

NEW METROPOLITAN PROCESSES ENCOURAGED BY HIGH-SPEED RAIL: THE CASES OF LONDON AND MADRID¹

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ABSTRACT

When High Speed Rail (HSR) was introduced in Europe it was seen mainly as an alternative to air transport between metropolitan areas 400-600 km apart. A few intermediate stations were created in small cities, mainly for security reasons, around 200 km from the metropolises, but also in the hope that these could act as a stimulus to local economies. Whilst early examples in France and Germany have not shown any such outcomes, in other cases, particularly in Spain, long distance commuting and discontinuous metropolitan processes have increased considerably in these cities, processes which have already been described in detail by the authors.

More recently, HSR stations have also been created in suburban areas or small cities within the limits of metropolitan areas (up to 100 km), opening up two new metropolitan transportation behaviour possibilities. First, the HSR is used between central and peripheral metropolitan areas as a special new type of suburban metropolitan transport. Secondly, peripheral HSR stations are used to travel to/from other far away places instead of using the central HSR stations or as interchange points between HSR services.

The fact that this new type of HSR connection facilitates or reinforces the integration of these small cities or suburban areas at the metropolitan corridor is foreseeable. Besides, the way they are incorporated into metropolitan and national corridors and the characteristics of the aforementioned corridors will have a considerable effect on the opportunities generated by HSR.

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The argument advanced in this paper, in comparison with other transportation means, is under which conditions HSR could facilitate the development of these small cities or suburban areas as special sub-centres of the metropolitan area, with particularly good connections to the metropolitan centre and to other distant metropolises and with high level office activities.

The paper focuses on a comparative study of this new type of metropolitan HSR in Spain and England. In order to understand the role of HSR in the periphery of a metropolitan area, six cases are analysed: Toledo, Segovia and Guadalajara around Madrid (Spain) and Ashford, Ebbsfleet and Stratford around London (U.K.). Infrastructure lay-out, station typologies and rail services are compared, together with each city's territorial contexts, activities and connections to other transport modes. This case-study approach, taking account of specific circumstances and contexts, has proved useful in previous research, facilitating the understanding of the similarities and differences in HSR's impact on urban and territorial development.

1 INTRODUCTION. SMALL CITIES WITH A HIGH-SPEED RAIL STATION

In Europe, HSR lines have been operating since 1982 in France, since 1992 in Spain and since 2003 in Great Britain. They were originally conceived as an alternative to air travel between metropolitan areas at distances of from 400 to 600km. Intermediate stations have progressively appeared on these lines, for various reasons: some for purely technical safety-stop considerations, some for socio-economic and political reasons so as to avoid leaving particular cities or regions without a HSR station, and some because of the convenience of sitting a station in cities through which a HSR line was already planned to pass.

It is difficult to distinguish accurately the specific effects of HSR connectivity on major cities, like Madrid, Seville, Paris, Lyon, London and so on, from those of other transport improvements, or of changes in economic and town-planning strategies. Furthermore, these are cities which already had excellent high-speed transport links by air before the arrival of HSR, and HSR meant for them only a marginal improvement of their connectivity (Plassard, 1991). On the other hand, understanding HSR strategies and their impact on small cities distant from major metropolitan areas has been relatively straightforward given these cities' previously low levels of dynamism (Ureña, et al. 2005).

HSR studies on small cities recommend considering two factors when investigating the territorial qualities which are favoured by the introduction of an HSR infrastructure: the distance between the cities in question and the major cities or metropolises, and their particular location advantages before the arrival of HSR. As to the first factor, the appearance of a new type of traveller has been identified, the long distance commuter (both centrifugal and centripetal), where HSR travel time is around one hour or 200 km

(Ureña et al., 2005). As to the second, HSR has been shown to have quite different effects if these cities were or were not already within significant transport corridors before its introduction (Fariña et al., 2000; Ureña, 2002).

Ureña et al. (2009) was a detailed analysis of small cities which are already integrated into metropolitan processes, classifying them in accordance with their connectivity into the HSR network, discussing the territorial opportunities opened up for them by their HSR connection and considering whether the decisions taken in relation to HSR and to the cities themselves have been the most effective in taking advantage of the new opportunities. They analysed ten European cities of this type and demonstrated that they are beginning to constitute a third identifiable type of HSR connectivity – the first being that of big cities 400-600km apart and the second that of small cities some 200 km away from metropolitan areas.

In these territorial conditions (within 100 km of the centre of a metropolis), it is impossible to isolate the purely HSR-related consequences from others derived from integration into metropolitan processes –indeed they should be considered integral parts of the same.

The debate that this paper addresses is what function do those HSR stations not far away from a metropolis actually fulfil and what opportunities may open at their cities.

2 HYPOTHESIS FOR HSR SMALL CITIES WITHIN 100KM OF A METROPOLITAN AREA

Small cities within 100km of a metropolitan area are already quite integrated into them. HSR can increase their level of metropolitan integration through the establishment of a new communications infrastructure that usually will not connect them to other intermediate zones within the same metropolitan area, but will instead connect them directly with that area's centre (Ureña, 2005; see Figure 1).

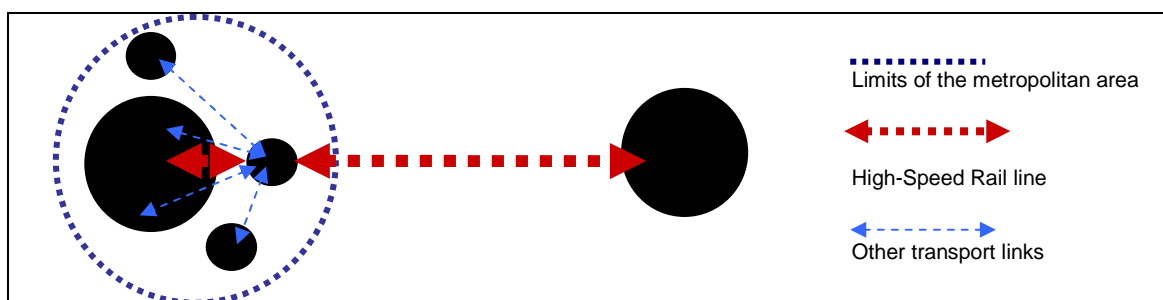


Figure 1. Cities half an hour away (100 km) from the centre of a metropolitan area by HSR.

Source: Ureña et al., 2009

These HSR stations can play at least two distinct roles. They can act simply as an additional means of metropolitan transport, of a particular kind (fewer routes, fewer stops and faster travel than other metropolitan railways). And they can also act as a

metropolitan area's second HSR station, more accessible to those who live or work in the peripheries of the metropolis or other non-metropolitan places and enabling them to travel to and from faraway places.

The paper proposes that the most significant new opportunity opened up for these small cities by HSR was not so much the strengthening of their metropolitan integration, given that many other means of communication such as motorways, suburban railways and bus services already existed, but rather that the same HSR service accessible from the metropolitan centre may now also be accessible from the metropolitan periphery for rapid travel to other, more distant cities might allow them to transform themselves into metropolitan sub-centres (Ureña et al., 2006 and 2009). Similarly, the environs of metropolitan airports have become much sought-after locations for particular economic activities.

