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BECKERICH (Christophe), BENOIT (Sylvie), DELAPLACE (Marie), « Ligne à grande vitesse et développement durable local. Une analyse qualitative dans huit villes françaises »

RÉSUMÉ – La grande vitesse ferroviaire est souvent perçue comme un moyen de combiner les transports et le développement durable dans un contexte d'augmentation de la mobilité. Cependant, la massification des flux de passagers qu'elle induit peut atténuer ses impacts positifs sur les aspects économiques, environnementaux et sociaux du développement durable. Peu d'informations sont disponibles au niveau local. Pour combler ce manque, une analyse qualitative a été menée dans huit villes françaises.

MOTS-CLÉS – Développement durable, développement local, transport, grande vitesse ferroviaire France

BECKERICH (Christophe), BENOIT (Sylvie), DELAPLACE (Marie), « High-speed rail service and local sustainable development. A qualitative survey in eight French cities »

ABSTRACT – The expansion of HSR services is often perceived as a means of combining transportation and sustainable development in a context of growing passenger mobility. However, the operation of these services in terms of the concentration of passenger flows can mitigate their positive impacts on the economic, environmental and social aspects of sustainable development. Little information is available at the local level. To address this gap, a qualitative research has been conducted in 8 French cities.

KEYWORDS – Sustainable development, local development, transportation, high-speed rail services, France

HIGH-SPEED RAIL SERVICE AND LOCAL SUSTAINABLE DEVELOPMENT

A qualitative survey in eight French cities

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INTRODUCTION

Since the early 1990s, sustainable transportation has appeared to be a key issue for the former European Conference of Ministers of Transport (ECMT), currently the International Transport Forum. The ECMT considers that sustainable transportation should contribute to economic prosperity and social welfare, without harming either the environment or human health (CEMT, 1991) with reference to the

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three dimensions of sustainability (economic, social and environmental). All transportation systems (goods and passengers) are concerned by sustainability. In this article, we shall focus only on high-speed rail transportation. We don't analyze HSL building but HSR operating. Indeed, the services linked to high-speed lines are often presented as virtuous solutions enabling sustainable development that is an economic development but also a social one with few environmental negative externalities. However, the three dimensions of sustainability are not taken into account. From an environmental point of view, HSR is supposed to allow a modal shift from road transportation. HSR services are also considered to boost the economic dynamism of major urban centers by favoring exchanges between major transportation hubs. Indeed, in many cities served by HSR, public stakeholders use it as a tool for local development. HSR is often perceived as an opportunity for improved accessibility, for a possible increase in mobility, and for exchanges that will favor the economic growth of the areas served. Regarding the social issue, literature is very poor. Moreover, when these dimensions are considered, they are taken into account separately and at different scales: national for environmental issues, national and local for economic issues and local for social issues.

Our aim is to reconcile these different viewpoints and to analyze the wider effects of HSR services through the lens of sustainable development at local level, i.e. the city served⁴. First of all, we shall consider the literature concerning HSR services and sustainable development. We shall then report the results of qualitative research⁵ conducted in eight French cities—three served by the North HSR Line, three by the East European HSR Line and two by the Atlantic HSR Line—based in particular on 60 interviews.

4 Here, we do not study effects linked to the construction of high-speed lines, but rather the effects linked to their operation.

5 This research has been approved by PREDIT (Programme de Recherche et d'Innovation dans les Transports Terrestres—Research and Innovation in Land Transport Program) and was financed by ADEME (Agence de l'Environnement et de la Maîtrise de l'Énergie—French Agency for the Environment and Energy Management).

I. HSR SERVICES AND LOCAL SUSTAINABLE DEVELOPMENT: A REVIEW

HSR services are supposed to contribute towards sustainable development by bringing economic, social and environmental benefits. However, these three elements have never been analyzed simultaneously for a given set of cities.

THE WIDER ECONOMIC IMPACT OF HSR SERVICES

The effects of HSR services on economic activities are various. They relate in particular to the location of new businesses, the development of economic activities, including tourism, and employment opportunities in general.

HSR services could help attract new businesses, particularly in leading-edge technologies or tertiary sectors in larger or intermediate cities due to improved accessibility. But in France, as in other countries, this is not always the case (see Bazin et al. 2016, for a review). The reality of these kinds of effects is debatable: they tend to benefit large cities more than intermediate areas (Vickerman, 2015). Nevertheless, HSR services may improve the economic attractiveness of cities for investors via image effects (Bazin et al., 2009, 2016), and can reinforce existing businesses and economic activity by improving contacts with clients and suppliers, or by facilitating access to new clients.

In Japan, Amano and Nakagawa (1990, reported by Haynes, 1997) have shown that employment locations with stations experienced employment growth levels 26% higher than those without stations. Hirota and Izawa (1985) showed that the *Shinkansen* induced higher growth in the wholesale, retail, industrial, manufacturing, and construction sectors in places with *Shinkansen* stations than in those without. However, in both cases, the calculations presented were overall results and not results for each location. Also in Japan, Okabe (1980) showed that growth in the retail trade varies significantly, and that growth of sales was extremely limited; furthermore, when growth was observed, it concerned only certain retail outlets in front of the station (Okabe, 1980, p. 125). In his review, Givoni also relates that growth only occurred in new stations; at

existing stations, “little or no development around the station occurred” (Givoni, 2006). Nevertheless, an HSR connection can ensure that existing companies stay in a given location, as in the case of Le Mans⁶.

The second category focuses on one of the effects of competitiveness in the field of tourism, and more specifically in urban and business tourism. With respect to this issue, expectations are high (see Delaplace et al., 2014, for a review), but ex-post results are again highly controversial. No general trend seems to have emerged in France (Delaplace et al., 2014; DB International GmbH, 2011). In Spain (Urena et al., 2009; DB International GmbH, 2011; Todorovitch et al., 2011), Germany (DB International GmbH, 2011; SEEDA, 2008), and the Netherlands (SEEDA, 2008), the effects are equally mixed. But in Taiwan (Cheng, 2009) and China (Wang et al., 2012; Chen and Haynes, 2012), an increase in the number of tourist trips has been reported in areas served by HSR. These results highlight the heterogeneity of situations, often with reference to specific cases, underlining their contextualization (Delaplace, 2012a). Moreover, while the number of tourists might increase, the duration of their stay, in some cases, can decrease (Delaplace et al., 2014). To sum up, while the number of tourists may grow with the arrival of HSR, a significant reduction in the average length of stay can lead to an overall reduction in spending by tourists (Levinson, 2012), a trend that reveals the contradictory effects of HSR services on tourism (Albalade and Bel, 2010).

