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Delaplace (Marie), « Evaluer *ex ante* les effets indirects de la grande vitesse ferroviaire dans les villes ?. Les enseignements d'une analyse en termes d'innovations de service »

Résumé – Début 2016, 35 000 km de lignes à grande vitesse étaient planifiées à l'horizon 2050 dans le monde. Les gouvernements doivent parfois choisir entre différents projets. Si l'analyse coût-avantage est l'outil le plus largement utilisé, pour effectuer ce choix, il semble inapproprié. À partir des théories de l'innovation dans les services, cet article montre qu'il est difficile d'évaluer *ex ante* les effets indirects dans les villes dans la mesure où ils sont coproduits dan le temps et dans l'espace.

Mots-clés – Desserte ferroviaire à grande vitesse, développement local, innovations de services, évaluation

Delaplace (Marie), « Assessing *ex ante* the wider effects of high-speed rail service in cities?. The lessons drawn from a service innovation-based analysis »

Abstract – In January 2016, 35,000 km of high-speed lines were planned worldwide for completion by 2050. Governments have sometimes to choose between different projects. If cost-benefit analysis is the most widely used tool to evaluate the effects of different projects, it seems to be inappropriate for evaluating the wider effects. Using service innovation theories, this paper shows that these wider effects in cities are difficult to evaluate *ex ante* because they are coproduced in space and time.

Keywords – High-speed rail service, local economic development, services innovation, evaluation

ASSESSING *EX ANTE* THE WIDER EFFECTS OF HIGH-SPEED RAIL SERVICE IN CITIES?

The lessons drawn from a service innovation-based analysis

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INTRODUCTION

In April 2017, there were 37,343 km of high-speed lines in the world, 15,884 km were under construction and 35,000 km were planned all around the world for completion by 2050 (UIC, 2017). But in the context of economic crisis, governments have to choose *ex ante* between different projects. Cost-benefit analysis is the most widely used tool to evaluate the net impact of different transport infrastructure projects. But the results of the cost-benefit analysis are strongly affected by the underlying hypotheses related to traffic and the way costs and benefits are valuated. Forecasts for high-speed rail projects tend to overestimate traffic levels and underestimate their financial cost (Bonnafous, 2014). Moreover, economic and political stakeholders of the served areas expect a lot of positive effects in terms of local economic dynamism. But these potential indirect effects (or wider impacts) of high-speed railway (HSR)

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on the local economy are difficult to assess and not automatic (Bazin *et al.*, 2006; Delaplace and Dobruszkes, 2013; Vickerman, 2015). The aim of this paper is not to present a critical review of the cost-benefit analysis (see Adler and Posner, 1999; Quinet, 2010 for a review on this subject), but to go beyond this type of analysis (Delaplace and Dobruszkes, 2016). We propose a service-based analysis that shows that the wider effects of high-speed rail (HSR) in cities cannot be assessed *ex ante* because they are coproduced. Therefore, effects cannot be put forward to justify the building of HSR.

Using service innovation theories, we highlight that the analysis must focus not only on infrastructures but also on services. We propose to conceptualize the arrival of an HSR service in a city as an innovation or a set of innovations with regard to the classic railway services. We put forward that these innovations are different according to the countries and cities concerned. This represents a first level of heterogeneity. We then show, at a second level of heterogeneity, that the potential of use of innovations linked to HSR services are different for different countries and cities. Finally, we highlight that the appropriation regimes of HSR services depend on the strategies of the various stakeholders located in the city in question. These three levels of heterogeneity make it difficult to conduct an *ex ante* evaluation of HSR services' effects on local economic development.

I. HSR AS A SET OF SERVICE INNOVATIONS

We first present a conceptualization of the classic rail transportation as a service, on the basis of the characteristics-based approach to products and innovations suggested by Gallouj and Weinstein (1997) . On this basis, the HSR service can be envisaged not just as a set of improvement innovations compared with the classic rail service, but also as a set of incremental innovations. But beyond this typology, HSR service can also be envisaged as a relational innovation, i.e. an innovative organizational arrangement between stakeholders seeking to produce the service.

SERVICE INNOVATION THEORY, A USEFUL FRAMEWORK FOR ANALYZING RAIL SERVICE

Besides their intangibility, what distinguishes services from goods is their relational character, i.e. the interaction between the provider and the user (Howells, 2010). Taking into account these specificities, Gallouj and Weinstein (1997) built a theoretical representation of services and suggested a typology of innovation models; we shall apply both of these to rail transportation.