The specific factors which can determine the extent of such opportunities to help these small cities to convert themselves into metropolitan sub-centres are the following (Ureña, et.al., 2009):

- Firstly, the small city's good connections with the other transport networks in the metropolitan area, both for long distance and intra-metropolitan travel, its location within a significant transport corridor (Ureña et al., 2005) and the existing long distance and metropolitan HSR services.
- Secondly, whether the particular metropolitan transport corridor² within which the small cities with HSR station are located houses significant population of highly-skilled professionals and a well-developed high level service sector (Bonnaeous, 1987; Ureña et al., 2005; Bellet, 2000), given that a high proportion of HSR travellers are highly-skilled professionals.
- Thirdly, the quality and variety of its urban, environmental and service characteristics. Being an administrative capital, having a university and a dynamic service-sector-based economy and having a high-quality image all improve its ability to capitalise on HSR (Garmendia et al., 2008).
- Fourthly, the particular sitting of the station in a small city can either hinder or help HSR open up different opportunities, by virtue of its accessibility³ or of the projects which spring up around it⁴.
- Fifthly, the specific forms by which they are connected to the HSR network (see Figures 2 and 3):

² These corridors are understood to be axes of diverse infrastructures, economic development areas, urbanisation axes (Priemus & Zonneveld, 2003) and networks of urban nuclei.

³ In general, a centrally-located HSR station improves accessibility to small cities' office districts for people from outside the city. A peripheral location makes such access more difficult unless there is a very effective public transport system – so far a very unusual phenomenon in these cases (Menéndez et al., 2006). However, small city inhabitants who use HSR to travel to other locations tend to be indifferent to the stations' central or peripheral sitting, having easy access to both – by walking or public transport to the centrally-sited station, and by private car to the peripherally-sited station, the great majority of HSR passengers being car-owners (Garmendia, 2008).

⁴ Central stations encourage city centre rehabilitation and improvement projects, while peripherally-located stations encourage the emergence of major redevelopment schemes in a form of dispersed urban expansion.

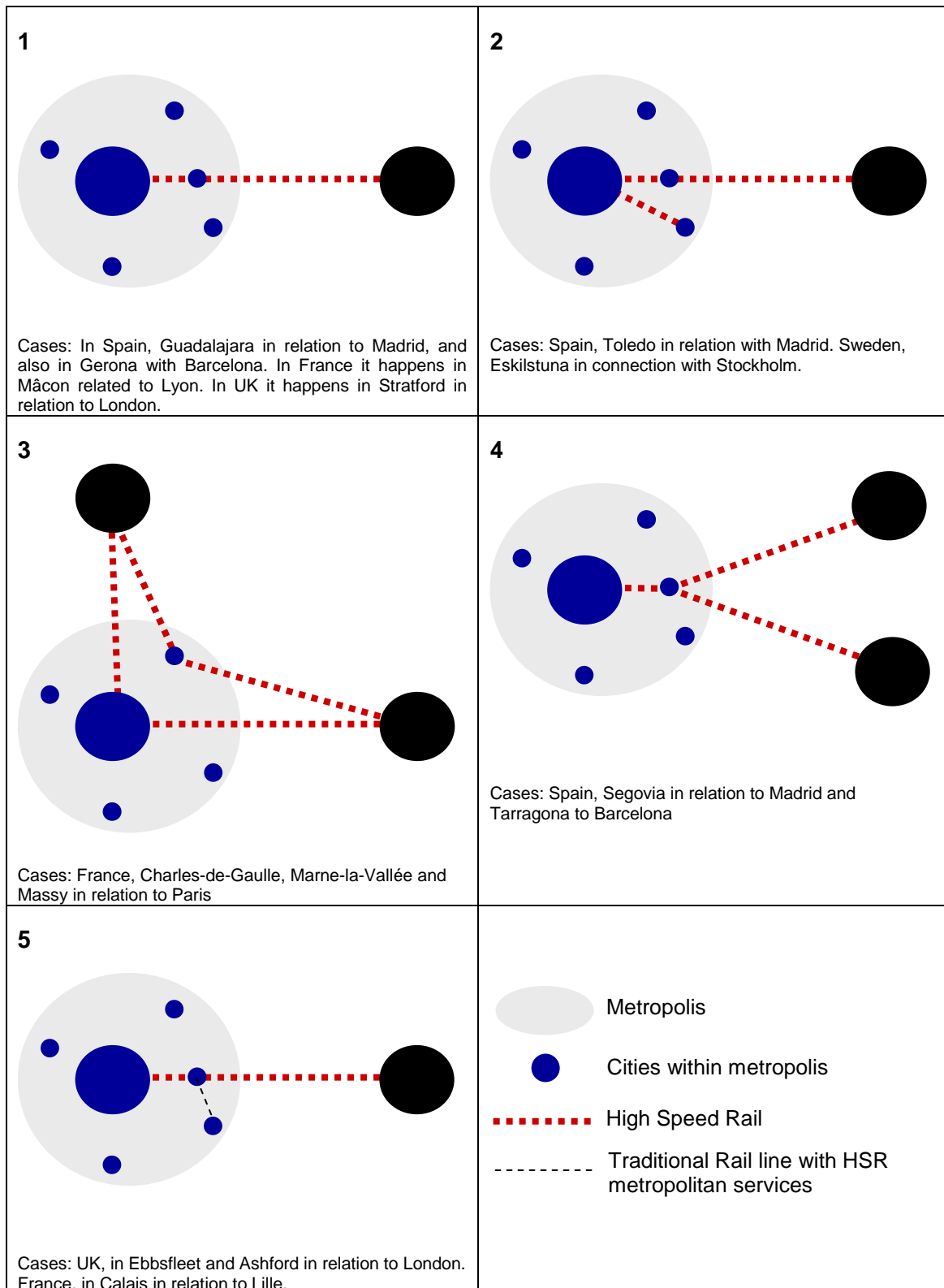


Figure 2. Alternative forms of HSR connection for small cities close by a metropolis.

Source: Ureña, et al. (2009) and authors

1. **Cities on an HSR through-line:** the small city has a station on an HSR through-line which connects it to the centre of the nearby metropolis and with other distant cities and metropolitan areas.
2. **Cities at the dead-end of an HSR line:** the small city has a station on a dead-end HSR line which connects it them exclusively with the nearby metropolis.
3. **Cities on a tangential HSR through-line:** the small city has a station on a tangential HSR through-line connecting distant cities, with no HSR connection to the centre of the nearby metropolis, the later is done only through other transportation means.
4. **Cities on several HSR through-lines:** the small city is on an HSR through-line which connects with the centre of the nearby metropolis and where it branches off towards various distant cities and metropolises.
5. **Cities on an HSR through-line with HSR services that serve the small city sub-region:** the small city has a station on an HSR through-line which connects the centre of the nearby metropolis with other distant cities and metropolitan areas and some HSR metropolitan services serve the sub-region of the small city leaving the HSR line and serving other places through the traditional lines.

The first connection type often leads to the HSR station not being located in the centre of the small city but at a certain distance from its urban area in locations easier for the long distance purpose of the HSR line. The second type, in a dead-end position, normally facilitates a central location of the HSR station. The third type is shown in France, all of them located at the HSR by-pass of Paris. The fourth type also leads to the HSR station not being located in the centre of the small city but at a certain distance from its urban area in locations more easily for the long distance purpose of the HSR line and for its dividing technical requirements. And finally the fifth type needs the station to assure a connection between the HSR and the traditional rail infrastructure.