The third category concerns the changing employment context. In this case, too, there is no conclusive evidence. In France, employment growth in cities that are served by HSR does not always appear to have been above the national average. Chen and Hall (2012) confirm this point in the case of Great Britain. Nevertheless, they show that Lille was characterized by the largest increase in knowledge-intensive employment. Moreover, in his review, Sands considers that, at the urban level in Japan, there is a correlation between the *Shinkansen* and employment growth rates, although these rates vary from one study to another (Sands, 1993).

More recently, a study conducted in 231 French urban areas⁷—some served by HSR, others not—with different economic specializations

6 L'Express, 27/11/2003.

7 Translator's note: the areas in question are known as *unités urbaines* (literally “urban units”) in French, which correspond approximately to continuously built-up urban areas

(some “productive”, some “presential”) showed the significant heterogeneity of the wider impacts on jobs as a result of reduced travel times (Koning et al., 2015). Some urban areas lost jobs between 1982 and 2010, while others gained jobs over the same period. This research highlighted the fact that the reduction of travel time due to the expansion of HSR lines and services was of greater benefit in terms of jobs in urban areas specialized in the “presential” economy. Moreover, growth was greater when these urban areas were connected to “productive” urban areas. Conversely, the “productive” urban areas lost more jobs following a reduction in travel time (Koning et al., 2015).

SOCIAL BENEFITS OF HSR SERVICES

HSR services can improve accessibility, but this is only the case for people who are able to make use of it. Some people cannot access HSR services because of high ticket prices or because they live in cities not served by HSR. Consequently, HSR services can produce forms of geographical exclusion and economic exclusion that are both part of social exclusion, defined as the individual’s inability to access the activities in which they need to participate (see Kenyon et al., 2002, Preston and Rajé, 2007 and Church et al., 2000 for an analysis of transportation-related social exclusion).

Differences in terms of accessibility can be analyzed from spatial and social points of view. The distribution of accessibility among different groups of people is referred to in terms of “social equity” and/or “social exclusion”. The analysis of the distribution of accessibility between locations is referred to in terms of “spatial equity” or “territorial cohesion” (Ortega et al., 2014).

Concerning the first point, an HSR ticket is frequently more expensive than a ticket for a conventional train. Consequently, HSR services are used disproportionately by higher social and occupational groups and by mobile workers, and in particular by consultants and executives (cf. Klein and Claisse, 1997, or Mannone, 1995, concerning the French case). Consequently the modal shift from air to rail concerns only these categories of high-income travelers.

(i.e. with no gaps in the urban fabric of more than 200 meters).

An HSR service reduces journey times, and sometimes makes same-day round-trip journeys possible. A study conducted by Zhao et al. (2015) shows that the market for HSR is influenced by the value of travel-time savings, which is determined by salary levels, the cost of travel and journey arrangements. For China, they show that, depending on their income, certain rail passengers prefer conventional overnight sleeper trains over high-speed trains for long-distance travel. But in some countries, like France, for certain destinations, passengers no longer have a choice between HSR and conventional rail. For example, in certain cities served by the East European high-speed line, conventional trains have disappeared altogether (Bazin et al., 2013). From a social point of view, HSR services can also exclude low-income populations from gaining access rail transport.

Concerning the second point, because HSR services do not serve all cities with the same frequency (with some cities not served at all), HSR can produce negative spatial impacts. Service levels (the frequency of trains per day, per week, or per weekend) vary from city to city. More specifically, they are higher in larger cities than in smaller towns: frequency is correlated with the size of the urban area (Delaplace, 2012b, for the French case). In South Korea, an analysis of the impact of expanding high-speed lines on accessibility changes and spatial equity shows that the first two generations of high-speed lines have been linked to a polarization effect around the main cities served (Seoul and Daejeon) and to a decrease in competitiveness for spaces far from these cities (Kim and Sultana, 2015). With regard to France, the development of high-speed lines seems to be spatially unjust for two reasons: first, HSR services are characterized by contrasting local effects on growth and second, the pricing system is unfair⁸ (Bouf and Desmaris, 2014).

EXPECTED ENVIRONMENTAL BENEFITS OF HSR SERVICES

From an environmental point of view, there are important debates on three issues: the expected modal shift from road or air transportation to HSR; the allocation of freed-up rail paths on conventional

8 The authors are also putting forward a third reason not interesting for this paper (the amount and nature of contributions to the funding of the LGV (HSR) network which differ significantly depending on the line).

lines to freight traffic; and the impacts of the operation of lines on greenhouse-gas emissions.

Concerning the first issue, in the case of France, passenger transportation was still dominated by road traffic in 2013, representing 88% of journeys. Moreover, HSR ridership fell (-0.5%) in 2013 compared to 2012, after approximately 30 years of continuous growth (Cour des Comptes, 2014). In France, 51% of high-speed rail traffic is induced traffic (CGDD, 2009). Consequently, while HSR enables modal shift, it also generates an overall increase in mobility and thus contributes to increasing emissions. More specifically, HSR services seem to generate new types of mobility: this is the case in particular for commuter mobility (Troin, 2010) and, in some areas, tourist mobility (Pagliara et al., 2015, Delaplace et al., 2016). With respect to the South-East high-speed line (HSL), traffic between Paris and Lyon has increased by 37% (27% of which is induced traffic) (Givoni, 2006, p. 601). But such increases in traffic appear to depend on the economic dynamism of the cities in question. Some 25 years of evaluations of high-speed rail investments in France puts these results into perspective (RFF, 2010): real traffic levels are often lower (by 10% to 20%) than expected.

