Taxi shows different behaviour depending on the size of the city. Except for Girona, it remains between 10-30% of “Car”.

4. Bus accessibility

In relation to the bus, and as can be seen in the Figure 4, the results highlight the following:

- There is a low participation of the bus, especially intercity bus, as access / egress mode.
- In Madrid and Barcelona, as has already been mentioned, the main “public transports” are metro and train (> 35%), Bus remains under 3%.
- In medium cities, Urban bus modal share between 4-12%
- Intercity bus between 2,5-5%, only for passengers of conventional services in Zaragoza, it reaches 7%.

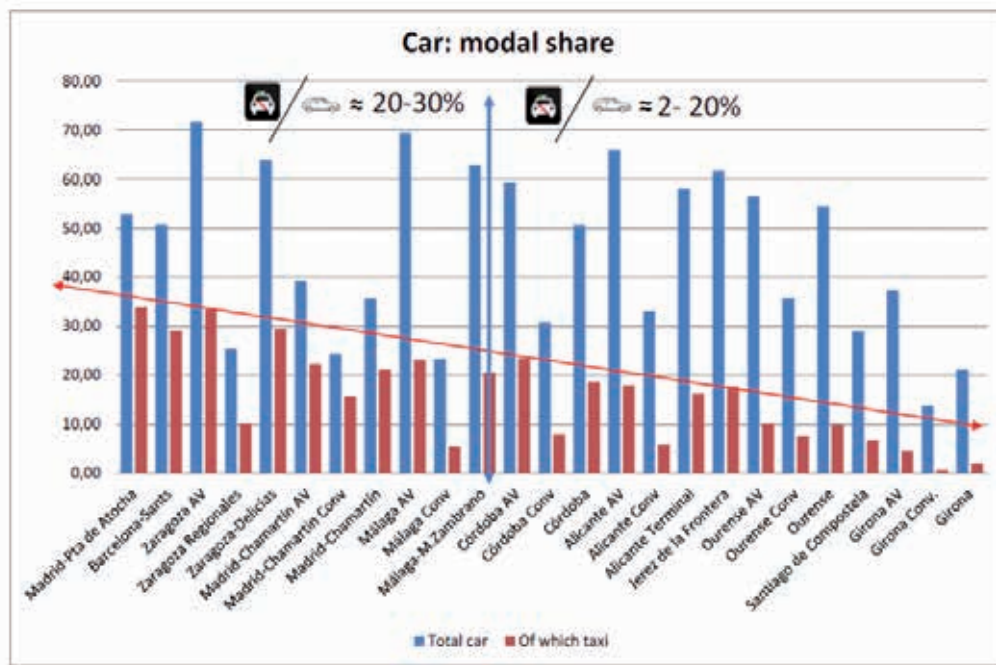


Figure 3 - Accessibility to stations. Car

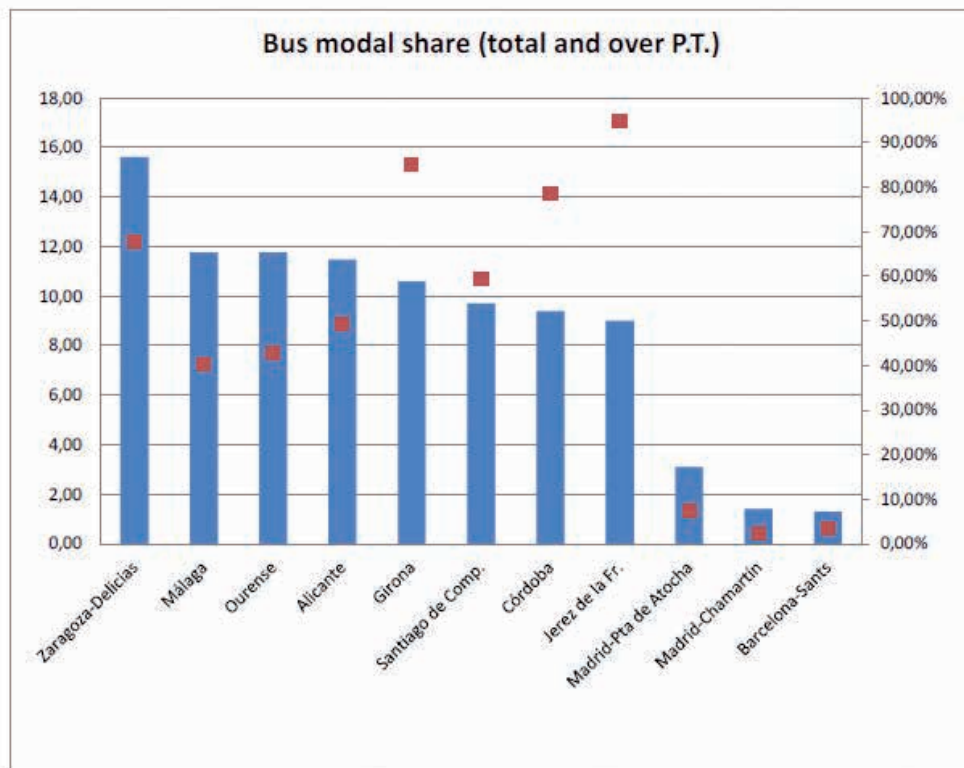


Figure 4. Bus modal share (total, left, over Public Transport, right)

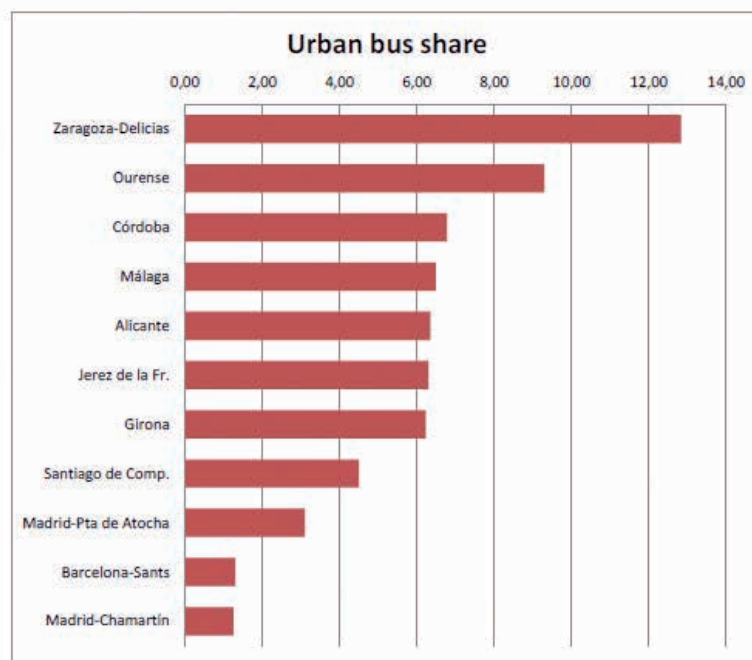


Figure 5 - Bus modal share. Urban

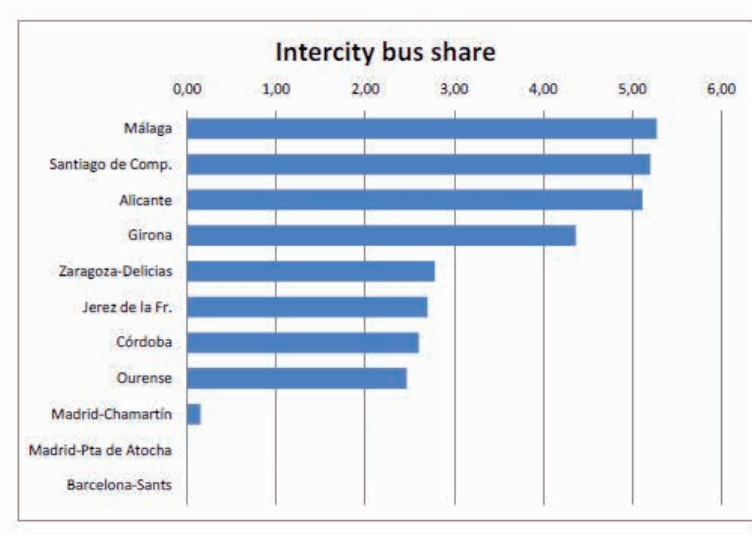


Figure 6 - Bus modal share. Intercity

5. Walking accessibility

Related with walking access, the main results are:

- For small cities, walking access lies between 30-60% of total passengers
- For medium/great cities this figures decrease up to 15-10%, except Madrid under 6%.

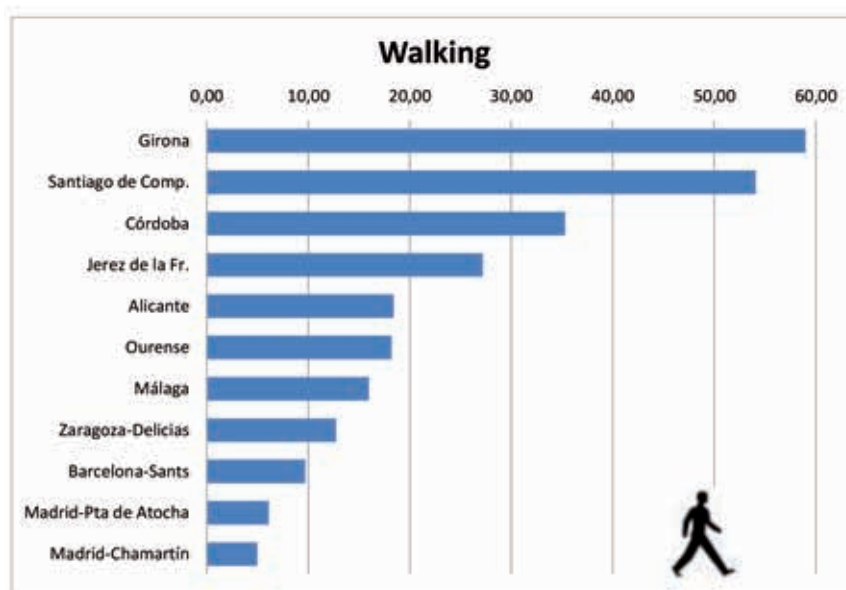


Figure 7. Walking Access. "Modal share"

6. Demand distribution. High speed details

As can be seen in figures 8 and 9:

- For Madrid and Barcelona, around 90% of passengers are coming/going to the cities and Metropolitan Areas, as well as Santiago de Compostela (¿Is this last city reflecting the feature of Capital City?)
- Córdoba and Zaragoza: the "unique" area is the city. More than 85% are coming from them.
- Alicante, Málaga and Girona: In these cities (50-70%), there are very important tourist areas generating between 25% - 40%
- Ourense reflecting the special population distribution in Galicia, including the connection with Lugo

