Assessing High Speed Railway Service Areas in Spain Mainland from a Multi-method GIS Approach

José Manuel Naranjo-Gómez
Universidad de Extremadura
jnaranjo@unex.es
Rui Alexandre Castanho
Universidad de Dąbrowa Górnicza (Polonia)
acastanho@wsb.edu.pl
José Cabezas-Fernández
Universidad de Extremadura
jocafer@unex.es
Luis Carlos Loures
Universidad del Algarve (Portugal)
lcloures@ipportalegre.pt

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INTRODUCTION

Nowadays, the new commercial forms and the increase of the index of motorization have produced deep transformations in the mobility patterns and in the displacements of all the population. In fact, the railway is not an exception. In this regard, High-speed railway stations are the only and most relevant access point to the rail service. Therefore, their location and spatial distribution as well as the roads to access them acquires critical relevance. In this regard, the location and spatial distribution of these stations; as well as the roads to be able to accede to them acquires enormous importance. Once these two factors determine which are the service areas that currently provide the high-speed rail network in Peninsular Spain. These influence areas are determined based on the access time of residents in each of the municipalities, using the road network that channels the movements of people according to the impedances of each of the road sections.

MATERIALS AND METHODS

Therefore, the access time is determined by the speed at which it can circulate along each road. Thus, considering the population of the Spanish mainland municipalities, the degree of coverage offered by the 35 existing and operating stations is identified. In fact, it is planned that by 2024 all provincial capitals in Peninsular Spain will be connected by high-speed rail lines. Contextually, a methodology based on the method of determining floating catchment areas in three steps was developed using territorial accessibility measures - obtained through the network analysis tool offered by a Geographical Information System. Through the use of R, ArcGIS 10.5 and its own network analysis tool, where all the information used is public and official it was possible to obtained from the Official Road Map (2018) the following: the administrative divisions of the municipalities and the delimitation of the urban land of the capitals of the municipalities of the National Cartographic Base at a scale of 1: 200,000 (BCN200); the population of the Spanish municipalities in 2017 was obtained from the Municipal Register Review; the location of the high-speed railway stations of the Railway Infrastructure Administrator (ADIF); the PITVI 2012-2024; and the number of services and destinations of high-speed trains. Furthermore, the total time of the journey between the municipal capitals and the urban

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centers that have some high-speed railway station is obtained by adding the inter-urban time plus the intra-urban time. Except when the municipal capital and the urban center that has the station are the same. Then, the total time of the journey is only the intra-urban time exclusively. The 3SFCA methodology assumes that the demand of the local population at a nearby site is affected by the time of travel from the population to a destination site, as well as their travel times to adjacent service sites, this being a logical assumption. The weight of the selection, Gij, reflects this change. Gij is equal to 1 when there is only one high-speed railway station accessible to a population, but it decreases with the increase in available alternatives. In fact, the multiplication of Gij, Pi, and Wij represents the demand of the population adjusted to the location of each railway station j. Once the municipalities were identified and classified, the percentage of municipalities and the resident population in each of them was determined using the structured query language based on the five assigned classes of railway coverage.

RESULTS

In this regard, the study results represented by thematic cartography allow identifying the municipalities with the highest high-speed rail coverage. The municipalities with less coverage are also identified, where the road access of the residents in these municipalities to high-speed rail stations should be improved. The Autonomous Communities where there are no high-speed rail lines have very low coverage, such as Extremadura, Principado de Asturias, Cantabria, País Vasco, Navarra, and La Rioja. Also, note the curious case of Murcia, although it does not have high-speed rail stations, has high coverage, due to the overflow effect of rail service produced in the nearby stations located to the north. It happens in the case of the easternmost part of Andalusia, in the southern part of Aragon, in the central part of Castilla-La Mancha and the north-western part of Catalonia. Bearing in mind the tunnel effect and the spatial distribution of the high-speed railway stations, some stations there is not very high coverage despite being in the vicinity of some stations. This happens between the municipalities that are between the stations of Huelva and Córdoba, Córdoba and Ciudad Real, Madrid and Cuenca, Cuenca and Albacete, Cuenca and Valencia, Madrid and Segovia, Madrid and Guadalajara, León and Palencia, and Zaragoza and Lleida.

DISCUSSION

Perhaps, this tunnel effect is due to the fact that there are a large number of railway stations for this typology transportation. Regarding the hierarchy of the territory, it can be observed that the most common model that is produced is the center-periphery model, centered on those cities that have a high-speed railway station. Consequently, the inhabitants of that region have greater mobility and have greater opportunities to receive and develop activities in other territories. This internal dynamic causes the periphery to be incapable of generating its own dynamics of development. In this way, a spatial organization model based on the inequality of socio-economic development is produced.

CONCLUSION

The analysis model used helps the analysis of one of the two most important land transport networks in Spain, the high-speed rail network. Likewise, the evaluation of its impact on the territory helps to visualize the structural effects that this important means of transport has on the territory of Peninsular Spain. Moreover, the study showed that there are municipalities that are far from the high-speed rail network, showing a low performance of this means of transport, understanding accessibility as a way to determine the redistribution and spatial arbitrage of high-speed rail coverage. Thus, the classification of municipalities according to their

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degree of coverage also allows determining that there are Autonomous Communities where, although there are high-speed rail lines, their large extension means that there are areas with low coverage.

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