Moreover, the reduction in the frequency of conventional rail can lead to a reverse modal shift from the train to the car! This reverse modal shift is frequently underestimated. But it has occurred, for instance, in French towns and cities located along the Marne Valley, following the opening of the East European HSL (Bazin et al., 2013). Moreover, the use of a car is frequently required to get to the station in order to take the train. Concerning the modal shift from air to rail, this tends to occur for journeys that take less than three hours by train. Indeed, travel time is an important factor in the competition between HSR and air travel (Dobruszkes, 2011)—an aspect underlined in Japan 35 years ago (Okabe, 1980). This modal shift has occurred in France on the Mediterranean HSL with respect to Marseille-Provence airport, but not with respect to Toulon or Nice airports (SETEC, 2004). The air service between Paris and Strasbourg has disappeared following the opening of the East European HSL. In 2009, Behrens and Pels showed that HSR was a competitor for both conventional and low-cost airlines on the London–Paris passenger market. On the Milan–Rome route, air travel has decreased by 1.3 million passengers a year while the modal share

for rail services between Milan and Rome grew from 36% in 2008 to 66% in 2012 (ECORYS, 2014). Nevertheless, when HSR prices are higher than air fares, as in the case of low-cost flights⁹, the modal shift observed is limited. On the other hand, modal shift from air to rail can lead to a negative environmental impact when the market size is too small. In this case, HST occupation rates are suboptimal. In this case, the environmental impacts per passenger are disproportionately high (D'Alfonso et al., 2015). Finally, reductions in greenhouse-gas emissions depend on mobility behaviors and how travelers adapt to new mass-transit alternatives (see Matute and Chester, 2015, concerning the Californian case).

With regard to the second issue highlighted above, modal shift can also be indirect, as a result of a shift from road or air freight to HSR, or alternatively to conventional rail freight using rail paths freed up due to the opening of a high-speed line. Currently there is very limited HSR freight in Europe (only for mail), and very little information exists about the use of conventional rail paths for freight following the opening of an HSL. But the building of HSLs in France seems to have primarily benefited regional passenger rail (Bazin et al., 2013).

Finally, with regard to the third issue relating to environmental benefits, knowledge concerning the impacts of operating high-speed rail lines in terms of carbon footprints is controversial. In France, the TGV—the French HST—is considered costly for limited environmental benefits (Cour des Comptes, 2014). Two kinds of costs are highlighted: the environmental cost of operating the line, and costs linked to energy consumption.

Concerning the environmental cost of operating an HST on a journey from Paris to Marseille, CO₂ emissions per passenger (g/pkm) are 2.7 g/pkm for HSR, compared with 153 g/pkm for air travel and 115.7 g/pkm for car use (EC, 2009, p. 96). For a round-trip journey between Paris and London, the consumption of CO₂ is 11 g/pkm for the Eurostar, compared with 168 g/pkm for an airplane (to Heathrow) (EC, 2009, p. 97). More generally, there are very few greenhouse-gas emissions associated with HSR. In France, emissions of CO₂ by TGVs (based on

9 Except in France with Ouigo, SNCF's new range of low-cost rail services. These services which were initially limited to just a few destinations have been extended in 2016 to more destinations.

energy consumption and occupation rates) are lower than those for other kinds of trains: in 2013, according to SNCF's calculations, emissions generated by TGVs amounted to 3.4 g of CO₂ per passenger-kilometer, compared with 6.2 g for Transiliens (suburban trains in the Paris region), 10.2 g for Intercités (conventional intercity rail services) and 30 g for TERs (conventional regional rail services). But emissions depend on the country in question—and the type of electricity production—and on occupation rates. In some cases, emissions can be lower for conventional rail (Spaven, 2006). In France, the benefits of HST are linked to high occupation rates compared to other trains (Cour des Comptes, 2014).

When taking into account the life cycle of an HSL, from conception to construction to operation over 30 years (including the construction and maintenance of stations and trains), the figures suggest that the total emissions generated amount to 1.9 MteqCO₂, 57% of which results from the operation of the line (Cour des Comptes, 2014). A modal shift from road or air to rail would appear to save 3.9 MteqCO₂ (for 1.2 million passengers per year). In this case “an HSL would become advantageous in terms of CO₂ emissions 12 years after inauguration, based on a total lifetime of 50 years or more” (Cour des Comptes, 2014). In the case of the Shanghai–Beijing HSL, Yue et al. (2015) show that, over the total life cycle of the line, environmental performance is not clear. Ultimately, emissions depend on the kind of electricity production used to power HSTs. The emissions benefits of an HSL depend on how much carbon is used during electricity generation. Nevertheless, some studies consider that HSR is a good solution over the long term. For instance, concerning the USA, Krishnan et al. (2015) show that if there is a large market for HSR in interstate passenger transportation, a reasonable decrease in national long-term CO₂ emissions and costs could be obtained by investing in HSR. Moreover, beyond sustainability, HSR would make it possible to achieve the goals of energy independence, security and efficiency.

In summary, this review shows that the economic effects, social and spatial effects and environmental benefits of the HSR services must be tempered by other considerations. Moreover, it highlights that the three dimensions of sustainability have, to date, been analyzed separately and at different levels. In order to analyze the impacts of HSR services on sustainable development, it is necessary to understand all three of these dimensions together at the local level.

II. HSR SERVICES AND LOCAL SUSTAINABLE DEVELOPMENT: THE CASE OF EIGHT FRENCH CITIES

The research on HSR services in terms of local and sustainable development (Bazin et al., 2013) concerns eight French cities. Two criteria were used to select cities from among all those served by HSR: their size (large, intermediate, and small), and their location on three different HSR networks: the North HSR (Arras, Hazebrouck, and Lille), the East European HSR (Metz, Reims, and Saverne), and the Atlantic HSR (Auray and Nantes) (see Figure 1 and Table 1). Some are directly served by an HSL (Reims and Lille), while others are served by HSR services that run on conventional lines after leaving the HSL.