Rail services: a characteristics-based approach

Using the analysis of Gallouj and Weinstein (1997), improved upon by De Vries (2006) (*cf.* Gallouj, Djellal, 2015 for a recent review), a service can be represented by a mapping of interlinked vectors of characteristics: vectors of technical characteristics and of services characteristics, and vectors of competencies of the client and of the provider(s). It is possible to analyze a rail service using this theoretical representation. At a given moment in time and in a given country, the representation of a rail service includes three types of vectors of technical characteristics (see figure 1). The first of these (T_{Z1}, T_{Z2}…T_{Zn}) involves the technical components of the "train" as a material product: for example, the kind of engine (diesel or electric), the braking system, the railway car stabilization system, or the size of the cars, as well as some technical characteristics of the train set (electrical outlet, turning seat, etc.). The second (T_{X1}, T_{X2}…T_{Xn}) encompasses technical characteristics related to the infrastructure: for example, the type of line (dedicated or not) or the type of railroad (rail gauge, compatibility of different railroads, etc.), and the third (T_{Y1}, T_{Y2}…T_{Yn}) the technical characteristics of the rail station: architecture, centrality, types of rail connection, types of intermodality, etc. These different vectors of technical characteristics also include intangible technical characteristics (methodologies) such as production methods, and time-scheduling methods that allow different trains to safely circulate on the network.

The theoretical representation of the rail service also includes a vector of service or vector of final characteristics (Y_1, Y_2…Y_m), which describes the utilities provided to the user: speed, safety, comfort, lower pollution in the case of an electric engine, etc. This vector of

final characteristics also includes service characteristics provided by additional services within the train (such as food, a Wi-Fi connection, use of electrical outlets, etc.) and/or in or near the station (facilities to enable users to park or hire a car, book a journey or a hotel room, buy newspapers, withdraw cash, use urban and inter-urban transport, etc.). A rail service is a central service in an architectural service – that is, a service "embedded into a complex system of other services that make use of different types of technologies and competencies" (Djellal, Gallouj, 2006, p. 1973).

Just like other services, a rail service is produced by the interaction between the provider(s) and the client. In a rail service, the service can be handled by various types of agents: one or several railroad carriers, the administrator of the infrastructure and, in some countries, public authorities. In France, for example, "SNCF Réseau"[2] manages the infrastructure (maintenance of lines and of the electrical network, setting of prices and attribution of the train path, etc.), and "SNCF Mobilités" manages the operations of railway services for passengers[3] and freight. It defines the rail service. In some extra-European countries there is no separation between the administrator of the infrastructure and the manager of the service (Campos and de Rus, 2009). In France, the public authority makes sure that the transport rules established by the national law on domestic transport (LOTI, or *Loi d'orientation des transports intérieurs*) are respected. Since 2002, regional councils have been responsible for organizing what are known as TER (*transport express régional*, or regional express transport) services.

Consequently, given the diversity of stakeholders, it is necessary to analyze the service provision not within an individual framework but within a multi-agent framework model (Windrum *et al.*, 2010; Gallouj *et al*. 2013), including both private and public stakeholders who collectively produce the service. Each provider mobilizes its own set of competencies that can be represented by a vector of competencies: for example, in France, $(C_1, C_2 \ldots C_p)$ for "SNCF Mobilités", $(C'_1, C'_2 \ldots C'_p)$ for SNCF Réseau", and $(C''_1, C''_2 \ldots C''_p)$ for local authorities.

2 SNCF Réseau has been one of the three state-owned industrial and commercial companies (*établissements publics et commerciaux*) of the SNCF group since 2015.

3 In Europe, the opening-up of rail services to competition changes this fact.

Clients also need some competencies to coproduce the service. Indeed, they must be able to use a computer, to print a ticket, to establish the different steps of their journey, to look for the best price and, for some of them (firms), to negotiate prices. Moreover, as suggested by De Vries (2006), Gallouj and Weinstein's representation could be improved by introducing a vector of technical characteristics for the clients themselves. Indeed, especially in the pervasive digital economy, clients will need to use their own technical tools in order to interact with the technical characteristics of the service provider(s). This is the case, for example, when clients book their train tickets over the Internet using a personal computer. The multi-agent scheme is also useful for clients, insofar as they can be either households or firms. Households might use a rail service for commuting, for tourism, etc., while firms might use it for business travel and/or for freight. To differentiate these two types of customers, we suggest introducing two vectors of customers' competencies into the multi-agent service representation: one for households (C_{B1}, C_{B2}…C_{Bq}), and the other for firms (C'_{B1}, C'_{B2}…C'_{Bo}); and, similarly, two vectors of technical characteristics (T_{B1}, T_{B2}…T_{Bq}) and (T'_{B1}, T'_{B2}…T'_{Bo}) for each type of agent. It should be noted that households and firms can also act indirectly in service provision through associations of users for households and business associations for firms. Because of their size and their audience, these associations can have an impact on the definition and subsequent modification of rail services (opening of stopping points, for example) or of service levels (schedules, number of round trips, etc.).

Last, because the service relationship takes place in time and in space, the rail service also heavily depends on the national and local contexts, included in Figure 1 below.

