

Urban integration of high speed train

Institutions of support in Spain and the keys to its success

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Abstract—The high speed train as means of transport in Spain is extending its network to many cities. Occasionally, this situation raises the opportunity to undertake large urban integration operations, associated with urban renewal and the construction of new residential areas. In these cases it has attended an institutional architecture based on extrapolated public companies for management. This study addresses these operations identifying and classifying them with variables that have proved to be decisive to make viable operations. As conclusion this model and the keys to their success is analysed.

Keywords—Metropolitan infrastructure, urban planning of rail transport, instruments of governance.

I. INTRODUCTION

The high speed train is by its nature a new way of transport due to their exploitation characteristics. Distances between stops are more similar to the spatial distribution of airports. Therefore is closer to the air transport than to the railway. In fact it competes with it at distances of up to 500 Km, but with a volume of passenger per unit superior than an airplane. In its recent history, the first one was opened in Japan in 1964 with the Tokyo-Osaka line, and in Europe it was introduced in France in 1981 with the line TGV (Train à Grande Vitesse) Paris-Lyon, obtaining a great success [1].

The high speed of the Spanish railway began with the opening of the line Madrid-Seville coinciding with the Expo which was held in Seville in 1992. Since then, both France and Spain have developed their high-speed networks within the formation of the Trans Europe network, connecting each other recently in 2013 through its borders thanks to its arrival in the city of Figueras.

Currently Spain with its AVE (Spanish high speed) is a world leader in length network, modernity and versatility of fleet and punctuality. In 2010 Spain stood as the first country in Europe and the second in the world, after China, in number of kilometres of network, reaching in 2013 the 3,100 km in service. Every day they circulate in Spain more than 300 trains high-speed service to 100,000 daily passengers [2].

This rapprochement between the cities of this network carries different consequences: development and structuring, competitiveness, Metropolitan cohesion, territorial polarization, changes in the mode of transportation, one way and return mobility, demand for induced mobility, quality of life and in

relation to the city, forming discontinuous metropolitan areas and transformations in the environment of the stations [3].

II. HIGH SPEED RAIL AND CITY

This high-speed network stations generate big expectations of all kinds: they attract companies and private users of this transport, as well as complementary services for the high flow of passengers is given. It is reproduced in some way the revolution started in the s. XIX and the effects on urban development with the arrival of the traditional rail network and its stations. This appreciation in value of the environment of the stations poses in his relationship with the city, the decision of where its location is more convenient.

In some cases, peripheral positions are chosen to enhance new enclaves or because of urban planning difficulties in penetration. It is also powered the intermodality with air transport by locating stations at existing airports. Two examples of this are the airports of Roissy-Charles de Gaulle in Paris or Satolas in Lyon.

In other cases, it is opted for the central location penetrating into the city where most of the activities and users are found, gaining accessibility and reducing the inconvenience of peripheral displacements. It is the case of stations like Gare de Montparnasse in Paris or Atocha in Madrid.

Occasionally, they do not have vacant land in the vicinity of stations, and there are no urban effects. However, when there is enough available space, large urban inner city renewal operations can be undertaken.

III. URBAN RENEWAL IN THE SURROUNDINGS OF STATIONS

It is the combination of stations in central positions of the city and vacant ground, together with the institutional will of the competent administrations, which allows setting up these large urban operations. We can highlight for the date and scale that of the city of Lille, capital of the region Nord-Pas du Cal.

It has a population of 225,000 inhabitants, a metropolitan area of 1,1 million inhabitants, and was called "Euralille" being commented on by François Ascher in his book "Metapolis" as an example of great urban operation that cooperated to the creation of the so-called "new urban regions" [4].

Due to its intermediate location in the triangle Paris-London – Brussels, it generated the renovation of the Centre of the city. With an area of 110,000 m² and a provided construction of 740,000 m² is made up of offices, shopping centers, hotels and equipment. Its first phase, which included the station, was opened in 1994 [5].