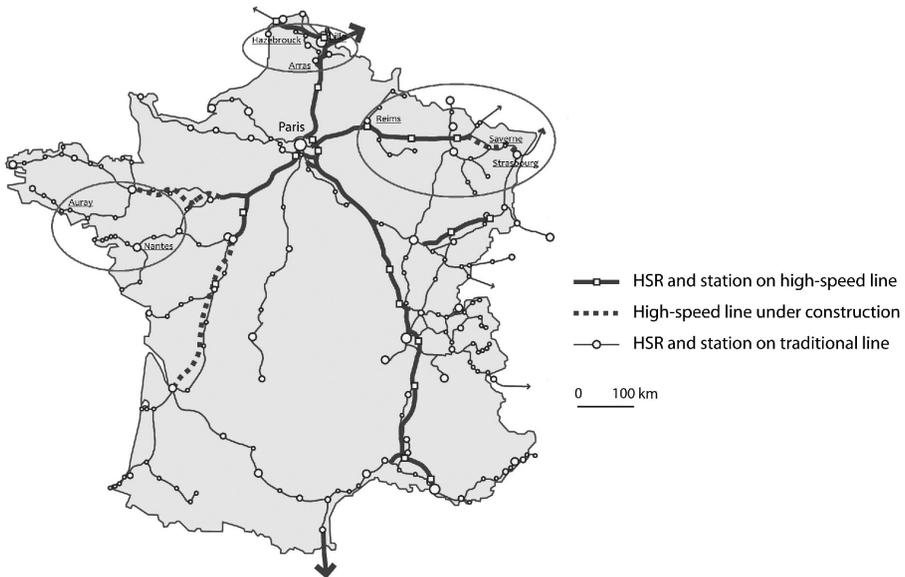


FIG. 1 – The eight French cities investigated.
Source: Adapted from Wikipedia Commons.

City (opening of the HSR service)	Network (Type of station on HSL or on conventional rail)	Population before HSR	Employment before HSR	Employment after HSR	Average annual Growth of Employment before	Average annual Growth of Employment after	Travel time savings to Paris		Type of use	Change in service levels + number of direct round- trip journeys to Paris (2010)	
							Average travel time	Travel time reduction (Return in the day or half-day)		Overall change in service levels since the opening of the service	Number of direct round- trip journeys to Paris per week (per weekend)
Arras (1993)	North C	82.239 (1990)	43.932 (1990)	47.768 (1999)	0,22 % (82-90)	1,3 % (99/06)	0h50	50% (HD)	Business travel and commuting	- 3	12,5 (9,5)
Hazebrouck (1993)	North C	25.134 (1990)	8.872 (1990)	9.560 (1999)	0,1 % (82-90)	0,9 % (99/06)	1h50	33% (D)	Business travel	NC	6 (4)
Lille (1993)	North HSL	978.794 (1990)	407.948 (1990)	422.963 (1999)	-0,1 % (82-90)	1,3 % (99/06)	1h	50% (HD)	Business travel and commuting	+ 7	26 (15)
Metz (2007)	East C	322.946 (2006)	154.472 (2006)	136.394 (2013)	1,5 % (99/06)	-1,3 % (08/13)	1h25	45% (D)	Business travel	0	10 (9)
Reims Central station + Bezaunnes station (2007)	East C + HSL	212.021 (2006)	108.383 (2006)	104.717 (2013)	1,4 % (99/06)	-0,7 % (08/13)	0h45	50% (HD)	Business travel, commuting and tourism	- 1	8 + 4 (4) + (3)
Saverne (2007)	East C	17.482 (2006)	10.020 (2006)	11.607 (2013)	2,1 % (99/06)	0,4 % (08/13)	2h00	47% (D)	Business travel	- 4	2 (1)
Auray (1991)	Atlantic C	17.508 (1990)	7.072 (1990)	7.831 (1999)	0,9 % (82-90)	1,1 % (90-99)	3h30	25% (N)	Business travel, and tourism	- 1,5	7 (10)
Nantes (1989)	Atlantic C	468.082 (1982)	205.590 (1982)	250736 (1999)	1 % (82/90)	1,3 % (90-99)	2h15	31% (D)	Business travel and commuting	+ 3	19 (13)

TAB. 1 – Characterization of cities (Urban Unit) investigated and their HSR service to Paris.
Source: The authors. Due to the change of the INSEE methodology,
figures after 2006 cannot be directly compared with data from previous years.

60 interviews were conducted, lasting half an hour to an hour each, either face to face or by phone: 27 were with firms—potential users of HSR services—concerning changes in their behavior in terms of mobility and freight, and 33 were with public stakeholders concerning the impacts of these services in terms of local and sustainable development (Annex 1). The firms were mostly chosen because of their size and their importance (major manufacturers), while certain companies were suggested to us by some of the public stakeholders we interviewed. The stakeholders surveyed were the main public actors involved in local economic development¹⁰ in each city.

The implications of HSR services in terms of sustainable development for firms and cities were analyzed by breaking down the sustainable development concept into its three dimensions (economic, social, and environmental).

This research shows that the potential impacts of HSR services in terms of sustainable development at the local level are both limited on the economic and environmental fronts, but not in social and institutional terms.

HSR SERVICES AND ECONOMIC DEVELOPMENT AT LOCAL LEVEL

We wondered first about the implications of HSR services on firms and territories through the economic dimension of the sustainable development on the local scale (Table 2).

For companies (staff mobility)	<ul style="list-style-type: none"> – Changes in staff travel costs (ticket prices and expenses such as accommodation) – Time savings – New market gains and extensions to existing markets – Productivity increases
For cities	<ul style="list-style-type: none"> – Opening-up of territories – Correction of economic development imbalances – Attractiveness for firms and growth of employment – Development of tourism

TAB. 2 – Possible implications of HSR services in terms of economic development for companies and cities. Source: The authors.

10 Cities' economic development departments, departments for intercity cooperation, associations seeking to attract firms, urban-planning agencies, chambers of commerce, tourist offices.

All the firms surveyed agreed that HSR services increase travel costs. It does, however, reduce hotel costs associated with the need for overnight stays on business trips. These firms also recognized that the time savings associated with HSR services for business travel led to greater productivity at work. For example, being able to make a round trip to Paris in half a day, for those cities closest to Paris, is an asset with regard to the previous situation, where a journey to Paris required a whole day. This is the case for Lille, Arras, Reims, and even Hazebrouck. For travel requiring three quarters of the day, the return leg of the journey can take place early enough to enable the scheduling of meetings at the end of the day. Similar reductions in travel time are also appreciated in cities where it is now possible to make the round-trip journey to Paris in one day (Auray, Nantes, Metz).

However, the improvement in accessibility does not really seem to have enabled firms to gain new markets. Access to provincial France, for example, is potentially faster, but the absence of HSR did not previously prevent companies from selling to customers far away.