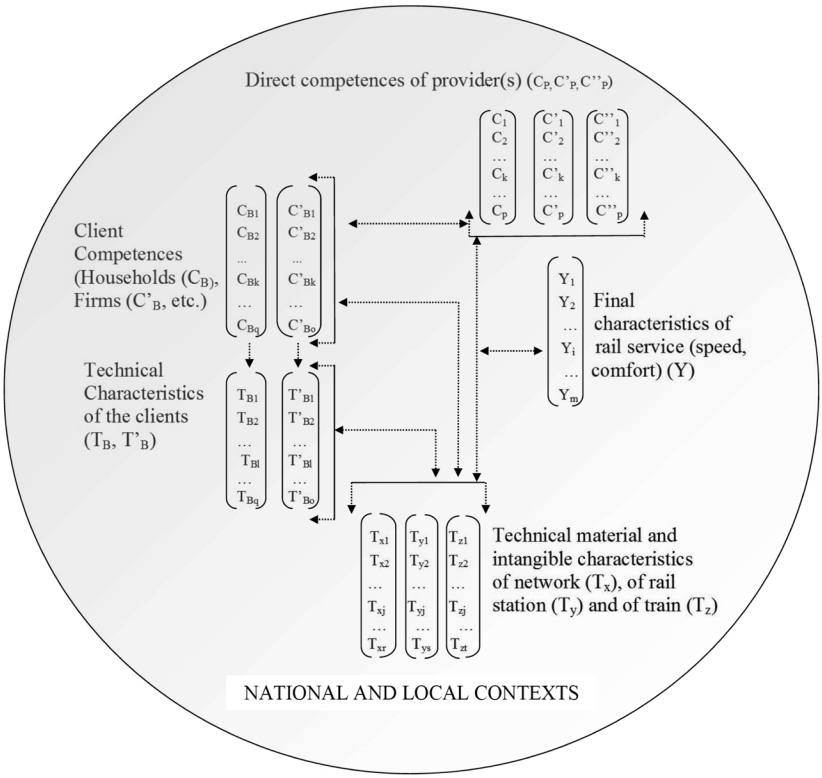

FIG. 1 – A rail service representation (adapted from Gallouj and Weinstein, 1997 and De Vries, 2006).

The different models of innovation derived from the characteristics-based approach to services

In their integrative model of innovation in goods and services, Gallouj and Weinstein (1997) analytically define innovation as an action or a series of actions affecting the components of the various vectors of characteristics representing the product. These actions include: addition, subtraction, association, dissociation, and the formatting of characteristics.

These different actions affecting characteristics led Gallouj and Weinstein (1997) to distinguish six models of innovation:

1. a radical innovation, which corresponds to the creation of a new system of technical and service characteristics (T^*, T^*_B, Y^*, C^*, C^*_B) or, in an extensive definition, to a new system of characteristics and competencies that leaves the service characteristics unchanged (to a certain extent);
2. an improvement innovation, which consists of improving certain technical or service characteristics, and/or certain competencies, without changing the structure of the system. For example, the value of Y_i is increased, or the competency C_k or the technical characteristic T_j is improved;
3. an incremental innovation, which from Gallouj and Weinstein's perspective corresponds to the addition of one or more service characteristics (Y_4, for example), which increases the utility of the agents but, again, without changing the structure of the system;
4. an *ad hoc* innovation, which is an innovation that is produced in order to solve a specific problem for a specific client;
5. a recombinative or architectural innovation, which recombines or separates out various technical or service characteristics;
6. a formalization innovation which "consists of putting service characteristics into order, specifying them, making them less hazy" (Gallouj and Weinstein, 1997, p. 553).

HSR SERVICE AS IMPROVEMENT INNOVATIONS THAT DIFFER BY COUNTRY AND CITY

The improvement innovations encompassed by the HSR service concern both the technical characteristics and the final characteristics. The corresponding enhancement of technical characteristics as well as the enhancement of service characteristics differs not just by country but also by city.

HSR service as innovations in technical characteristics

HSR service is an improvement innovation (in the sense of Gallouj and Weinstein's typology) resulting from changes (improvements) in the technical characteristics of high-speed trains (HST) and high-speed lines (HSL) (*cf.* Campos and de Rus, 2009 for an analysis of different HSLs and HSTs).

With regard to rolling stock, high-speed trains are characterized by new more or less powerful engines, new improved train stability systems, different train lengths, and sometimes new facilities for passengers. These technical characteristics differ from one country to another (Givoni, 2006). As Dosi (1982) points out, this is because they have been developed at different times, within the context of technological trajectories that are specific to individual countries, as has been highlighted by previous analyses of national systems of innovation (Nelson and Rosenberg, 1993; Freeman, 1995)[4].

First, in France, for example, HSTs appear to be a direct adaptation of classic rail techniques (Klein, 2001; Speck, 2003). In other countries, such as Japan or China – in particular with the Shanghai Maglev Train (SMT) linking Pudong Airport and Longyang Road in Shanghai – the Maglev (magnetic levitation) technology used is quite different and the magnitude of the technical innovation greater[5]. In Italy, the Pendolino is characterized by a specific mechanism to tilt on bends, etc. In some countries, several technologies coexist.