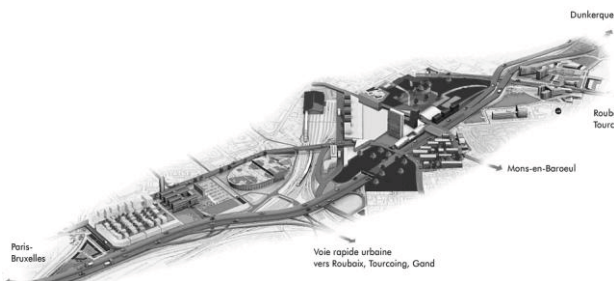


Figure 1. Urban action of Euro Lille. [5].

Previously and to make it reality, it was created in 1988 the society of studies Euralille-Metropole, responsible for its definition and preparation of the station, and in 1990 was established the public limited company of mixed economy Euralille (SAEM) responsible for the management and development of the project. This experience has demonstrated to its viability, the usefulness of the support of institutions that integrate different administrations.

In Spain, after the first AVE line opened, there have been others with stations located in cities that have had these three characteristics of centrality, availability of ground and institutional support, so it has been repeated the French model of creation of public corporations for the urban integration of high speed.

IV. SPANISH INSTITUTIONAL NETWORK TO SUPPORT THE INTEGRATION



Figure 2. Network of high speed rail current Spanish, and cities with institutions for urban integration. [2].

After the southern corridor formed by the Madrid-Seville line and its subsequent extensions to Malaga and other cities, the Northeast Corridor was followed by because it is what allows the connection with France. Consisting of the line Madrid-Barcelona-Figueras, the first city in this corridor with integration was Zaragoza.

In 2002 was set up the first Spanish public society to support the integration of a city: Zaragoza high speed, seeing the completion of its station a year later. Both this first society and all the others follow the same composition in their participation: 25% the city, another 25% administration of the region, and the remaining 50% the administration of the State through its railway infrastructure manager.

Almost simultaneously in 2003, were established similar societies in other cities. In the same line were established Barcelona-Segre society, and in other corridors as the Northwest, Valladolid, and León, or as in the Southeast corridor, Valencia Parque Central, & Alicante (AVANT).

Of these, nowadays only the first two have achieved this integration, while the rest are pending. To the cities of Valencia and Alicante the AVE arrived in 2010 and 2013 respectively, without having fulfilled their goals, and even in the case of Leon, for the transformation of society to working groups between administrations.

Years later, and in a second and a third generation, they were created four more companies, whose cities are located in less priority corridors, such as in 2006 Murcia and Cartagena, and already in 2010, Almería and Vitoria, in a context of real estate market and investment availability very different from the previous. Nowadays, any of them count on integration and their projects are currently questioning.

A. Urban integration in the cities of the Northeast Corridor: Zaragoza and Barcelona.

Zaragoza, with a distance to Madrid of approximately 300 km, has an upper-intermediate size (679,000 inhabitants). After the establishment of the society Zaragoza Alta Velocidad, it was approved the Master Plan "Milla Digital" collecting the needs of the area.

This area for the integration is next to the destined for the Universal exhibition, connected by a new bridge over the River Ebro. It has an area of half a million m² most located in the ancient ways of Navarre Avenue (Figures 3a, b, and c).

Among its objectives are included the location of the new intermodal station, the underground works and covering of the routes until the old station of Delicias, communication between the affected neighbourhoods and new access to the city.

It is composed by the performances in three neighbourhoods. It includes different residential areas with a total of 3,600 homes and about 215,000 m² of other compatible applications, with a total cost of the investment, estimated at 248 million euros [6].