In addition, HSR services allow economically weakened cities to maintain strategic functions. This is the case for company head offices whose employees need to go to Paris or Parisian airports, as in the case of Saint-Omer in northern France (home to the headquarters of two important groups) where some managers take the HST via Hazebrouck. The arrival of HSR generally involves the restructuring of stations, as well as urban regeneration driven by the development of new residential and office real estate. This was the case for the largest cities in the study, such as Reims, with the regeneration of the Clairmarais district (Bazin et al., 2016), as well as Lille and Nantes. According to the Nantes Chamber of Commerce and Industry (CCI), companies from outside the city have become established in Nantes in part because there is an HSR service, as well as an airport and a metropolitan dimension to the city. The service sector and financial and real-estate activities have been strongly developed. Call centers have been set up in the city, and companies based in Nantes have developed on the international stage.

There has also been a complete regeneration of the station district in Arras, with the creation of ATRIA, a European center for exchanges and communication, offering over 3.6 hectares of office, conference and

commercial space, a hotel and a large parking facility (1,200 spaces). In these new districts, firms are moving in, although in most cases they are local firms (Bazin et al., 2016). But HSR services don't systematically induce an employment growth especially concerning cities served by the East European High Speed Line, as Metz and Reims (Table 1). In general, it is the big cities (Lille, Nantes) that reap most of the benefits of HSR in this field, while smaller cities (Auray, Saverne, Hazebrouck) are too small to undertake such regeneration operations.

There is also an image effect and a location effect at play for intermediate cities such as Reims or Arras. It seems that it is not only the improvement of accessibility that is important, but also the image effect associated with the arrival of HSR. In Reims, for example, around the central station, the image effect is essentially local, benefiting local private and public stakeholders. The implication of developers and investors with local roots and the city's willingness to cooperate were important factors in boosting the district's dynamism. Together, this has produced an image effect that can attract national developers and investors (Bazin et al., 2016).

Finally, regarding economic activities linked to tourism, HSR was used to promote tourism in Lille, but this was associated with a public policy aimed at modifying the city's image. HSR has a negative impact on the length of visitor stays (especially in Arras, Metz and Reims). Moreover, the frequent reduction of the average length of stays is not always compensated by an increase in the number of stays. However, there is a real image effect at play. In Reims, for instance, while the number of tourists from the Paris region continues to increase, the data collected by the tourist office at the station show that the overall proportion of tourists traveling by TGV has decreased, although more European tourists (especially from Britain and Spain) are choosing to travel by HSR; Chinese and American tourists visiting Paris also arrive in Arras for day trips by HSR (Delaplace et al., 2014).

In Arras, tourism has increased but tourists typically go there by car, including Parisian clientele. The British come by car. The Canadians sometimes travel by HSR for a same-day round trip that includes a visit to the city and the Canadian memorial of Vimy. Shuttles or taxis are chartered by the tourist office in high season, offering special tourist packages. The HSR effect is thus above all an image effect, as

confirmed by the manager of the Arras tourist office (Bazin et al., 2013). In Auray and Saverne, which are located in touristic areas, HSR has not really been used to develop tourism, because the tourism in question is diffuse. In Auray, however, HSR services are considered important for thalassotherapy centers located near the sea, but these centers must take into account the issue of having to change trains to reach the final destination.

HSR SERVICES AND THE ENVIRONMENTAL DIMENSION AT LOCAL LEVEL

From an environmental point of view, the primary expected effect concerns the modal shift enabled by HSR, which should in theory lead to a reduction in the number of cars on the roads and highways. There are several possible impacts of HSR in environmental terms for firms and territories (Table 3).

For companies (staff mobility)	<ul style="list-style-type: none"> – Use of rail travel (transfer from cars) – Increased staff mobility via rail (increase in the number of rail season-ticket holders in the company)
For cities	<ul style="list-style-type: none"> – Development of sustainable transportation modes (reduction of GHGEs) – Reduction of associated nuisances (noise pollution, damage to landscapes, etc.)

TAB. 3 – Implications of HSR services in environmental terms for companies and cities. Source: The authors.

Our research is not intended to calculate the extent of the modal shift for every city—information which, moreover, is impossible to obtain from the French national rail company¹¹. However there do seem to have been modal shifts on the various HSLs (see above). Concerning the north of the Champagne-Ardenne region, where Reims is located, it seems that there has been growth in private-car mobility. The observatory of the East European HSR indicates that HSR services had no positive incidence in terms of modal shift (Observatoire, 2013)

11 The assessment (in connection with the LOTI law) provided about the North HSR indicates that the forecasts of traffic (modal transfers and induced demand) were overestimated by about 70%. Concerning the East European HSR, modal transfer from car to rail exists for services between Paris and the Lorraine region, and air to rail for the Alsace region.

leading to a rise in greenhouse-gas emissions (+4%)¹². However, the interviews allowed us to identify the existence of this modal shift in connection with the modification of firms' travel practices in the case of the Atlantic HSL. In Nantes, this modal shift very much exists, as the works of Klein and Claisse (1997) have shown. In spite of the economic crisis, the volume of business journeys between Paris and Nantes grew by 40% between 1989 and 1993, and rail traffic doubled. Air travel, which represented 27 % of journeys in 1989, had become marginal by 1993. And while road traffic grew for journeys involving overnight stays, it decreased for same-day round trips. Firms and local public stakeholders indicated that HSR has changed the way in which people travel to Paris. For their business trips to the capital, Nantes residents preferred the train over the plane. But, more significantly, Parisians going to Nantes also abandoned the plane for the train, especially for same-day round-trip journeys.

In Reims, HSR was associated with the disappearance of conventional trains and, because of the proximity to Paris, the increase in train ticket prices and growth in highway use; here, the modal shift was from rail travel to the private car use. In Metz, a survey made it possible to estimate the modal shift: 25% of HSR users in Metz indicated that they would not have made the trip without this HSR service (induction effect). Furthermore, 5% considered that, without the HSR service, they would have taken the plane, and 25% said they would have traveled by car. Ultimately, just 3% would have still taken a conventional train (CETE, 2013).

In addition, a more indirect consequence of this modal shift can be characterized by a modification of practices in the transportation chain. Habits are changing, in particular in the small and medium-sized cities near metropolises: rather than reaching an HSR service by car, more and more users are choosing to take a TER (regional express train) to get to the HSR station if a direct HSR service does not exist or if its frequency is not sufficient.