The equipment and facilities inside the train also differ according to the country in question. For instance, the Spanish AVE is equipped with radios and TVs. In China and Japan, trains are equipped with rotating-seat systems.

Second, the kinds of networks on which HSTs circulate can also differ from one country to another (Vickerman, 1997; Campos and de Rus, 2009; Givoni, 2006). New high-speed lines (HSLs) are characterized by different rail gauges, different curve radii, etc.

In some countries (e.g. Japan), high-speed trains only circulate on dedicated lines, while in others (e.g. France) they can circulate on the conventional rail network. In certain others (e.g. Germany, Italy), conventional trains can circulate on the high-speed network and vice versa (Campos and de Rus, 2009). Furthermore, in some cases the network is centered on a big city, like Paris in France, Madrid in Spain or Seoul in South Korea, while in others it serves many cities in a non-hierarchical way (Germany).

Third, the location of stations also varies by country (Givoni, 2006; Urena *et al.* 2009). In some cases, new stations are built for HSR service, sometimes outside the city; in others, HST arrives in existing central

4 Where several high-speed technologies exist in a country, the technical characteristics also differ by city.

5 In this case, the innovation is more radical, although the system of characteristics is not totally modified.

rail stations. For example, in the case of Italy, there are connections with classic rail lines every 30–35 km and classic lines have been modernized. In Germany, all the new stations are connected to the classic rail network, which also benefited from improvements. Conventional rail stations are served, even though this service induces a waste of time. In Belgium, HSTs arrive in the city center. In France, different kinds of stations exist: they are generally in city-center locations for high-speed connections to Paris and conventional ones with certain provincial cities, while interconnection stations for high-speed links to other provincial areas are to be found in some cases within the city but more frequently outside it.

The differences between countries are important because they have an impact on the use of HSR infrastructure (Campos and de Rus, 2009) and consequently on the potential effects of HSR service (see below).

HSR service as innovations in final service characteristics

HSR service can also be seen as an improvement innovation that involves the enhancement of final characteristics of services[6]. But this improvement is different according to the countries and the served cities concerned.

First, commercial speed is improved, reducing journey length (*cf.* Bazin *et al*. 2011 for a review on this subject). The International Union of Railways (UIC) defines high-speed rail as services with a commercial speed of at least 250 km/h. The magnitude of this service innovation is correlated to the speed increase achieved. The speeds attained depend on the technical characteristics of the HSTs and/or of infrastructures (Campos and de Rus, 2009), which vary from one country to another (see above). But speeds also differ according to the lines in question and the cities that are served. For example, in France, HSTs run at 320 km/h on the recently opened East European high-speed line but attained speeds of only 260 km/h in 1981 when the first high-speed line, from Paris to Lyon, was inaugurated. Moreover, as mentioned above, services may run on dedicated HSL tracks or on classic tracks, with higher speeds possible on HSLs than on conventional lines. The speed increase is therefore greater for cities directly served by HSLs. So in France, for instance, the

6 It is important to point out that the importance of this form of innovation also depends on the quality of the existing rail service (see below) and on the types of actors concerned: an innovation may be minor for the rail company but significant for the client.

biggest cities are more directly connected to the network than small and medium cities: 30.3 % of cities with more than 200,000 inhabitants are located on or near a high-speed line, whereas this is the case for only 11.6 % of cities with fewer than 200,000 inhabitants (Delaplace, 2012).

In addition, speed improvements depend on the geographical characteristics of the served cities (Campos and de Rus, 2009). In some cases, speeds are lower because of urban or mountainous areas, or because trains have to run on sections of bridge, etc.

The magnitude of the improvement innovation also depends on the existence and quality of the classic rail service in the city (Garmendia *et al.* 2008). If the quality of the previous classic rail service was very good, the HST innovation will appear to be less significant. Ureña *et al.* (2006, quoted by Garmendia *et al.* 2008, p. 251) suggest that big cities located one hour's HST ride from metropolises may find fewer new opportunities than small cities because they were already located on important transport corridors. Under these circumstances, the accessibility amelioration will represent only a marginal improvement.

This speed increase can allow for a better frequency: as trains run faster, it is possible to increase their number. This frequency of trains in a week, in a weekend or in a day also varies by city (Bazin *et al.* 2011 for a review of literature on this subject, and Sanchez-Borras *et al.* 2011 concerning Spain). For example, the frequency is often correlated to the size of the urban areas in question. In France, there are 3.3 direct round trips to Paris for cities with 20,000 to 100,000 inhabitants and 10 for cities with more than 200,000 inhabitants (Delaplace, 2012).

Second, HSR service can allow for increases in railroad service capacity (Givoni, 2006). Indeed, it sometimes replaces services on other lines. In such cases, the classic lines freed up in this way can be dedicated to other transportation needs (such as regional passenger transport and/or freight).