Figure 3a, b, c: Urban integration of the AVE in the city of Zaragoza: planning projects. Google Earth and [6]

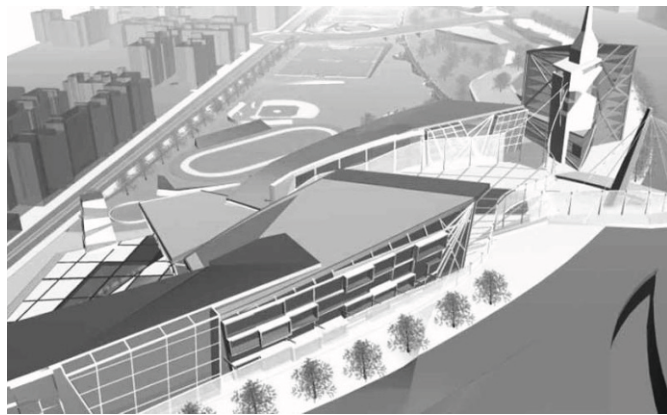
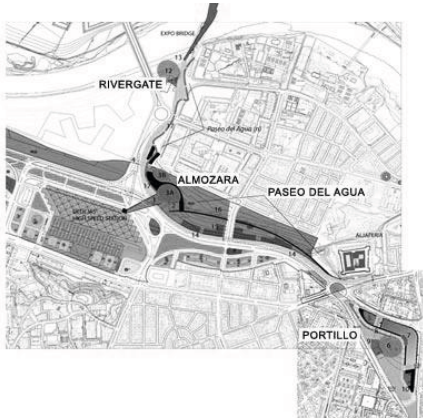


Figure 3d, e, f: Urban integration of the AVE in the city of Barcelona: planning projects. [7]



Figure 3.

Barcelona, the second largest city of Spain, (1.6 million inhabitants), raising its metropolitan area to five million inhabitants. The integration of the AVE began with the creation of the company Barcelona-Segre Alta Velocidad, being which has had the largest area of action, approximately 1.6 million m². On this surface is where the station the Segre connecting subterraneanly with the second AVE station Barcelona: Sants [7].

Articulated through a linear park of 3.7 km in length, it is including different urban growth, with a total of 9,300 houses as well as other equipment and office complexes (Figure 3d, e, f). Nowadays, each of the eight subdivided areas has a different degree of development, with a majority executed. In any case, the station is built with an investment of 335 million euros and it can be said that the integration is assured, and urban renewal will be completed in the next few years.

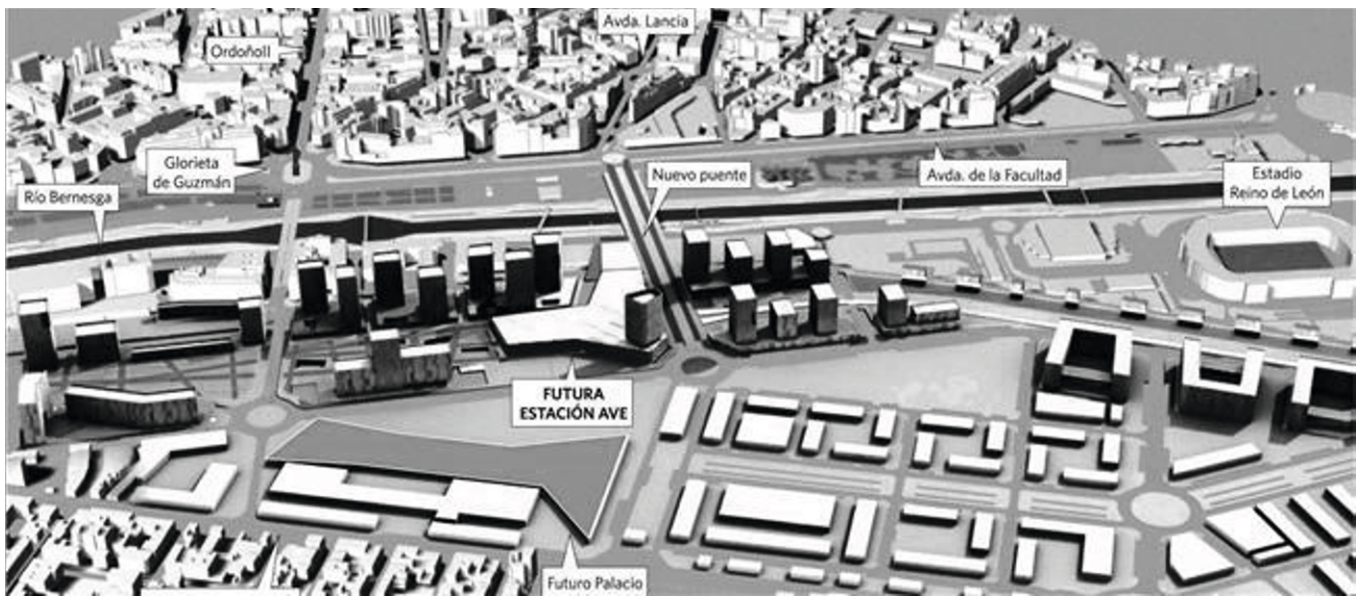
B. Urban integration in the cities of the Northwest Corridor: Valladolid, Palencia, León and Vitoria.