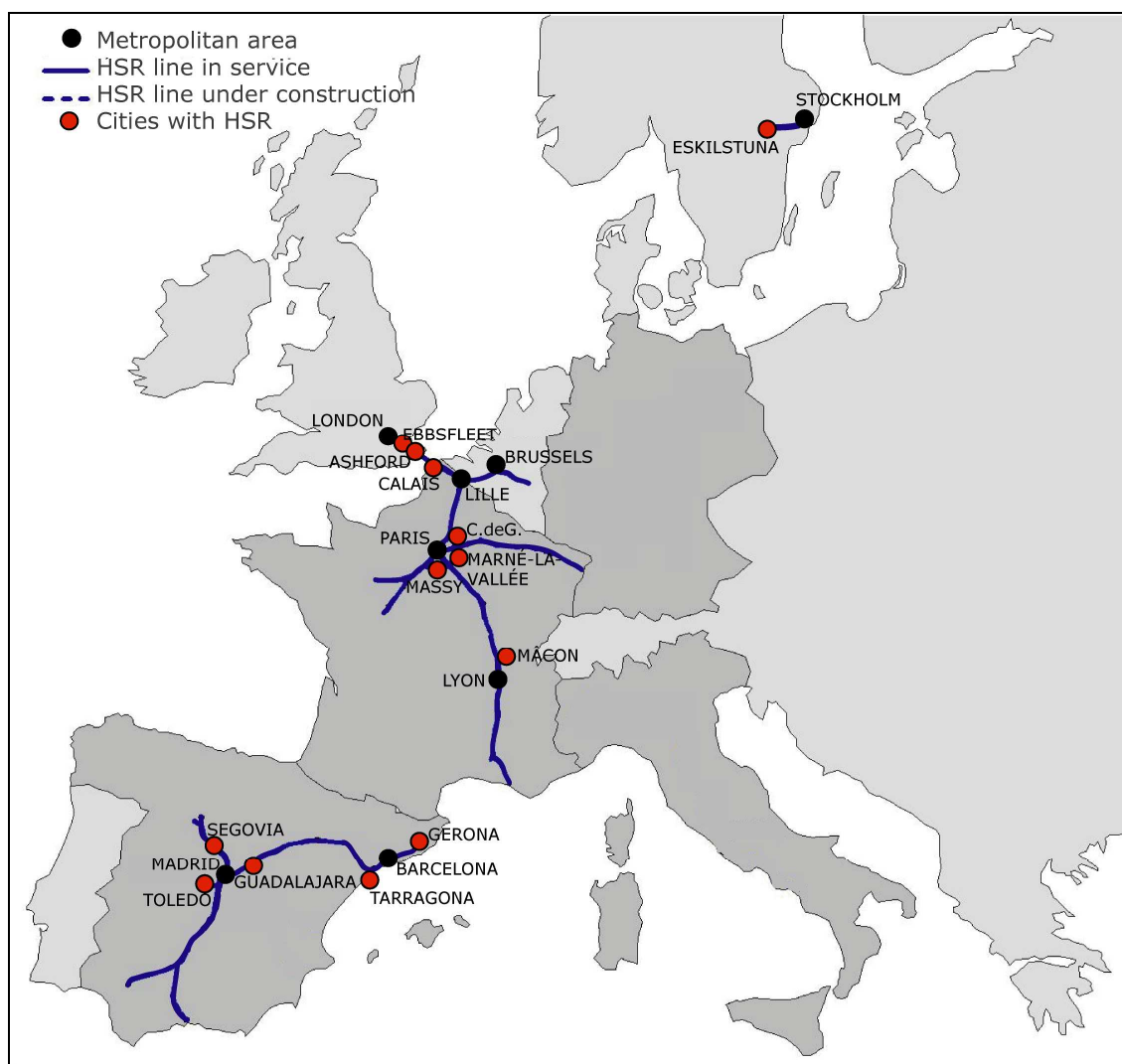


Figure 3. High-speed rail lines in Europe with examples of small cities with HSR stations at less than 100km from metropolitan areas.

Source: Ureña, et al. (2009) and authors

3 JOB AND HOUSING METROPOLITAN DECENTRALIZATION

Relocation and location of economic activities and housing towards the metropolitan outskirts has taken place for a long time. In the first instance it happened with low class and high class housing and with industry, meanwhile, offices and commerce remained polarized in the metropolitan centre. More recently offices and commercial centres have started to relocate to more peripheral places. The reasons for such changes are environmental conditions, government regional and congestion policies, changes in transportation means, in accessibility and in spatial division of labour, changes in the internal organization of activities and households and price of land.

The service sector can be subdivided into the trivial one, which is more or less proportional to the number of residents and/or workers (bank branches, travel
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agencies, corner shops, libraries, etc.) and follows the sprawling metropolitan urban pattern, and the more specialized one, the so-called “high-order service/office subsector”, whose spatial rationale tends to be concentrated, in many cases to facilitate face-to-face contacts.

The metropolitan locations of this “high-order service/office subsector” are threefold. First, they intensify their location in the traditional metropolitan centre, because the central city as a tertiary and commercial centrality is still paramount for some companies (Mignot, 1999; Coffey and Shearmur, 2002), in some cases by using rehabilitated historic buildings and in others by increasing the office building surface.

Second, the expansion of the traditional centre to new areas beside it, in a concentrated manner, in some cases by large scale renovation processes, in others by using land that was preserved for this objective in special quarters. Cases such as La Défense or the Signal Tower in Paris, AZCA or the Four Real-Madrid Towers in Madrid or Canary Wharf or the Shard London Bridge Tower in London are examples of this second type of process. Following the current stage of globalisation, major cities in the world have to compete with each other, in this case by carrying out buildings which have a relevant recognition as a city icon, and that are used by companies to set up their headquarters in order to benefit from this proximity to other similar companies or specialised labour force; and by the city itself to create a first-order CBD centrality.

Third, by creating new concentrated activity areas, normally of a big surface, in specific peripheral areas not too distant from the metropolitan traditional centre. This office decentralization/relocation in London is taking place nowadays towards places either just inside or outside the greenbelt, in many cases along the M-25 ring road (Thames Gateway/Ebbsfleet, Watford; IAURIF, 2008); this means distances up to 20 km from the centre, or in some cases further away (Milton Keynes, Reading)⁵. In Madrid the situation is similar but closer to the centre (15 km), in many cases by the M-40 ring road, and to a great extent in the north, north-west and west and to a much closer and/or lesser extent to the north-east (López de Lucio, 1999). In Madrid, the Banco Santander Head Quarters has moved 16 km to the west, the Telefónica Head Quarters 12 km to the north, Tyspa Head Quarters (the second biggest Spanish civil engineering consultancy) and Dragados Head Quarters (the biggest construction and service providing Spanish company) have moved 16 km north, while the Regional Courts Head Quarters is going to move 10 km to the north. The French Nestlé Head Quarters are located 21 km to the east of central Paris.

These new peripheral concentrated office areas at a certain distance from the traditional metropolitan centre normally have the following characteristics:

- Areas very well served at the same time by public transport means (suburban rail, metro, etc.) and by motorways.

⁵ Reading has the advantage of being close to Heathrow, while Milton Keynes is half the way between Birmingham and London.

- Areas of good natural and entrepreneurial environments and that can offer some added values and/or services.
- They house big companies where internal face-to-face relations have become more relevant than external ones and, in the medium and long term, they may produce agglomeration of other companies that serve them.
- Sometimes government decisions and policies, such as designation of growth areas or supply of urbanized land and/or transport means, are crucial for their location: decisions and policies worried about an equilibrated and sustainable development of the metropolitan regions and trying to prevent/avoid the unplanned urban sprawl and land use segregation.

In this outward process, metropolitan expansion has traditionally included small villages or towns, increasing their size, and transforming them into suburban areas. These areas are characterized by a late urban development due to a suburban process of metropolitan expansion/integration and by a low level of administrative and office activities. Only when these suburban places have grown in terms of population, have they started to attract some of these high level activities.

The further outward metropolitan expansion has also included cities that have played relevant regional roles (administrative capitals, university cities, public services, railway nodes, etc.). In the very big metropolis, such as London, this has happened some time ago, in other smaller or denser metropolises, such as Madrid, more recently. See Bontje and Burdack (2005).