Third, in some cities, changes in service characteristics can have the effect of eliminating transport interchanges and/or allowing access to new destinations by train.

Fourth, the magnitude of this service innovation depends on the strategy of the provider, the competition that exists, and these competitors' strategies. Competition will differ according to the country and the location of the city within that country. For example, competition may exist with airlines for long journeys, and with highways for short trips.

But in some cases, air travel and HSR services can also be complementary (DAST, 2006; Givoni and Banister, 2006).

HSR SERVICE AS INCREMENTAL INNOVATION

HSR service can also be analyzed in terms of incremental innovation regarding service characteristics (here, rail transportation), i.e. an innovation mode which consists of adding one or more new service characteristics (Gallouj and Weinstein, 1997). The addition of new service characteristics can take various forms.

It may first take the form of the addition of peripheral services to the core service that is high-speed mobility (Table 1). Examples of added peripheral services include Wi-Fi, foot spas on the "Toreiyu" Shinkansen to Yamagata in Japan, of TV screens on the AVE high-speed train in Spain, or new forms of customer relations such as subscription systems with online booking only. These incremental innovations can increase the number of users. To be effective, they need to exhibit new technical characteristics and benefit from changes in the competency vectors of providers or clients. More specifically, providers must build competencies that enable these service innovations to be produced. Likewise, client competencies are central.

New relations with clients	"*E-forfait*" (Annual flat-rate subscription fee)
New services in high-speed trains	Wi-Fi connection
	Family spaces
	"*TGV Live*" (Music in trains serving music festivals)
	Enjoying a foot spa
	Watching TV
New services inside the station	Offices for rent
	New shops and services
	Walking, shopping, food and drink
New image for the city	Modernity
	High accessibility
	Dynamism

TAB. 1 – Examples of incremental innovations.

Second, it may take a more symbolic form. Indeed, HSR services add a new characteristic, in terms of modernity, to the traditional rail service. This additional service feature can be described as semiotic in the sense that it conveys a sign to numerous stakeholders of both served and non-served cities. Like a fashion brand whose purpose is to distinguish the person who wears it, an HSR service provides a distinctive sign for cities, and a new image (Vickerman, 1997; Sands, 1993; Willigers *et al.*, 2005; Kamel and Matthewman, 2008; Bonnafous, 1980; De Jong, 2009; Bazin *et al.*, 2009; *cf.* Bazin *et al.*, 2011 for a review of literature on this subject).

Third, using Bertolini and Spit's model (1998), we can consider a rail station not only as a node but also as a place within a district or neighborhood. As a result of urban renewal (Terrin, 2011; Pol, 2008, Bazin *et al.* 2009, 2010; Yin *et al.*, 2014) around central HSR stations, there is a growing recognition of the station as a place and a destination in its own right (De Jong, 2009; Mannone, 1997) where train passengers – but also inhabitants – can wander around, go shopping, etc.

But beyond these improvements and incremental innovations, it is also important to take into account the way these innovations are produced, and in particular the existence of what is called relational innovation.

HSR AS A RELATIONAL INNOVATION

A relational innovation can be defined as the implementation of new partnerships between stakeholders in order to produce a service (Dupuis, 2007), or "the establishment of particular relationships with a firm's partners, whether they be customers, suppliers, public authorities or competitors" (Djellal and Gallouj, 2001, p. 58). This relational innovation can be considered a process innovation in the production of the service because it is necessary for new providers to coordinate themselves in order for the service to be produced (Blanquart and Delaplace, 2009; Delaplace, 2012).

In some countries, several stakeholders may jointly carry out the production, building, and funding of an HSL and sometimes the HSR service itself. This was the case in France, where the state, RFF[7], SNCF[8] and certain local authorities have produced the HSR service. For instance,

7 "SNCF Réseau" since 2015.
8 "SNCF Mobilités" since 2015.

the financing of the East European HSL was the result of an *ex ante* deal between public authorities at the local and regional level, RFF, SNCF and public authorities at national level (France and Luxembourg). Discussions were necessary in order to reach an agreement and consensus on the rail route, the location of the stations, and the rail service provided. These discussions modeled the rail service and, in some cases, the existence of a junction with classic rail services. The coproduction of this HSR service required each actor to develop some new competencies. Furthermore, in France, the classic rail service was improved by local authorities after the launch of the HSR service. This was made possible following the transfer of responsibility for TER services from SNCF to regional authorities.

In terms of local economic development, these relational innovations are important because they are likely to facilitate the subsequent appropriation of service innovations as a whole (see below). This issue is important because, while HSR services can generate innovations in served cities, these innovations alone are not enough to induce the emergence of real effects: they need to be used and appropriated by stakeholders.

