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A methodology to assess the connectivity caused by a transportation infrastructure: Application to the high-speed rail in Extremadura

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ABSTRACT

High-speed rail (HSR) affects enormously on the territory and provokes intense socio-economic dynamics because it articulates the territory according to the distribution of the accessibility in the settlements. Thus, the easier it would be the access of the residents from a city to another, the better it would be its opportunities of socio-economic development.

These effects motivated by the different degree of accessibility produced in the territory are more acute in the less developed regions. In this regard, this work proposes a methodology applicable not only to any place in general, but in this particular case also to Extremadura because this region is the least developed in Spain.

This methodology in which importance resides that it is applicable before the physical implantation of the HSR in the territory allows to achieve the following objectives: delivers a judgment if the distribution of the population which will accede to the HSR is balanced, shows the future hierarchical organization of the territory in more or less favoured zones and determines the degree of connection of the region on a national scale with Spain and an international scale with Portugal.

This paper is based on the use of tools for network design and the geographic information systems (GIS) and proposes a new indicator of absolute accessibility parameters application, together with the exploitation of information use of the descriptive statistics.

The obtained results show how the isolated areas, without adequate access to high-speed service, are going to continue to exist although it diminishes the lack of equity in the different zones of Extremadura, which is the object of study.

1. Introduction

The transport infrastructures according to the classic geography receive a prominent role in the socio-economic development of a territory (Potrykowski and Taylor, 1984; Dematteis, 1995). Thus, the transport and communications network act as a linchpin of a set of spatial connections having the population as its actor and the territory as the reference scenario (Reques et al., 2012). Accordingly, the structures and forms of transport systems grow in parallel to the society (Escolano, 2012) because they allow to supporting the relations between the inhabitants from different parts in the socio-economic system (Bauman, 2000). Therefore, without being a sufficient condition for economic growth and wealth creation, the implementation of the high-speed rail (HSR) can stimulate the fundamental aspects of social and economic structures (Plassard, 1997). Nevertheless, the structural effects to this transport infrastructure such as the physical transformation caused by the infrastructure construction, the changes in the mobility patterns and land use, the impact in the dynamics and structures, social and economic, and the physical transformation caused by new and increased mobility patterns, which cannot be isolated. As a result, these depend on three factors as the following: the territorial context where it is implemented; the characteristics and dynamics of the territory; and, the measures carried out by the social agents who act in the local environment (Bellet et al., 2010).

Then, the implementation of the HSR in the existing transport network modifies unevenly the degree of connectivity to the nuclei

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affected, since this variable depends on the characteristics of the network itself and the location of settlements. So, the settlements that have major connectivity present also a major accessibility to the offered services and more opportunities of socio-economic development. Therefore, it is possible to affirm that the connectivity somehow determines the evolution of the territory (Menéndez et al., 2002).

Considering the previous premises, in this paper, a methodology is described to measure the influence of the HRS in the accessibility of the region where the infrastructure is implemented.For this, the degree of territorial peninsular connectivity is evaluated once well-established the infrastructure, by means of a series of accessibility indicators and making the use of proper tools such as the geographical information systems (GIS). The combination of both tools can generate a model with which to analyse the level of interconnection. The effects provoked by the HSR have to be perceived in the alteration of the network-space in this territory and in the modification of the accessibility level to the centres of economic activity.

These effects of the HSR specifically cause a new spatial and urban hierarchical organization (De Ureña, 2012a,b). Thus, they have a big territorial coverage and must be studied on a regional, a national and even an international scale (Varlet, 2000; Vickerman, 1997; Gutiérrez, 2001; Zembri, 2005; Ureña et al., 2006). This study analyses the impact that supposes the extension of the high-speed railway infrastructure in the Iberian Peninsula, about the inhabitants of Extremadura. The cartography uses the network model of roads and railroads in the peninsular and all the urban centres in Extremadura, together with the location of the future stations of the HSR in the peninsular of Spain. In the same way, initially a model of analysis applies to regional scale in Extremadura and later expands to a national scale, to the stations of the bordering provinces and to the peninsular centres of economic activity. Of this form, it is determined in a more realistic way, the impact of the above-mentioned infrastructure.