These cities that have played a traditional relevant regional role are now immersed in two processes, their traditional role which polarises and serves a certain region, and their new suburban role in relation to the metropolis, which means that some metropolitan activities may localise and/or re-localise at them. In this sense the metropolitan role may facilitate the trivialization of their previous functions, being increasingly transformed into mere suburban places, it may facilitate industrial and logistic roles or it may facilitate the increase of their polarizing roles as sub-centres of the whole metropolis. The factors that created their traditional regional relevance may be very different from those that facilitate the new metropolitan roles.

4 OPPORTUNITIES OPENED BY HSR IN THE MADRID AND LONDON METROPOLITAN AREAS

The Madrid metropolis has traditionally been very polarized and spatially segregated: the north and north-west being the residential area of high income population and the economic area of offices, the north-east and east being the residential area of medium income population and the economic area of big technologically sound industries and logistics, and the south being the residential area of low income population and the economic area of small and low technology industries (Mendez, et al., 2007). The

Madrid metropolitan area now reaches up to 80 to 100 km outwards including parts of the adjacent provinces.

The London Metropolitan area, in contrast, has developed in a polycentric manner with a large commuter catchment area. The London labour market area stretches typically around 100 km in each direction and London's economic influence spills over into all the adjacent regions. The outer areas, particularly those to the west in easier reach of Heathrow airport have however been the main destination of newer high-technology employment in both the manufacturing and service sectors of the knowledge economy.

Living in low density areas and commuting long distances for work has been usual in Great Britain, even for high level professionals and up to 2 hours or 150 km is not uncommon, while Spanish urban patterns have been denser until recently and commuting was undertaken along shorter distances, 50 km (long distance commuting was only done by some lower level jobs in metropolitan areas, i.e. masons). The HSR stations around 200 km south of Madrid in the Madrid-Seville HSR line at the cities of Ciudad Real and Puertollano generated the first high level professional long distance commuting (Menéndez, et al., 2002; Ureña, et al, 2005).

Within a 100 km radius Madrid has two central terminus stations, one by the south of its CBD (Atocha) and the other one by the north of it (Chamartín), and three stations rather far away from the metropolitan centre, at about 60-70 km distance from it, at or nearby the small provincial capitals of Guadalajara, Segovia and Toledo, each one in a different HSR radial line (south, north-east and north). See figures 4 and 5.

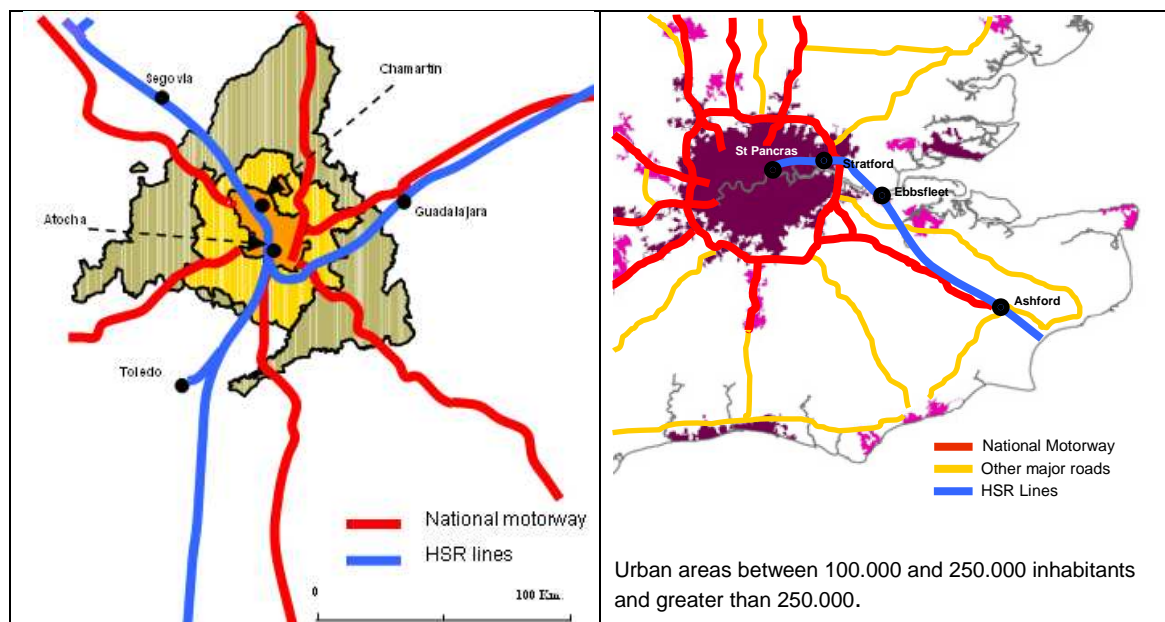


Figure 4. HSR lines and stations within 200 km of Madrid and in the south east of London.

Meanwhile, London has one central terminus station at the north of its CBD (St. Pancras) and three stations at one sole HSR line which connects London with the

continent, progressively distant from its centre, at 9 km (Stratford), 37 km (Ebbsfleet) and 88 km (Ashford). See Figures 4 and 5.

A. Opportunities due to their metropolitan location

The opportunities for the creation of new metropolitan sub-centres in the area of London are greater than in Madrid, because the HSR stations locations are closer to the metropolitan centre in comparison to its size, because the HSR connection types fulfil better the long distance, metropolitan and local sub-regional services, and because the local stations locations are more central (see Figures 2, 4, 5 and 6). The distances to metropolitan centres of similar HSR stations in relation to the size of several metropolises (including Madrid and London) together with the office decentralization distances are shown in Figure 5.

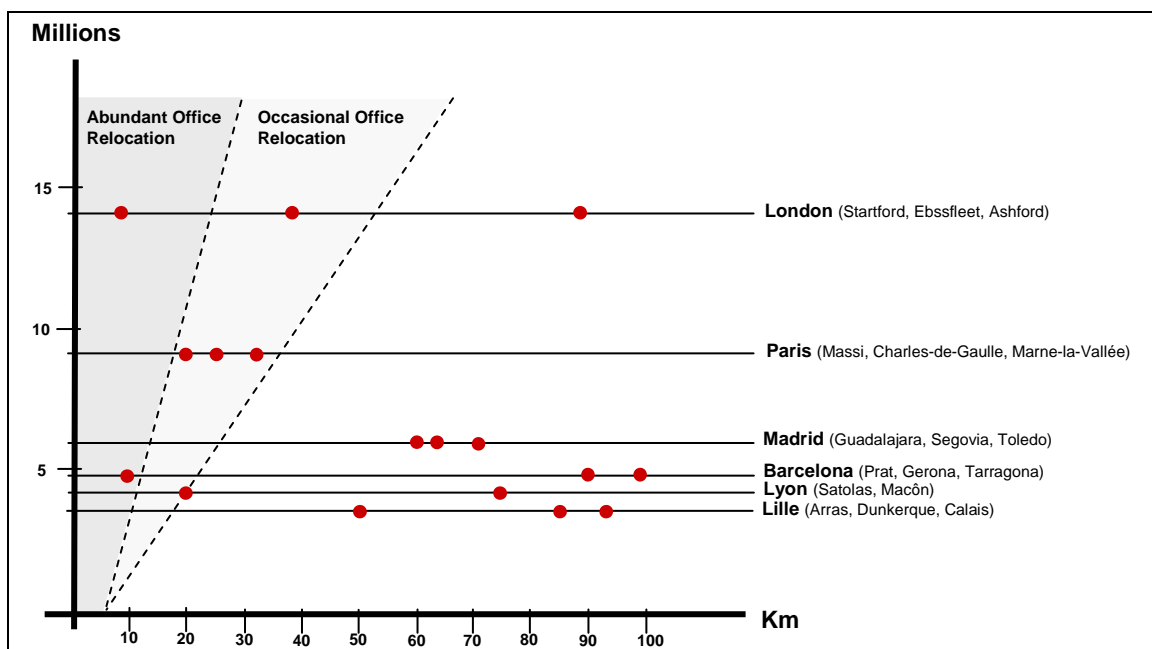


Figure 5. Metropolitan size in relation to HSR stations location distances to metropolitan centre in London, Paris, Madrid, Barcelona, Lyon and Lille.