II. THE USE AND APPROPRIATION OF INNOVATIONS LINKED TO HSR SERVICE IN A CITY

If we consider HSR to be a set of innovations that vary by country and city, an important issue concerns the use and appropriation of these different innovations. This use and appropriation will differ according to the city concerned, as different elements will have an impact on the use of HSR services. But beyond use, HSR needs to be appropriated individually and collectively by local stakeholders in served cities.

THE POTENTIAL OF USE OF HSR SERVICE IN A CITY

Assessing the wider effects of HSR service in a city means taking into account how it is used. This use depends on national considerations, on city-specific socioeconomic and geographical characteristics, and also on the strategy of the rail service provider.

National considerations that affect direct and indirect HSR use

First, as outlined above, the kinds of HSR service and HST model that stakeholders have access to are important because they allow a more or less intensive use of HSR infrastructure (Campos and de Rus, 2009). Moreover, in certain countries (for example, France), traffic on the high-speed network is limited to passengers, while in others (Italy, Germany), it also accepts freight (Wolkowitsch, 1987).

Second, the use of HSR services depends on the economic context and its effects on rail traffic (Klein and Claisse, 1997), which varies over time and according to the countries and cities concerned. This relationship between the economic situation and HSR traffic is well documented in the literature. For instance, regarding the future HSR in California, Sands (1993, p. 50) stated that "the current recession will reduce all development effects, from the regional to station level". More recently, Nash underlined that the prospects for success of the high-speed railroad depend largely on future economic growth (Nash, 2009, p. 24).

It is true that the economic climate influences the dynamics of cities, mobility, and consequently also the use of HSR services. It also affects stakeholders' expectations and public policies through its effects on public resources and spending (Bazin *et al.*, 2006). This was recognized in many cases of HSR introduction: in the city of Reims (France), where HSR was implemented in 2007, the economic crisis has limited the settlement of firms in the business park of Bezannes, located near the Champagne-Ardenne rail station. In the city of Le Mans, also in France, there were some difficulties in marketing office developments in the Novaxis neighborhood because of the deterioration of the economic situation in the early 1990s. The second phase of offices, planned for 1995, was postponed until 1997 (Bazin *et al.*, 2006). In the smaller French town of Vendôme, a technology park was also created during the economic slowdown, preventing the development of a synergy between the technology park and the HST (Bellanger, 1991). Valdeluz in Spain is today a ghost city as a result of the economic crisis and its real-estate repercussions, including the failure of a real-estate project in the vicinity of the rail station[9]. Furthermore, while business tourism (congresses,

9 J.-J. Bozonnet, "'Bienvenidos' à Valdeluz, ville fantôme", *Le Monde*, 22 October 2008.

conferences, symposia, seminars or workshops, incentives, etc.) is an activity that can profit from the existence of an HSR service, it is a sector that is very much linked to the economic situation (Bazin *et al.*, 2011; Delaplace and Perrin, 2013). Lastly, the use of HSR services in tourism depends on working time, which differs from one country to another. In France, for example, there was a reduction in the maximum weekly working time, which enabled fast growth in short-stay urban tourism.

The local characteristics that affect HSR use

HSR use depends on the resources that exist in a given city and on certain natural and historical constraints that shape this city. On the one hand, the resources that exist in a city will depend on geographical conditions. For example, every city has specific characteristics in spatial terms (its location in relation to other cities, its internal spatial structure and its physical geography). The location of the city with regard to other cities – and consequently the time savings linked to the distance between served cities (Kamel and Matthewman, 2008; Sands, 1993; Givoni, 2006) – and more generally the spatial configuration of the city and the urban structure of the country in which it is located can influence potential HSR use. In the same way, proximity to metropolises also influences the potential use of HSR service (Urena, *et al.*, 2009). Lastly, the size of the city influences its characteristics – for example, regarding real-estate prices and quality of life. On the other hand, resources also depend on the historical conditions that have shaped the city: the existence of an architectural, cultural or gastronomic heritage, for instance.

In particular, geographical and historical conditions determine the type and shape of the city and its degree of concentration. Concentrated cities are better suited to the use of HSR service (Campos, de Rus, 2009). Geographical and historical conditions also determine the possibilities and kinds of tourism that exist, and consequently the possible use of HSR services. For instance, the location of served cities near the sea or mountains is a characteristic that may generate a specific use of HSR services for tourism-related (*i.e.* leisure) travel.

Furthermore, the resources of a city depend on the kind of local stakeholders (large companies, institutions, subsidiaries, as well as the organizational structure of these companies, etc.) that are located in that

city and on their competencies and their industrial, commercial or technological specialization. The types of firms (industrial or services, large or small) and markets they serve (local, national, international) and the competencies they possess are essential for analyzing the potential use of a HSR service (Mannone, 1995). Industrial specialization influences the level of qualification of the local population, which also impacts this use. For example, if the city is characterized by a population of executives, there will be a more significant use of HSR services because executives favor this kind of transport (Klein and Claisse, 1997; Bertrand, 1997). If the city is characterized by companies whose employees travel frequently, a good HSR service can be very useful, but this is less true if employees' mobility is low and based on short distances. More generally, the profile of a city's inhabitants as a whole impacts the use of HSR services (Garmendia *et al.*, 2008).