With regard to the centres of the economic activity, the Iberian Peninsula is taken into account. For the Spanish case, it is considered to be the urban areas whose resident population exceeds 200,000 inhabitants, whereas for the Portuguese case, it has the urban agglomerations exceeding 100,000 inhabitants. The Portuguese limit is lower because its morphology is slightly different and with the previous threshold settlements would be obviated by an important area of influence and a capacity of important market (Gutiérrez et al., 2010).

The aims of the study are to determine if the population distribution that can potentially access to the HSR in Extremadura is homogeneous or not, to establish which are the areas that will be more or less favoured by the arrival of the HSR infrastructure.Thus, it determines how the Spanish rail transport policy influences the improvement of accessibility. Nonetheless, there does not forecast the potential demand of HSR, since Spain is the only example of high-speed rail network extended from criteria of equity, cohesion and territorial development. As consequence, in the development of HSR, there have been ignored criteria of economic efficiency and a great priority has given to meta-political objectives. For this reason, territorial governments require the incorporation of their territories in the network of HSR, generating a radial network which center is the political capital of the country, Madrid. Consequently, investments has been carried out with negative financial and social profitability, since the intensity of use of HSR is very low in comparison with the rest of international experiences, and the contrast is going to tend to worsen with the entry in service of new lines whose demand is declining (Albalate and Bel, 2014).

Later, a brief literature review is described about similar studies in other regions, to depict the methodology used in this particular study. In the Section 3, the obtained results are enumerated and finally in the Section 4, the main conclusions and proposals result of the research carried out.

1.1. State of the art

The infrastructures are one of the fundamental elements in the regional development, since they modify directly the conditions of the territories' accessibility in which it is constructed and indirectly that of the adjacent ones (Condeço-Melhorado et al., 2010; Quan and Si-Ming, 2011). Moreover, they constitute an important instrument of territorial cohesion and integration, acting as catalysts in the unification of multinational spaces (Vickerman, 1994).

An evident proof of the value that the infrastructures receive in the territorial cohesion and integration is the marked interest that has the European Union (EU) in its development. Thus, the White Book of Common Transport Polices already gathers in 1990 that the major barrier for the development of the isolated regions is the proper transport infrastructure, since isolated to the peripheral regions at the same time as congested to the head offices, by the increase of the activity concentration as the mentioned above (Vickerman, 2012). In this sense, the principal aim of the EU is to convert the policy of infrastructures into a policy of territorial integration, in order that the population of these isolated regions could access to others with major economic dynamism and to form a part of activities that would be inaccessible without the above-mentioned infrastructures. The consequence of this policy is that, the transport systems in general and the HSR in particular, it generates homogeneous economic and social development in the territory revitalizing the sector of the railroad and turning it into a key piece of this development for its high commercial speed and its capacity of passengers (CEE, 1999). The proof of its importance is that the majority of the developed countries possess technologically at the present with a network of high-speed trains (Terribas, 2011; Martí-Henneberg, 2013).

All these European recommendations can be found nationwide in Spain in the plan of infrastructure, transport and housing (PITVI) for the period 2012–2024. In this plan, it foresees the development of the high-speed railway line in Madrid–Extremadura–Portuguese border. The stations projected to accede to this service are the result of the consensus between representatives of the Department of Promotion, Government of Extremadura and the municipalities affected.

This new projected infrastructure is looking for the incorporation of Extremadura to the Spanish high-speed network, improving its connection with Portugal and the peninsular centre. The consequence of all this is that the region would be peripheral to turning into an integrated national and European level. Nevertheless, they must not neglect the intraregional environments and, therefore, have to be avoided the breaks of the socio-economic relations between the peripheral and central areas,

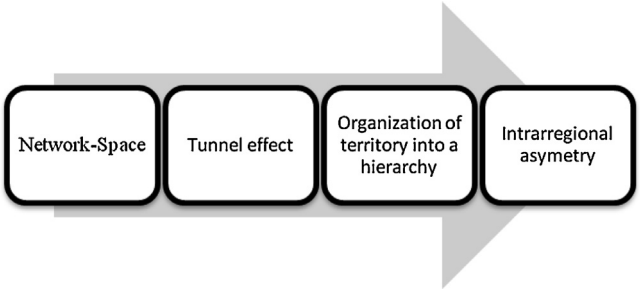

Fig. 1. Successive phases of the network-space effect.