-Dots represent HSR stations.

-Areas of office relocation have been induced from cases in London, Madrid and Paris (see section 3).

In London there are HSR stations in all types of metropolitan peripheries, though in a sole/the same HSR line, thus decentralization may happen in some of them; while in Madrid they are all too far away from the metropolitan centre and in different lines.

In the Madrid case, the HSR stations have three different types of connections, in three different corridors at the outer edge of the metropolitan periphery (around 60-70 km from its centre), too far away from the metropolitan centre to promote office decentralization, at or nearby three small cities (two administrative provincial capitals and one regional capital, see Table 2), and one central and two peripheral stations (see Figure 6). Hence, there are strong contradictions between the most appropriate corridors, cities and type and location of HSR stations for office decentralization, each

HSR city having a mixture of positive, neutral and negative characteristics to produce synergies with HSR (see Table 2 -last row).

	Guadalajara	Segovia	Toledo
Population	-83.000	-56.000	-82.000
City's transportation location and distance to metropolitan centre	-On North-East strong national & metropolitan corridor -Very good suburban rail and buses -60 km from Madrid	-30 km of North-West national & metropolitan corridor -Bad suburban rail and good buses -90 km by motorway and 63 km by HSR	-50 km west of South strong national corridor -On South-west metropolitan corridor -Suburban rail cancelled since HSR, good buses -80 km from Madrid
Corridor lodged activities	-Industry, storage and distribution firms, of big size and good technology -Intermediate socio-professional groups	-Tertiary, university and office activities -Qualified socio-professional groups	-Industry of small and low technology firms -Low socio-professional groups
Characteristics of the city	-No research university -No quality image -Provincial capital	-Private small University -World Heritage -Provincial capital	-Public University -High quality services -World Heritage -Regional capital
Station's characteristics and location (see also Figure 6)	-Through station, type 1 -8 km from city centre -Not connected to suburban/regional rail/bus	-Through station, type 4 -6 km from the city centre -Not connected to suburban/regional rail/bus	-Terminus station, type 2 -By the edge of the city centre but distant from offices.
Synergies with HSR and offices -- negative = neutral + positive	+ city transport location -- distance = corridor activities -- city characteristics + station characteristics -- station location	-- city transport location -- distance + corridor activities = city characteristics + station characteristics -- station location	-- city transport location -- distance -- corridor activities + city characteristics -- station characteristics + station location

Table 2. Characteristics of Madrid metropolitan HSR cities, HSR stations and transportation corridors. Source: Mendez, et.al. (2007), López de Lucio (1999) and authors

In the case of London, the metropolitan area is in much greater need of office decentralization and reduction of inward commuting, the three HSR stations are through stations, two of them with transport services to their sub-region, which strengthens connections of the one small city and the two suburban areas with HSR stations with the metropolitan centre, with their sub-regions and with other more distant cities, in this case all of them foreign (France). The three stations are in one sole HSR line at different distances from the metropolitan centre, which may facilitate the definition of a more robust office decentralization strategy. Nevertheless, attracting offices towards the east and south-east of the metropolis would have to change the existing tendencies whereby the west has been the main destination of newer high-technology employment of the knowledge economy (see section 3).

Table 3 synthesises each HSR station and area characteristics and synergies with HSR. Stratford, just north-east of the CBD and due to the planned important redevelopment and urban transportation connections may attract some offices of the type: “extension of the existing metropolitan centre”. Office decentralization seems more difficult in Ebbsfleet, and if any take place they might be of the type: “new big concentrated activity in specific peripheral areas not too distant from the metropolitan centre”. Finally, office decentralization at Ashford may be quite unlikely, although it has recently been designated as a Growth Area by the South East Plan (2009).

	Stratford	Ebbsfleet	Ashford
Population	-250.000*	-155.000**	-70.000
City/area's location and distance to metropolitan centre	-Just north-east of the CBD -9 km	-To the east, just outside the Green belt, to the east. -37 km, distance of abundant office decentralization	-Important metropolitan and international corridor -Traditional Railway junction for the south-east -88 km
Lodged and planned activities	-No office activities	-High technology activities to the west, not to the east	-Low density housing and rural areas -Other more relevant cities nearby (Canterbury)
Characteristics of the city/area	-Suburban area -Redevelopment for the 2012 Olympics, to become singular housing, offices and institutions	-Mixed Suburban area of industry and quarries and housing	-No University -No quality services -No administration roles -Growth Area in South East Plan
Station's characteristics and location (see also Figure 6)	-Through station, type 1 -Good urban transport connections planned	-Through station, type 5, servicing the sub-region -Good transport connections -Very big car park	-Through station, type 5, servicing the sub-region -By the edge of the city centre.
Synergies with HSR and offices -- negative = neutral + positive	+ area location planned + distance -- activities + future characteristics + station characteristics + station location (future)	-- area location -- activities + distance -- city/area characteristics + station characteristics + station location	+ city transport location -- corridor activities -- distance -- city characteristics + station characteristics + station location

Table 3. Characteristics of London metropolitan HSR cities, HSR stations and transportation corridors. Source: authors

*London Borough of Newham (36 km²)