Finally, the adoption of an HSR service depends on the type of client targeted (different kinds of firms, of households, etc.), the type of mobility in question (professional mobility, commuting, leisure travel, etc.) and the value of time, which is different according to the kind of mobility. These points are partly determined by the characteristics of the city itself, but also by the strategies adopted by the HSR service provider.

The provider's strategy

The type of HSR service depends on the type of mobility that the provider wishes to develop (commuting, business travel, leisure travel, etc.) in each city. Use of this service also depends on ticket price and, more specifically, on the price differential compared with tickets for conventional services (Willigers *et al.*, 2005; Garmendia *et al.*, 2008). The provider might also develop new low-price offers, such as Ouigo, the new low-cost HSR service launched by SNCF (Delaplace and Dobruszkes, 2015), which serves certain cities in France. It might also introduce a number of special offers. For instance, following the launch of the East European High-Speed Line, SNCF sold tickets at a reduced price in order to temporarily develop tourism in the cities served by the line in the east of France. The ability and willingness of the provider to implement additional offers during exceptional events (Delaplace, 2012) in different cities is also important. For example, when the Braderie de

Lille (a sort of huge, citywide garage sale) is held in early September each year, the capacity of certain high-speed services between Lille and Paris is increased. In the same way, in Belfort, during the Eurockéennes music festival, two high-speed trains with only discounted tickets (non-refundable, non-exchangeable tickets known as "Prem's", sold at very low prices) were operated. As these examples show, the provider of the HSR service thus plays a fundamental role in the way rail services in a particular city are promoted and valorized (Delaplace, 2012; Bazin *et al.*, 2006; Bazin *et al.*, 2011; Menerault, 1997; Chevalier, 1997).

Moreover, the provider can use new HSR services to offer new ways of managing customer relationships in the context of transport services (for example, new booking methods, new services directly related to transport – see above).

Consequently, an *ex ante* evaluation of the effects of an HSR service on a city must take into account the specific potential of use in this city. However, in addition to these considerations, HSR services and the innovations they convey also have to be appropriated by users and by local stakeholders.

INDIVIDUAL APPROPRIATION OF HSR SERVICES IN A CITY

Appropriation occurs when users integrate HSR services into their behavior and modify this behavior as a result (Haddon, 2011). Appropriation goes beyond absorptive capacity (Cohen and Levinthal, 1990)[10] and depends on factors such as station location and the strategies implemented by local stakeholders.

First, the type of appropriation of HSR services depends on the location of the rail station (Givoni, 2006; De Jong, 2009), which can differ according to the country and city in question. Furthermore, for the same kind of location, a different appropriation of the area around the station can be achieved. Garmendia *et al.* (2008, p. 251) underline that in France, new activities around peripheral HSR stations have focused on economic production, while in Spain they have taken the form of housing developments. A central location can generate a specific appropriation scheme in terms of office development. It can also

10 Absorptive capacity allows a firm to produce innovations but also to increase its capacity to explore and use the knowledge which exists in its environment. It depends on its competencies.

promote urban tourism in a city, characterized by cultural amenities. But this is not always the case for new stations located outside the city. Consequently, the effects of HSR services differ according to the location of the station (Sands, 1993).

Second, the individual appropriation of HSR services can take various forms and be implemented in various ways by the different stakeholders (firms, households, local authorities, etc.). We propose to distinguish appropriation by local public stakeholders and appropriation by local private stakeholders. Both actors can introduce innovations in products or services.

A new HSR service and its resulting service innovations may raise questions for public actors regarding a cities' ability to use this service in order to generate new dynamics. Many case studies and diagnoses, whose purpose is to map the future development prospects of cities, are often produced in newly served cities or in cities which are about to be served. These diagnoses, made *ex ante* or *ex post* the arrival of the HSR service, constitute the most immediate form of appropriation. In some cases, they have led to the definition and implementation of policies integrating the new service. For instance, diagnoses can lead local stakeholders to modify the urban transport system to allow for better intermodality at the rail station.

Local stakeholders can also more generally use the image conveyed by the HSR service (see above) to differentiate their city from other cities. Appropriation of the semiotic characteristics of the HSR service may, for example, be achieved through the implementation of communication strategies by the public stakeholders in charge of city development.

Lastly, the rail station, which constitutes one of the gateways to the city, can be used by the local authority as a key element in redefining the city's image and/or its access channels.