This pre-routing via TER allows offers greater reliability with regard to their transportation time, which is more uncertain by car, given

12 Across the whole area studied, greenhouse-gas emissions decreased (25%) after the East European HSR opened, in spite of an increase (all modes combined) of more than 13% in the number of travelers/km/day (Observatoire, 2013).

the risk of congestion on the roads. This is the case when the TER service is frequent with a good service interval during the day, which further underlines, should it be necessary, the importance of intermodal management.

Use of HSR by private actors has therefore been high. In the case of Nantes, HSR has enabled the city to strengthen its role as the regional metropolis. For example, between winter 1988/89 and winter 1994/95, the number of services between Nantes and Angers increased from 16 to 25 per day, while those between Nantes and Saint-Nazaire rose from 11 to 18 and those between Nantes and La Roche-sur-Yon from 10 to 16 (Wolff, 1997, p. 440). However, when the frequency of service is poor or degraded, combined with the fact that HSR services are more expensive, the car is always used (from Hazebrouck, Arras and Reims, for instance) to access destinations on the edges of the Paris region.

The “Grenelle de l’Environnement” (environment round-table organized by the French government in 2007) had supposed that a rail network with high levels of service would be able to bear a 25% increase in the market share of non-road transportation modes market by 2012 (RFF, 2009). By freeing up rail paths, the arrival of HSR should then have resulted in the growth of rail freight transportation on conventional lines. However, none of the companies interviewed validated this hypothesis for modal shift for freight. More generally, the change in the volume of freight traffic on the freight network between 2009 and 2011 provides evidence that this hypothesis cannot be confirmed: freight volumes did not increase in France during this period. Indeed, freight traffic fell by 5.7%, dropping from 94.8 million path-kilometers in 2009 to 91.1 million in 2010 and 89.4 million in 2011. At the same time, the proportion of cadenced rail-path requests for long-distance passenger traffic, TER services and Transilien services increased.

In both Nantes and Reims, when firms have moved into premises near the station, this has been due to the office real estate on offer, not the existence of HSR. That being said, in the case of firms that have chosen locations near the station in Nantes, their new-found proximity to the station, to TER services and to the tram network that serves the whole urban area, were appreciated by the employees who use these modes of transportation. It is nevertheless hard to estimate the modal shift.

HSR SERVICES AND SUSTAINABLE DEVELOPMENT
FOR CITIES: THE SOCIAL DIMENSION

It is in social terms, and more specifically in terms of improved travel comfort, that progress has been more noticeable (Table 4).

For companies (staff mobility)	– Improvement of working conditions as a result of changes in travel conditions (journey time, journey quality, comfort, etc.)
For cities	– Improved accessibility for the city

TAB. 4 – Impacts of HSR services in social terms for companies and cities. Source: The authors.

Significant progress regarding the social dimension of sustainable development was identified in companies' responses to our survey. These advances were thus recognized in the changes in travel conditions, with regard to journey time and comfort. The reduction of journey time allows for a later start in the morning and a return home earlier in the evening for employees. In some cases, this leads to a decrease in the number of nights away from home, which is often considered an improvement in quality of life. When journey times are not counted as working time, this improvement is even greater. For example, one of the companies surveyed compensates the journey time with an annual premium that is not proportional to the journey time itself. The employees of this company benefit both from the premium and from reduced journey times thanks to HSR services.

This situation cannot be generalized for all the destinations considered. Sometimes, the arrival of HSR does not change anything. On the one hand, the employees of one company surveyed in Reims continued to use their cars to visit clients in Lille, due to an insufficient direct train frequency and to a limited gain in journey time. On the other hand, the companies from all the cities surveyed serving the center of Paris by HSR always use this mode of transportation, thanks to the reduced journey times and greater reliability it offers, as well as the increased safety it provides for staff who previously drove. This progress therefore translates into a decrease in fatigue, greater comfort, and greater security for employees in the context of business trips and commuting alike.

While an improvement in service levels for major cities is generally observed, the opposite is often true for small towns or intermediate cities. Users suffer a significant increase in ticket prices and often no longer have the option of taking a conventional train, unless they are willing to accept an increase in journey time compared to the pre-HSR situation or to change trains at an intermediate station. Customers in these areas are polarized: there are those who use the HSR service and who are willing to pay the price, and those who switch other transportation options, such as carpooling.

The second area that is impacted by HSR according to stakeholders is the institutional dimension in relation to the territorial solidarity. Within a framework of territorial solidarity, some public and non-public stakeholders have sought to share the benefits of HSR by serving peripheral areas using HSTs on conventional lines. This is the case in France where HSTs continue their journeys into the Ardennes in order to serve the towns of Charleville-Mézières and Sedan. In other areas HSTs have been used for regional travel. The Nord–Pas-de-Calais region, for instance, has created regional high-speed train services by purchasing HST tickets for passengers who make intra-regional journeys and by renting HSTs specifically for this purpose.

These policies supported by local communities are the expression of a certain territorial solidarity in the use of HSR services. These trains are being diverted from their initial use, which was to link together certain large, important cities while bypassing others. However, these experiments are not always long-lasting. Cities such as Calais and Saint-Omer have recently lost this type of service due to low ridership levels and high costs for local communities (Bazin et al., 2013).

CONCLUSION

While HSR is often presented as a transportation mode associated with sustainable development, the results of research focusing on the three dimensions of sustainable development linked to HSR services have been less obvious and more mitigated. Unsurprisingly, the big

cities (Lille and Nantes) benefit first and foremost from HSR from an economic standpoint, in particular because of the service improvements it offers, as well as enhanced attractiveness. The intermediate cities (Reims and Metz) are in a different situation. Reims, for instance, adopted an offensive strategy and was counting on economic development, but the proximity of Paris and the cost of HSR services limited the modal shift from car to rail, and the environmental and social contributions of HSR are weak. In Metz, the modal shift was more significant but the economic effects have been a long time coming and companies seem little concerned by the HSR service. The small and medium-sized cities, on the other hand, generally experience a reduction in the rail services on offer, associated with an increase in price and the disappearance, in certain cases, of conventional rail services.