**Dartford and Gravesham urban area's districts (8 km radius from the station)

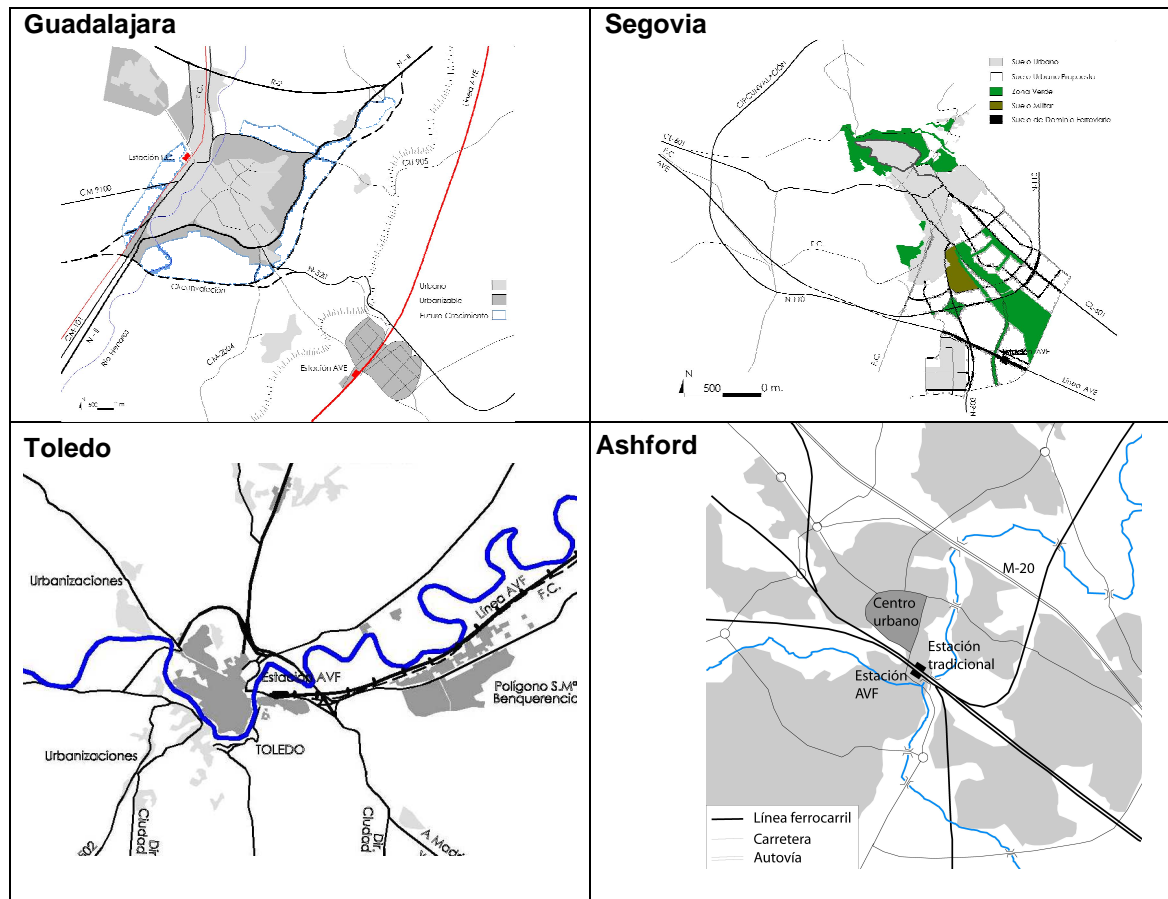


Figure 6. Location of HSR Stations

B. Opportunities due to the existing HSR services and to the type of areas

In these metropolitan contexts, and taking into account that Spain has two different rail gauges, traditional and high speed, making it difficult for HSR trains to continue along traditional lines, while in Great Britain they are all the same, Spain has three types of HSR services while Great Britain only two⁶:

- Pure long distance services (AVE in Spain and EUROSTAR in Great Britain):
 - only along HSR tracks, all national in Spain and international in Great Britain,
 - most stop only in major stations,
 - fare is expensive,
 - abundant number of services between major cities (15-20 / day and direction).
- Metropolitan services (AVANT and AVE Lanzadera in Spain and DOMESTIC HIGH SPEED in Great Britain):
 - connect metropolises to cities at 30-200 km distance,
 - along HSR tracks in Spain, in Great Britain along HSR and traditional ones,
 - stop in most stations,
 - fare is cheaper than long distance and has reductions for frequent travellers,
 - few services (6-12 / day and direction) in Spain and many more (30-80 / day and direction) in Great Britain,

⁶ However, the UK has a long tradition in high-speed (as opposed to very high speed) on traditional main lines to the north and west of London with speeds of 200km/hr in regular service for over 30 years.

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- useful for commuting on long distances or with congestion near metropolises

-Long distance mixed services (ALVIA and ALTARIA in Spain):

- partially along HSR and partially along traditional tracks,
- most stop in all stations and are less punctual,
- fare is slightly cheaper than pure long distance services,
- small number of services to each final destination (2-3 / day and direction)

Contrary to our hypothesis, none of the six HSR stations have similar number of HSR services to distant destinations as available from the central metropolitan HSR stations. The hypothesis established was that the same HSR services accessible from the metropolitan centre were now also accessible from some small cities of the metropolitan periphery for rapid travel to distant cities, which allowed these small cities, in similar ways as around metropolitan airports, to transform themselves into metropolitan sub-centres.

According to the existing HSR services (see Table 1), this is not the case in either Madrid or London, because long distance HSR services available in these six HSR stations are substantially less numerous than those existing in the central HSR stations.

- In Madrid they are about four times less numerous at Guadalajara and about half at Segovia, while at Toledo there are none.
- In London the international services are about 3 times less at Ebbsfleet and 7 times less at Ashford, while there are currently no international services at Stratford (these may be developed by the time of the Olympics)⁷.

Meanwhile, the 6 stations are much more linked with HSR services towards the metropolitan centre than to distant cities (see Table 1). This is so at Madrid, with the same number in Guadalajara because there are no metropolitan HSR services, and 20% more at Segovia, while Toledo has only HSR services with Madrid. They are significantly more numerous at London, 6 to 7 times more at Ebbsfleet and Ashford, while Stratford has no long distance ones but about 80 metropolitan ones. In the case of Madrid metropolitan HSR frequencies are significantly small (6 and 8 per direction), while in London they are much more numerous (between 38 and 78 per direction), similar to normal frequencies of traditional suburban trains (around 60 in the relation Madrid-Guadalajara and 100 in the London-Ashford one).

In Madrid, only Toledo has the local required characteristics to become a sub-centre, but lacks good long distance transport connections, while Guadalajara, the one that fulfils the best the long distance transport connection (apart from the HSR ones) is the one that fulfils worse the local requirements (see Table 2), and while Segovia aims to grow towards its new distant HSR station (Ribalaygua, 2005a).

⁷ In the case of the HSR station of Marne-la-Vallée, with a connection type 3 (see Figure 2) the number of long distant HSR services is about half of those existing in each one of the three central Paris stations (24 services to Lyon from central Paris while only 12 from Marne-la-Vallée).

Table 1. Number of HSR outward services departing from central Madrid HSR stations and from the three small cities stations in the outer metropolitan periphery

Number of outwards Daily Services by type of HSR service			
	Pure long distance	Mixed long distance	Metropolitan
MADRID			
Northeast Corridor			
Central-Northeast	21	5	0*
Central-Guadalajara	3	3	0
Guadalajara-Northeast	3	3	0
Northern Corridor**			
Central-North	2	10	5*
Central -Segovia	0	5	7
Segovia-North	0	5	5
Southern Corridor			
Central -South	22	4	12*
Central -Toledo	0	0	8
Toledo-South	0	0	0
LONDON			
Southeast Corridor			
Central-Continent	30	0	0
Central-Stratford	0	0	78
Stratford-Continent	0	0	0
Stratford-Ebbsfleet	0	0	67
Central-Ebbsfleet	0***	0	67
Ebbsfleet-Continent	10	0	0
Ebbsfleet-Ashford	0	0	31
Central-Ashford	0***	0	38
Ashford-Continent	5	0	0

* Metropolitan services serving cities further away than Guadalajara, Segovia or Toledo

** The HSR infrastructure is established only till Valladolid, so there are few HSR services.

*** There are trains that stop in this station but tickets are not available for this relation

Source: Renfe Web Page (www.renfe.es) and Southeastern Web Page (www.southeasternrailway.co.uk)

Meanwhile, in London, Stratford and Ebbsfleet depend more on the redevelopment projects that are being undertaken, and Ashford lacks some of the local requirements (i.e. no university), fulfils others (i.e. central HSR station) and fulfils very well the existence of other means of transport (apart from HSR) both metropolitan as well as long distance.

C. Opportunities derived from the use of HSR

The use of the HSR has already been measured in the three Madrid stations, while it has not been done in London because the metropolitan services only started in December 2009⁸, and there are only opinions derived from a few qualitative interviews.

The first opportunity is that the metropolises have additional stations to be used as alternatives to central stations for long distance travel. This happens in Guadalajara and in Ashford (and it is also planned at Ebbsfleet). It also happens with the stations near Paris (see Ureña, et al., 2009).

The north-east Madrid-Guadalajara corridor offers multiple means of communication. A radial suburban rail with a much more central station, several intermediate stops in

⁸ Although a preview service began on 29th June 2009.

places with important job opportunities, four stops at the Madrid centre (Atocha, Recoletos, Nuevos Ministerios and Chamartín), a great frequency (60 a day in each direction compared to only 3 HSR services) and low fares. There are also suburban buses, with similar characteristics to the suburban rail and two motorways. Suburban rail to Madrid takes only one hour's travelling time, while the HSR takes 25 minutes. In these circumstances, aside from the station situation at 8 km from Guadalajara, passengers use the limited HSR services available as an alternative station for long distance travel rather than for commuting.