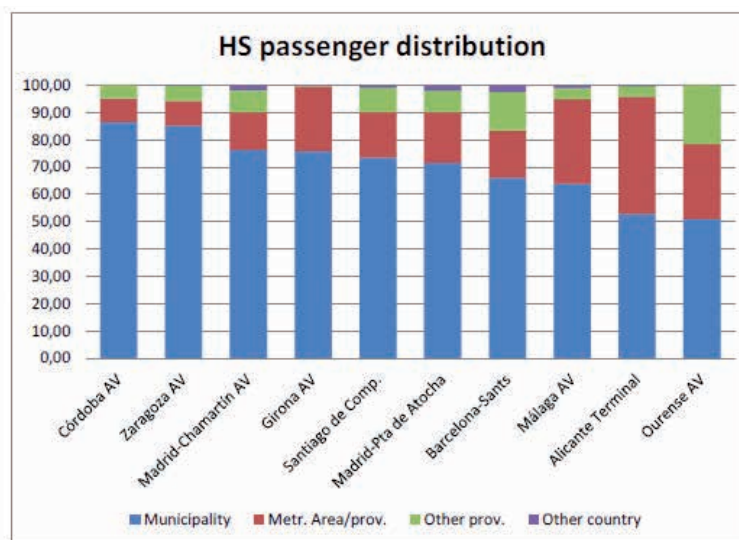


Figure 8. Distribution. Rating Criteria, Municipality

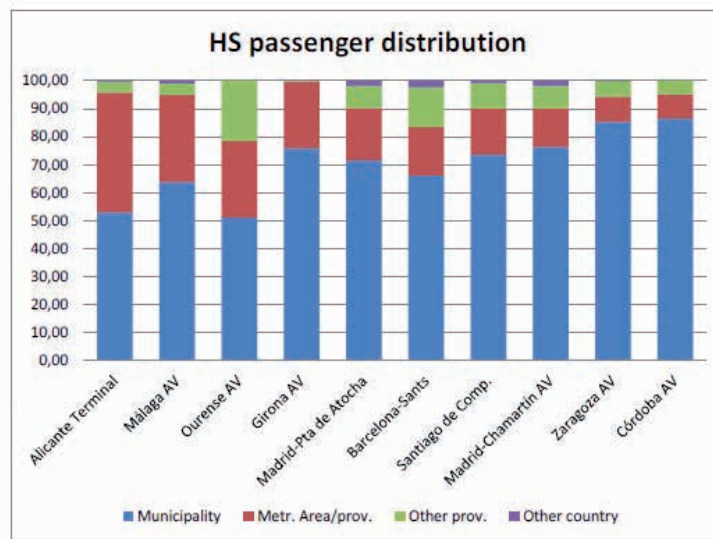


Figure 9. Distribution. Rating Criteria, Metropolitan Area/province

7. Demand purpose. High speed “vs” conventional services

Figures 10 and 11 show that:

- High Speed and Conventional Services are very different depending on purpose
- For HS, except for Galicia (Santiago and Ourense) where study purpose is important (15%), work purpose lies between 40-55%
- For Conventional services the main purpose is “study” between (20-45%)
- The cases of Jerez de la Frontera and Santiago de Compostela with different kind of services, show similar purpose distribution. This is the result of similar fares (reduced fares for HS services in Santiago)