The “economic” contribution of HSR services for users or companies in terms of employees’ business travel is relatively limited because of high-ticket prices. However, this should be contrasted with journey time gains, which allow for an increase in employee productivity.

From the environmental point of view, the hypothesis concerning the possible transfer of rail paths freed up by HSR lines to freight traffic was not confirmed. These rail paths, once freed up, are of greater benefit to the development of TER services. Moreover, the development of freight traffic on HSLs seems, to date, to have been based on nothing more than anecdotal evidence.

By contrast, it is in terms of the social aspect of sustainable development that the impacts have been most convincing for the most distant large cities. The reduction in fatigue resulting from the decrease in journey times and the development of interregional connections are considered important social advances. In terms of user comfort and comfort for business travel, the balance sheet is thus positive. However, owing to its price, HSR service is not available to everyone! Nevertheless, in France at least, the new low-cost HSR service, Ouigo is gradually changing the picture.

REFERENCES

- ALBALATE D., BEL G. (2010), *High-Speed Rail: Lessons for Policy Makers from Experiences Abroad*, Research Institute of Applied Economics Working Paper /03, 34. http://www.ub.edu/irea/working_papers/2010/201003.pdf [Accessed 9 December 2016].
- BAZIN S., BECKERICH C., DELAPLACE M. (2009), « Desserte TGV et localisation des entreprises sur les quartiers d'affaires: nouvelle accessibilité ou nouvelle offre immobilière de bureaux? Le cas de la gare centre de Reims », *Les Cahiers Scientifiques des Transports*, n° 56, p. 37-61.
- BAZIN S., BECKERICH C., BLANQUART C., DELAPLACE M. (2013), *Les enjeux et opportunités des dessertes ferroviaires à grande vitesse en matière de développement local et de développement durable*, rapport final, 186, Paris, PREDIT, ADEME.
- BAZIN S., BECKERICH C., DELAPLACE M. (2016), "High-speed rail, corporate real estate and firm location: the results from two surveys (2008; 2014) in Reims", *Open Transportation journal*, n° 10, p. 7-21.
- BEHRENS C., PELS E. (2009), *Intermodal Competition in The London-Paris Passenger Market: High-Speed Rail and Air Transport*, TI 2009-051/3 Tinbergen Institute Discussion Paper.
- BOUF D., DESMARIS C. (2015), "Spatial equity and high speed trains: the example of France", *Revue d'économie régionale et urbaine*. [online] Available at <https://halshs.archives-ouvertes.fr/halshs-01194897> [Accessed 19 December 2015].
- CEMT [(1991), *Le transport de marchandises et l'environnement*, OCDE, Paris.
- CETE de l'EST (2013), *Enquêtes en gares de Metz et Strasbourg, Principaux résultats*, Février, Nancy, France.
- CGDD (2009), *Le bilan positif d'une évaluation du programme TGV, Le point sur*, n° 34, p. 1-4.
- CHEN C-L., HALL P. (2012), "The Wider Spatial-Economic Impacts of High-Speed Trains: A Comparative Case Study of the Lille and Manchester Sub-Regions", *Journal of Transport Geography*, n° 24, p. 89-110.
- CHEN Z.; HAYNES K. (2012), *Tourism Industry and High Speed Rail, Is There a Linkage: Evidence from China's High Speed Rail Development*. George Mason University School Of Public Policy Research Paper 2012-2014.
- CHENG Y.-H. (2009), "High-speed rail in Taiwan: New experience and issues for future development", *Transport policy*, 17, n° 2, 51-63.
- CHURCH A., FROST M., SULLIVAN K. (2000), "Transport and social exclusion in London", *Transport Policy*, vol. 7, n° 3, p. 195-205.

- COMMISSION DES COMMUNAUTÉS EUROPÉENNES (2009), *Un avenir durable pour les transports: vers un système intégré, convivial et fondé sur la technologie*, COM(2009) 279 final, Bruxelles, Belgique.
- COUR DES COMPTES (2014), *La grande vitesse ferroviaire, un modèle porté au-delà de sa pertinence*, Rapport Public Thématique, 173, Octobre, Paris, France.
- D'ALFONSO T., JIANG C.B., BRACAGLIA V. (2015), "Would competition between air transport and high-speed rail benefit environment and social welfare?", *Transportation Research Part B*, vol. 74, April, p. 118-137.
- DB INTERNATIONAL GMBH (2011), *High Speed Rail as a tool for regional development; In-depth Study*, 2011-08-08.
- DELAPLACE M. (2012a) « Pourquoi les "effets" TGV sont-ils différents selon les territoires? L'hétérogénéité au cœur du triptyque "Innovations, Territoires et Stratégies" », *Recherche Transports et Sécurité*, vol. 28, n° 3-4, p. 290-302.
- DELAPLACE M. (2012b), « TGV, développement local et taille des villes; Une analyse en termes d'innovation de services », *Revue d'économie régionale et urbaine*, n° 2/2012, p. 265-292.
- DELAPLACE M., BAZIN S., PAGLIARA F., SPOSARO A. (2014), *High Speed Railway System and the tourism market: between accessibility, image and coordination tool*, 54th European Regional Science Association Congress, 26-29 August, Saint-Petersburg, Russia.
- DELAPLACE M., PAGLIARA F., LA PIETRA A. (2016), "Does High-Speed rail affect destination choice for tourism purpose? Disneyland Paris and Futuroscope case studies", *Belgeo*, n° 3, <https://belgeo.revues.org/18132>.
- DOBROUSZKES F. (2011), "High-speed rail and air transport competition in Western Europe: A supply-oriented perspective", *Transport Policy*, vol. 18, n° 6, p. 870-879.
- EC (2011), White Paper, *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*.
- ECORYS (2014), *The Economic Footprint Of Railway Transport In Europe*, report for Community of European Railway and Infrastructure Companies (CER), Brussels, October.
- GIVONI M. (2006), "Development and impact of the modern high-speed train: a review", *Transport reviews*, 26, n° 5, p. 593-211.
- HAYNES K.E. (1997), "Labor Markets and Regional Transportation Improvements: The Case of High Speed Trains. An Introduction and Review", *The Annals of Regional Science*, 31, n° 1, p. 57-76.
- HIROTA M. AND IWATA, M. (1985), « Impact du Shinkansen », in *Les aspects socio-économiques des trains à grande vitesse*. Tome II, Paris, La Documentation française, p. 655-665.