The Guadalajara HSR station passengers have the following characteristics (Ribalaygua et al., 2006)⁹:

- Only 18% of HSR passengers embark or disembark at Madrid (Atocha), while the remaining 82% have their origin/destination at cities at least 250km away.
- About one quarter of the passengers live in the north-east periphery of the Madrid metropolis and travel to distant destinations.
- Only 27% of passengers are travelling for work-related reasons, which across HSR services in general accounts for around 50% of all journeys (Rivas, 2006). The most important purpose for travel given is for family reasons, at 55%.

Currently, in Ashford HSR station, UK inhabitants board and disembark on their journeys to and from the continent, mainly for leisure purposes. Especially those for whom this station is more convenient than the central London one, given its good conventional rail connections with the rest of the south-east, its easy accessibility by private car and the fact that it enables passengers to avoid London's traffic congestion and lack of parking space.

The second opportunity is to increase its metropolitan integration, by inwards commuting. This happens especially in Segovia and also, but with some doubts, in Ashford, Ebbsfleet and their sub-regions.

In Segovia, HSR is mostly used for commuting (the long distance HSR infrastructure is still being built), almost only inwards towards Madrid (each day there are about 400 vehicles parked nearby the Segovia HSR station), many of them people who previously used other means of transport. This inwards commuting is done because the previous suburban traditional rail services have been cancelled (even though they took 2 hours while HSR takes 25 minutes), because road distance is 90 km while HSR distance is 60 km and because inwards traffic congestion is very high. Reversely, HSR commuting outwards from Madrid to Segovia is very small for four reasons: because there is little traffic congestion in that direction, because the station is 4 km away from the centre of Segovia, because possible commuters (fairly high socio-professional level) live in the

⁹ Information obtained by a survey of a sample of HSR passengers on all HSR trains stopping at Guadalajara on 17-19 November 2005 (see Ribalaygua et al., 2006).

same north-west corridor and find it much easier to commute by car, and because of the limited high-level jobs offered in this small provincial capital.

In the case of Ashford, and to some extent the other urban areas in Kent which have services using HSR infrastructure from either Ashford or Ebbsfleet, although time savings are not so substantial in some cases, the relative advantage of using these metropolitan HSR services as opposed to traditional suburban services are limited.

Commuting advantages derived from the introduction of HSR metropolitan services may be substantial or not depending on the origins and destinations, taking into account the total travel and connecting time, the service frequency and comfort and the stations served.

The traditional rail network allows good services for most places in the south-east London metropolitan periphery to reach several stations in the southern part of central London: Victoria, Waterloo, Charing Cross, Cannon Street and London Bridge; while the metropolitan HSR services allow good opportunities for a lesser number of places to reach one sole place in the northern part of central London: St Pancras. From all these stations there are good underground connections to all places in central London, but underground comfort and speed are low, thus most people prefer to arrive as close to their work as possible either by suburban traditional rail (southern part of central London) or HSR trains (northern part).

Time reduction using HSR metropolitan services are not that relevant (Ashford-London reduces its time from 70 to 37 minutes, Canterbury-London reduces it from 80-90 to 59 minutes), while frequencies and stations served are less than traditional rail and price is higher. Time reductions are more relevant for those using HSR services entering the HSR infrastructure in Ashford than for those entering in Ebbsfleet because the distance travelled on HSR infrastructure is longer (see Figure 4).

The third opportunity is not only to reinforce the inwards metropolitan commuting relations but also the outwards metropolitan ones, may be helping to decentralize some activities to the metropolitan periphery. This happens in Toledo, but has not yet happened towards Ashford.

In Toledo, where HSR only allows travelling to/from Madrid, a significant proportion of its passengers commute outwards from Madrid to Toledo.

HSR passengers in this relation have the following characteristics (Guirao et al., 2008):

- Only 30% of people previously used other means of transport.
- 50% of journeys are carried out for work reasons, 30% for tourism and 8% for university studies.
- 70% of commuters live in Toledo and work in Madrid, while 20% live in Madrid and work in Toledo.

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- 70% of the tourists travelling by HSR are foreigners.

Commuting outwards, from Madrid to Toledo, is important due to four reasons: because Toledo has become the regional capital of the third largest (in surface area) Spanish region and the number of jobs of high socio-professional level has increased importantly, because the station is within walking distance from the urban centre, because the traditional suburban rail has been suppressed to build the HSR one (although traditional suburban rail services took 90 minutes while HSR ones take 25 minutes), and because possible commuters (fairly high socio-professional level) do not live in the same south corridor. Additionally, quite a number of tourists based in Madrid use morning HSR trains to access Toledo and return in afternoon ones.

The fourth opportunity is to cross the metropolis, to be able to avoid the congestion traversing the metropolitan area, in order to go from a periphery of the metropolis to a distant place to the other side of the metropolis. In London, HSR metropolitan services allow a good connection of the south-east part of metropolitan London to the north of the country, since they reach St Pancras station which is adjacent to the Kings Cross Station and close to Euston Station, from which two termini most northern trains depart.

D. Opportunities opened up with the new HSR infrastructures

There are two problems for using the HSR infrastructure for metropolitan HSR services: first, the small number of stops and second, the use of the HSR infrastructure by long distance trains.

One of the present problems of using HSR in Madrid as a suburban metropolitan transport is that each line only connects one point in the metropolitan centre with one point in the metropolitan periphery (see Figure 7) and that the number of services is small, because the HSR infrastructure is mostly assigned to long distance services.

In London this problem does not happen at the present south-east HSR line. The number of metropolitan HSR services can be numerous and the same gauge of traditional and HSR infrastructure allows that HSR services serve areas along traditional rail infrastructure. The introduction of HSR between London and the continent was closely connected with the establishment of 'special' high-performance metropolitan services using the south-east HSR infrastructure on this particular line. So far, there is little or no conflict between metropolitan and long distance passenger HSR services; given that the demand for London-Continent passenger HSR services and Channel Tunnel freight trains is less than the previously expected. Both things have made it feasible to allocate enough periods of HSR infrastructure time to metropolitan HSR services, allowing for very important frequencies (60 to 80 in each direction, See Table 1).