Valladolid, at only 190 km from Madrid is the first AVE stop corridor Northwest town for now. The city has an intermediate size (313,000 inhabitants, Figure 4b).

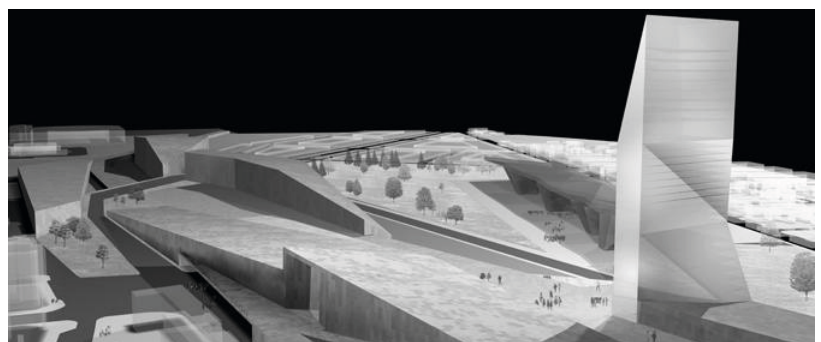
The action planned by the Valladolid society has an area of approximately one million square meters, with a total of 6,000 houses and an investment of 527 million euros. Its urban development objectives were the underground works of the new line of the AVE, the construction of a new underground station in Campo Grande, and the transfer by surface of the University Station [8].

The following city located just 50 km from the previous one is Palencia. With small size (only 82,000 inhabitants) its importance lies in being split point of the corridor between the destination of Galicia and the Basque country. With a surface area available for the integration of 290,000 m², the society estimated as project the possibility to build 2,000 housing units, and a total investment of 346 million euros.

The last city of the corridor towards Galicia with public support society is León (135,000 inhabitants). This company made the projects planned in an area of about half a million m² of surface, on which was contemplated 5,853 houses divided into five sectors, and 267 million euros of investment (Figures



Figures 4a, b, and c: Urban integration of the AVE in the cities of Valladolid and Leon: planning projects. http://b720.com/pt/proyecto/estacion_ave_leon
<http://www.lacronicadeleon.es/2009/10/27/>
http://canales.elnortedecastilla.es/canales_provinciales/php2/web/porta/valladolid/sitios/alta_velocidad/suplemento/ave_012_a.html



4a, and c). As it was indicated, these two cities are rethinking their integration projects. In 2013 the society has been dissolved in Leon without their targets, betting on a peripheral station without burying [9].

In Basque Country direction, and already in 2010 the city of Vitoria together with other administrations has also created a society for urban integration. As Palencia, Vitoria is positioned at the crossroads for access to other cities nearby, although in this case the future integration features are not defined.