- KENYON S., LYONS G. AND RAFFERTY J. (2002), "Transport and social exclusion: Investigating the possibility of promoting inclusion through virtual mobility", *Journal of Transport Geography*, Vol. 10, n° 3, p. 207-219.
- KIM H., SULTANA S. (2015), "The impacts of high-speed rail extensions on accessibility and spatial equity changes in South Korea from 2004 to 2018", *Journal of Transport Geography*, Vol. 45, May, p. 48-61.
- KLEIN O., CLAISSE G. (1997), *Le TGV-Atlantique: entre récession et concurrence*, in Études et Recherches, LET, Lyon.
- KONING M., BAHOKEN F., BECKERICH C., BENOIT BAZIN S., BLANQUART C., DELAPLACE, M., JOIGNAUX, G., SAVY, M. (2015), *Dessertes TGV et dynamiques économiques locales: un éclairage à partir de la distinction entre territoires productifs, résidentiels ou intermédiaires*, final report for PREDIT, Paris, France.
- KRISHNAN V., KASTROUNI E., PYRIALAKOU V-D., KRITZA K., MCGALLEY J-D. (2015), "An optimization model of energy and transportation systems: Assessing the high-speed rail impacts in the United States", *Transportation Research, Part C.*, Vol. 54, May p. 131-156.
- LEVINSON D. M. (2012), "Accessibility impacts of high-speed rail", *Journal of Transport Geography*, n° 22, 288-291.
- MANNONNE V. (1995), *L'impact régional du TGV sud-est*, Thèse pour l'obtention du doctorat de géographie, 2 tomes, Université de Provence Aix-Marseille I.
- MATUTE J-M., CHESTER M-V. (2015), "Cost-effectiveness of reductions in greenhouse gas emissions from High-Speed Rail and urban transportation projects in California", *Transportation Research, Part D*, Vol. 40, October, p. 104-113.
- OBSERVATOIRE DE LA LGV EST-EUROPÉENNE (2013), *Bilan des émissions de GES et des consommations énergétiques*, V5, 22 mars, Paris.
- OCDE [2016], *Decoupling the environmental impacts of transport from economic growth*, Paris, OCDE, France.
- OKABE S. (1980), "Impact of the Sanyo Shinkansen on Local Communities", in STRASZAK, A. and TUCH, R. (eds), *The shinkansen high-speed rail network of japan*, Oxford, Pergamon Press, p. 105-129.
- ORTEGA E., LÓPEZ E., MONZÓN A. (2014), "Territorial cohesion impacts of high-speed rail under different zoning systems", *Journal of Transport Geography*, Vol. 34, January, p. 16-24.
- PAGLIARA F., LA PIETRA A., GOMEZ J., VASSALO J-M. [2015] "High Speed Rail and the tourism market: evidence from the Madrid Case Study", *Transport Policy*, Vol. 37, January, p. 187-194.
- PRESTON J., RAJÉ F. (2007), "Accessibility, mobility and transport-related social exclusion," *Journal of Transport Geography*, Vol. 15, n° 3, p. 151-160.

- RFF (Réseau Ferré de France) [2010], *Bilan de 25 ans de construction de LGV. Les LGV à l'heure du bilan*, Lignes d'avenir, n°8. <http://www.rff.fr/IMG/lignedavenir-fev2010.pdf>
- RFF (2009), *Vers un réseau durable, orientations stratégiques, 2008-2012*, Paris, France.
- SANDS B.D. (1993), "The Development Effects of High-Speed Rail Stations and Implications for California", *Built Environment*, vol. 19, n° 3/4, p. 257-284.
- SETEC (2004), *Étude relative aux effets socio-économiques et en termes d'aménagement: évaluation des premiers effets de la LGV Méditerranée*, 64, Paris, France.
- SOUTH EAST ENGLAND DEVELOPMENT AGENCY (SEEDA) (2008), *HST Impact Study*, Final report for the European Commission. [online] Available at <http://www.hstimpactstudy.net/HTdocs/Images/mainreport_150408.pdf> [Accessed 19 December 2015].
- SPAVEN D. (2006), *Are high-speed railways good for the environment?* A Discussion Paper, 28, TRANSform Scotland, October.
- TODOROVICH P., SCHNED D., LANE R. (2011), *High-Speed Rail International Lessons for U.S. Policy Makers*. Policy Focus Report Series, Lincoln Institute of Land Policy.
- TROIN J-F. (2010) « Désirs de gares TGV: du projet des édiles locaux au "désaménagement" du territoire », *Belgeo*, n° 1-2, p. 23-23.
- URENA J., MENERAULT P., GARMENDIA M. (2009), "The high-speed rail challenge for big intermediate cities: a national, regional and local perspective", *Cities*, 26, n° 5, p. 266-279.
- VICKERMAN R. (2015), "High-speed rail and regional development: the case of intermediate Stations", *Journal of Transport Geography*, Vol. 42, January, p. 157-165.
- WANG X., HUANG S., ZOU T., YAN H. (2012), "Effects of the high speed rail network on China's regional tourism development", *Tourism Management Perspectives*, n° 1, p. 34-38.
- WOLFF J-P. (1997), « Transports ferroviaires, aménagement et question régionale. L'exemple des Pays de la Loire », *Norois*, vol. 44, n° 175, p. 433-444.
- YUE Y., WANG T., LIANG S., YANG J., HOU P., QU S., ZHOU J., JIA X., WANG H., XU M. (2015), "Life Cycle Assessment of HSR in China", *Transportation Research, Part D*, vol. 41, December, p. 367-376.
- ZHAO J., ZHAO Y., LI Y. (2015), "The variation in the value of travel-time savings and the dilemma of high-speed rail in China", *Transportation research, Part A*, vol. 82, December, p. 130-140.

ANNEX 1
Interviews conducted in cities

City	Interviews number		
	Total (rail operator)	of which public actors	of which private (non-profit) actors
Arras	4	2	2
Hazebrouck	6	2	4
Lille	5	4	1
Metz	12	7	5
Reims	9	4	5
Saverne	6	5	1
Auray	8	3	3 (2)
Nantes	9 (1)	6	3
Total	60	33 (2)	24