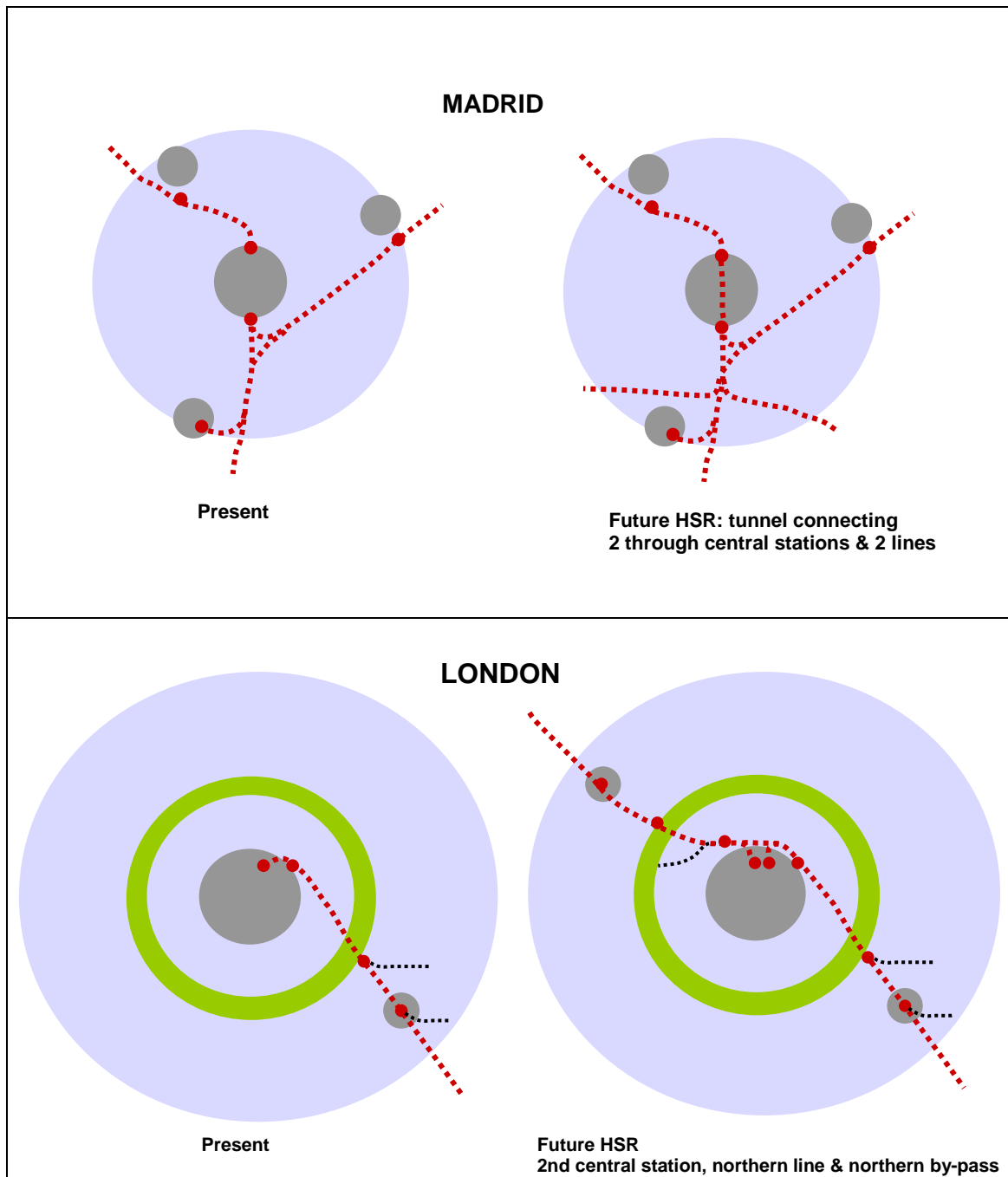


Figure 7. Synthesis of present and future metropolitan HSR infrastructure within 100 km from Madrid and London

- In London it considers the latest recommendation to the British Government.
- They don't include the connections to the airports.
- Green ring corresponds to London's Green Belt.

With the present HSR infrastructure at Madrid and London there are only periphery to/from centre metropolitan HSR services; in Madrid without intermediate stops and in London with intermediate stops in the other HSR stations. In Madrid there are a further two additional metropolitan HSR services that today could exist, but do not: a radial one (Guadalajara-MadridAtocha) and a tangential one (Guadalajara-Toledo, along the north-east/south by-pass not touching the Atocha central station).

With the future tunnel and two through central stations in Madrid, and with the future northern HSR line, the two central terminus stations and the northern by-pass in London, the metropolitan HSR services could be not only periphery to/from centre but also through ones connecting different peripheries (see Figure 7):

- In the case of Madrid, metropolitan HSR services connecting Segovia-Toledo and Segovia-Guadalajara could stop at two through central stations MadridChamartin, and MadridAtocha, but still will not have intermediate stops in the different peripheries.
- In the case of London, metropolitan HSR services could connect the south-east periphery with the north one, but without central stops, because St Pancras and Euston remain dead end stations, but could stop in intermediate stations of both peripheries (similar to Ebbsfleet and Stratford).

Meanwhile, it is not clear that high frequency metropolitan services will be possible in the new northern HSR line in London, because there may be a greater number of long distance services to/from London and they may use a greater percentage of line time than in the southeast HSR line.

5 CONCLUSIONS

At the beginning of the HSR in Europe, almost 30 years ago, it was thought of as an alternative to air transport connecting large cities between 400 and 600km apart. The implementation of different HSR networks is showing other uses and concepts of HSR, particularly more intermediate stations and mixed services using both HSR and traditional infrastructure to irrigate the benefits of HSR to more places.

This study makes clear that another new concept of intra-metropolitan HSR is getting established, that of HSR stations at/by small cities or suburban areas already integrated in metropolitan processes. Moreover, this study compares the cases of Madrid and London and highlights that this new concept is not uniform, but on the contrary has different forms.

In the case of Madrid all three stations are in small provincial capital cities, by three different HSR lines, at the same big distance from the metropolitan centre, by the edge of the metropolitan periphery. They have a small number of intra-metropolitan HSR services, much smaller than normal suburban traditional rail services, which only connect each HSR station with a central HSR Madrid station.

In the case of London all the three by the same HSR line, two in suburban areas, one nearby the centre and another one just outside the greenbelt, and the third one at a small city with no relevant administration role by the edge of the metropolitan periphery. They have a great number of HSR intra-metropolitan services, similar to normal

suburban traditional rail services, which connect the London central station with them, between them and other stations in the sub-region of two of the three HSR stations.

Other possibilities are envisaged taking into consideration the five different connection types described in the paper and the new HSR infrastructures being built or planned in Madrid and London¹⁰. Further research should be undertaken with existing and future cases (see Figures 2, 3 and 5) in order to reach sound conclusions.

The hypothesis that these HSR stations in the metropolitan peripheries may facilitate the creation of metropolitan sub-centres because similar long distance HSR services could be available at them as in the metropolitan central HSR stations is not the case both in Madrid and London. Long distance services in the later HSR stations are about four times more numerous than in the HSR stations in the metropolitan peripheries.

Furthermore, the paper shows that the two eastern London HSR stations closer to the centre (9 km and 33 km) are at distances where office decentralization is already taking place, although preferentially towards the western peripheries more than the eastern ones, so the redevelopment projects of their surroundings combined with HSR and the government planning decisions may result in the attraction of offices and change the existing tendencies. Meanwhile the three Madrid HSR stations are too far away from the metropolitan centre to attract offices, and more so because the corridor that attracts more office decentralization (the north-west corridor) has a HSR station 4 km from the centre of a small city (Segovia) with a small office attraction potential and the city with more office attraction potential (Toledo) is located in a metropolitan corridor that doesn't attract offices and its HSR infrastructure and station doesn't allow for long distance HSR services. It looks as if the existing HSR network in London (one line with three stations) has been thought of more in relation to metropolitan planning, while the Madrid one has only been thought of as an additional transportation tool.

These HSR stations in the metropolitan peripheries and the future HSR investments nearby the two metropolises of London and Madrid are or will be facilitating the following uses:

- Alternative stations to central ones for long distance travel, in order to avoid metropolitan centre congestion and to benefit from easier access and parking from within or outside the metropolitan areas.
- Inwards commuting to a limited number of places in the metropolitan centre. The future investments may facilitate in Madrid access to more metropolitan central places. The limited places HSR services access central London and the greater variety of central metropolitan places accessed by traditional suburban rail may not compensate the small time savings of using HSR.

¹⁰ Nevertheless, the frequent intra-metropolitan HSR services in the southeast-continent HSR line near London may be an exception in what may happen in most other cases, since this line may not be used for long distance HSR passenger trains for an important percentage of time.

- Outwards commuting only towards those places that offer high level professional jobs (i.e. Toledo).
- The new HSR investments in both metropolises will facilitate through traffic across the metropolis in order to access a few other metropolitan peripheries or distant places.

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