C. Urban integration in the cities of the corridor Levante: Valencia, Alicante, Murcia and Cartagena.

Valencia, 350 km from Madrid, is the third largest city in Spain, (807,000 inhabitants) and a metropolitan area of 1.7 million people. The arrival of the conventional railroad to the city occurs in the middle of it, having a large space of approximately 656,000 m².

As a result, the company which was created in 2003 took the name of Valencia Parque Central. The keys of this project are 9 km of railway tunnel that crosses the city from North to South, four new interms stations connected to the subway and train network, 6,300 dwellings, 425,000 m² of green areas and new equipment. The total cost of the investment is 804 million

euros [10].

These days the project only has been built with the provisional station Valencia-Joaquin Sorolla for the arrival of the AVE that occurred in 2010. This station will be dismantled when starting in operation the Central underground station, using the historic lobby, as it was made in Madrid-Atocha station. The rest of performances as urbanization and the underground works are pending (Figures 5a, and b).

As regards Alicante, it constitutes the end of one of the branches of this corridor Levante, getting the separation with Valencia to move to the South, towards the city of Albacete. As a city, Alicante has medium size (334,000 inhabitants).

The arrival of the railway to the city generates a space of approximately 175,000 m². The management of this space is pending for the approval of municipal planning. Its main objectives are the underground works of railways for the release of the surface space and the replacement of the current station on other intermodal station [11].

The previous study commissioned Alicante society was about 1,100 houses with an investment of 188 million euros. In 2013 the AVE arrived to Alicante, without having started the works, so urban integration is not achieved, and it is estimated several years for this (Figure 5c).

Murcia set up the third branch of this corridor Levante, sharing most of the infrastructure up to few kilometres from Alicante. With a medium size (441.000 inhabitants) and a



Figures 5a, b, and c: Urban integration of the AVE in the city of Valencia and Alicante: planning projects. [10] and [11].



metropolitan area of 633.000 inhabitants, this city established his company in 2003, with a very extensive plan of underground pathways and generating of new underground station (Figures 6a, b and c).

The surface area available for the intervention of 207,000 m² was referred to in a modification of the municipal planning to achieve these objectives, developing the performance a special plan, with 1,400 homes, in addition to other surfaces for complementary uses. Its total investment is of 195 million euros [12] although the actual value rises to 500 million euros.

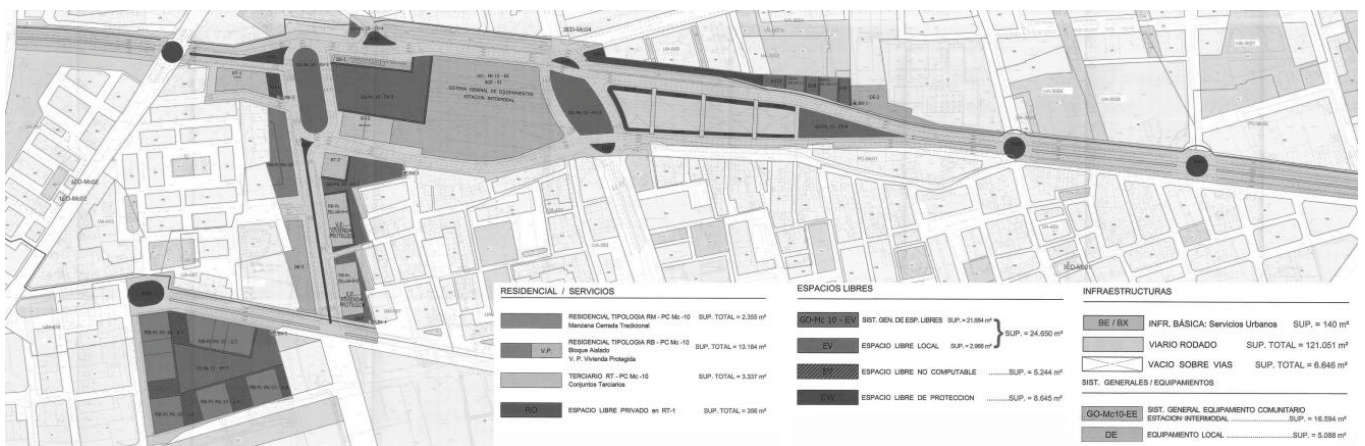
Excavation and construction projects are currently stalled; having considered different partial underground works solutions. To the extents that succeed the arrival in these circumstances, it will be increasingly difficult to take up again to the complete underground solution.