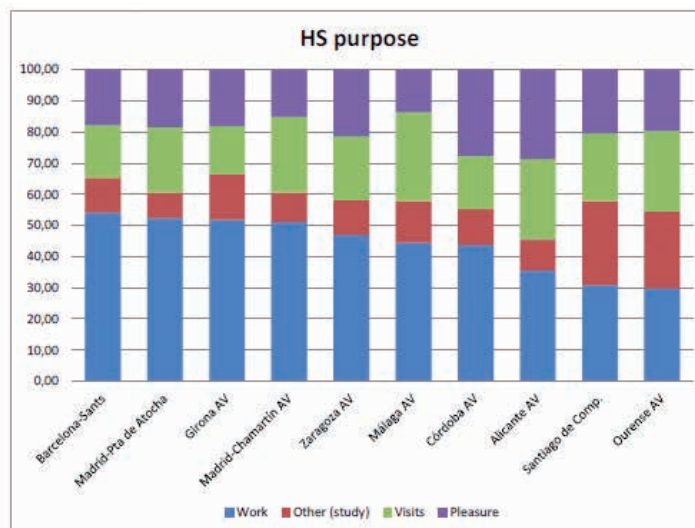


Figure 10. High Speed passengers Purpose. Per stations

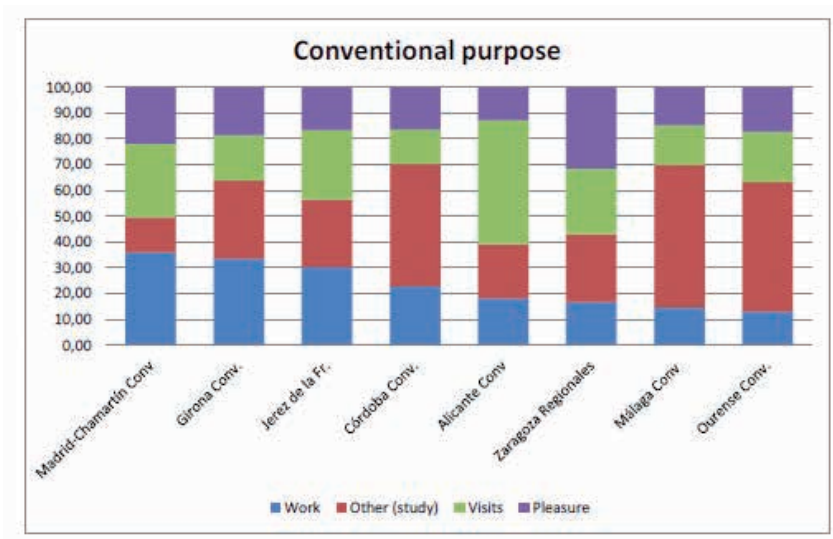


Figure 11. Conventional passengers Purpose. Per stations

8. Air/rail intermodality. The cases of Madrid and Barcelona

According to the results obtained in the survey:

For Madrid:

- 2,5% of the passengers leaving/arriving Puerta de Atocha (HS) went/came from Madrid-Airport (Barajas). That means about 450.000 passengers per year.
- 80% of these passengers had their O/D in foreign countries, the rest (20%) had it in Spain
- The main mode chosen to link airport and HS is train (40%), followed by taxi (33%)

Mode chosen FROM/TO the Airport TO/FROM Puerta de Atocha	%
Private car	6,8
Taxi	33,1
Metro	9,1
Urban Bus	10,5
Commuter railways	40,3
Renting car	0,3
Total	100,0

Table 2. Modal choice: Madrid Puerta Atocha - Madrid Airport link

- 2,9% of the passengers leaving/arriving Chamartín (HS) went/came from Madrid-Airport (Barajas). That means about 130.000 passengers per year.
- 61% of these passengers had their O/D in foreign countries, the rest (39%) had it in Spain
- The main mode chosen to link airport and HS is train (53%), followed by Metro(24%)



Mode chosen FROM/TO the Airport TO/FROM Chamartín	%
Private car	3,3
Taxi	18,8
Metro	24,2
Urban Bus	0,7
Commuter railways	52,9
Total	100,0

Table 3. Modal choice: Madrid Chamartín - Madrid Airport link

For Barcelona:

- 2,5% of the passengers leaving/arriving Sants Station (HS) went/came from Barcelona-Airport (El Prat). That means about 250.000 passengers per year.
- 86% of these passengers had their O/D in foreign countries, the rest (14%) had it in Spain
- The main mode chosen to link airport and HS is train (61,5%), followed by taxi (37%)

Mode chosen FROM/TO the Airport TO/FROM Puerta de Atocha	%
Private car	1,5
Taxi	37,0
Commuter railways	61,5
Total	100,0

Table 4. Modal choice: Barcelona Sants - Barcelona Airport link

9. Conclusions

The main conclusions of these studies are:

Car (including taxi) is the main mode of access, followed by public transport in great and medium cities or walk access in little cities.

For public transport, commuter trains and metro are the main options. Only bus (urban bus) is the selected choice when there is no other public alternative. Intercity bus is a low option as access/egress mode (3-5%).

For capital cities most of the passengers (85-90%) are going/coming from the very cities or their Metropolitan Area/province, whereas other capitals with important “tourist” destinations, show a lower value (50-70%).

Related with Air/HSR intermodality in Madrid and Barcelona, currently there is an important flow of passengers using both Terminals, rail and air, with estimations of 600 Madrid and 250 Barcelona (000 yearly pax)

10. References

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