Finally, the city of Cartagena, located 50 km from the

of integration are the construction of 800 houses and an investment of 32 million euros [13].

However it is of all the integrations of this corridor the most delayed, among other reasons, for being the furthest city and with less population. In fact, the municipality requested the central administration a change on the place of the station, form the center to a peripheral position, which is cheaper and faster to build.

In a position shared by this corridor of Levante and the southern corridor is the neighbouring city of Almeria, about 200 km from Murcia, and 175 from Granada (where without a society to support the integration, the works are being carried out for the arrival of the AVE from Córdoba). Their situation is even more previous than the one Cartagena, focused on informative studies of the solution proposed.



Figures 6a, b, and c: Urban integration of the AVE in the city of Murcia: planning projects.

<https://www.youtube.com/watch?v=6XpCjFVu-44> and <http://opweb.carm.es/urbumurcia/>



former and with a new airport pending opening (Murcia-Corvera) along the way, simultaneous with Murcia the creation of their society. It has a small size (218,244 inhabitants) and its metropolitan area 407,000 inhabitants.

The area of available performance was 113,000 m², also contemplating underground works but in shorter length and a new station to improve the existing one. Other urban features

V. CONCLUSIONS

Faced to the challenge posed by the integration in the city of the high speed train, modern urbanism has been aware of the advantages that can provide an appropriate institutional architecture, allowing the coordination between administrations affected in their different scales, and addresses the complexity and the multidisciplinary nature of the solutions.

The creation of a new urban environment according to the flows that are generated in a high-speed train station requires the release of spaces from roads and new buildings at the service of travellers. It also requires the completion of the urban edge or its renewal through new residential areas.

All of this makes consider taking advantage of the sales of these new spaces to finance part of the investment made in infrastructure, and gaining new resources. Thus, to a greater or lesser extent all the actions of integration in Spanish cities that have attended an inter-administrative society formula for the promotion of the performance.

However, its results have been very different depending on the characteristic of each city. These factors have been studied in this article, are in first place the distance to the capital of the State, Madrid, since it is the most densely populated city and all infrastructure networks have a radial diagram.

Secondly, the relevance of the rail corridors is according to the size of the link cities, and its possibility to connect with other countries achieving the completion of the trans-European network. Thirdly the technical solution chosen, the model of financing and its relationship with the economic situation of the country, and in fourth and last place the possibility to divide the intervention in separate areas for an action distributed over the time in different phases.

All the societies chose underground solutions access and financing of part of its investments by capital gains from the residential areas included in the proceedings. However, it has been the combination with the other factors which have tested the issue of this model implementation. Mainly the moment it had to take place in relation to the economic situation.

Thus, the cities that have achieved their objectives of integration were those which first began their projects, and therefore affect them to a lesser extent the economic crisis. They were also knew how to better organize the intervention divided into different areas. They also knew are the case of Zaragoza and Barcelona, which are also located in a very strategic corridor to connect with France. Also Valladolid was success, for being relatively close to the capital of the Spanish State. However, even in these cases, the development of pending town planning is committed, due to the repayment of bank loans undersigned by societies.

In the rest of the cases, the delay in setting-up the societies coinciding with the economic crisis, its peripheral position, low population favoured with the service and an overly ambitious technical project together with an excessive financing depending on the capital gains from sales, have been the triggers of its failure. According to studies, it is estimated that financial debt accumulated by societies supporting the AVE until 2013, is about 1.3 billion euros [14].

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