Private stakeholders (either firms or households) can also appropriate HSR services. The arrival of an HSR service can induce changes in the way companies access the new service and implement their economic activity. For example, an HSR service can modify the labor organization of consultancy firms, as it makes it possible for consultants to travel to numerous served cities in a day or half a day, thus replacing remote relationships with face-to-face encounters with their clients. It can modify a production unit's relationship with its head office and lead to a

decrease in managerial posts in the production unit due to job transfers to the head office (INSEE, 2017). For these firms, the appropriation of the HSR service can be considered an organizational innovation. The productivity of employees can be increased insofar as the HST is also a workplace – a kind of office extension. But in order to achieve real appropriation, firms have to modify their production processes and routines (Nelson and Winter, 1982). Accordingly, a new HSR service is likely to modify the production processes of companies whose activities require frequent movements towards, say, the capital city of the country in question and other destinations served by HSR. But this change in production processes depends on the ability and desire of companies to reorganize and to rethink these processes.

The HSR service may also lead to the production of complementary services in the field of real estate. In some cases, HSR stations are used to temporarily boost office supply (Pagliara *et al.*, 2016; Delaplace *et al.*, 2014). However, a city's private and/or public stakeholders can seize upon the launch of HSR services as an opportunity to create new real estate that is likely to meet a pre-existing demand, or even to stimulate new demand, in both the residential and the office real-estate sectors (Bazin *et al.*, 2009, 2010, 2016). In the residential real-estate sector, the arrival of an HSR service can induce fast growth in residential construction. Local and/or national investors can provide households with additional housing supply (Bazin *et al.*, 2010). Similarly, office real-estate promoters and/or private investors can supply additional office space by constructing office buildings or new hotels near the station (Kamel and Matthewman, 2008; De Jong, 2009). These actions depend on the promoters' forecasts and expectations regarding the effects of the HSR service on demand for office space (Bazin *et al.*, 2010, 2016), as well as on the decisions of the local authority regarding land use (Garmendia *et al.*, 2008) and the economic climate.

Households can also appropriate the HSR service by modifying the way they commute from home to the workplace, or by modifying their leisure mobility habits – for instance, by being able to travel more frequently for short breaks.

In addition to these different individual appropriation strategies, collective appropriation strategies also come into play.

THE COLLECTIVE APPROPRIATION OF HSR SERVICES: A CENTRAL ELEMENT OF WIDER EFFECTS IN A CITY

Collective appropriation is the joint appropriation by several stakeholders, who in this case use HSR to collectively implement new actions. This collective appropriation depends on the characteristics of the city, the competencies of the public and private stakeholders, and their ability and willingness to cooperate. This ability and this willingness can be seen as resources from the city's point of view.

Collective appropriation of this kind can arise in numerous domains and among different kinds of stakeholders (public and private).

First, it can take the form of collective communication when the city and a private company jointly conduct a marketing campaign that benefits both of them.

Second, the introduction of HSR services can be accompanied by innovations in complementary services directly related to the physical or commercial components of transport (car-hire services in a rail station, reorganization of taxi services, etc.). Moreover, the transport system may be modified to take account of the new HSR service. In some cases, the construction of a new rail station or the arrival of HSR services at the central station can lead the city to rethink connections with the other transport infrastructures: for example, the way in which highways, urban transportation, and TER trains serve the city. Similarly, access to rail stations may be improved in terms of local public-transport provision. A new station can be served by both rail services and urban transit services. The reorganization of the latter depends on public and private coordination. For example, in France, SNCF and regional councils coproduce TER services. This means that interconnections between HSR and TER services can be set up so as to enable inhabitants of the served city and its environs to benefit indirectly from HSR services by inducing time savings.

These changes require coordination between local authorities and the urban public-transport operator. As underlined by Sands (1993, p. 55) with respect to HSR in California, "[t]he state agency responsible for the development of a high-speed rail network must work closely with local transportation authorities to guarantee that adequate road and transit connections are provided to high-speed rail stations". These kinds of collective appropriation schemes seem to be central among the effects of HSR services.

This collective appropriation can also give rise to relational innovations in the city, i.e. the emergence of new relationships between stakeholders in order to produce new product and/or service innovations. For example, the stakeholders of urban tourism use HSR services as an opportunity to produce new complementary services, such as tourist packages (train tickets combined with hotel accommodation and/or entertainment and/or cultural visits, etc.). This requires the coordination of a number of stakeholders (transport service providers, tourism service providers such as travel agents, restaurants, hotel owners, museum managers, etc.).

These collective appropriation and relational innovations in the city seem to be a key element for the enhancement of HSR services and the emergence of new dynamics. They can be regarded as a process and an organizational innovation seeking to produce a project for the city. They can give rise to new action procedures and to the definition of common goals and coherent and collective policies likely to enhance economic, cultural, human, land-related, heritage-related or touristic territorial resources. In such cases, in addition to pursuing individual interests, private and public stakeholders coordinate their actions in order to promote a form of city development that will also foster their own development.

The collective appropriation of HSR services is likely to generate the most important effects on local development. Indeed, the emergence of several relational innovations associated with product/service innovations, which could be described as a cluster (Porter 1998) of service innovations in a served city, is a major determinant of the possible positive effects of the arrival of HSR services in a city.

Together with the kind of HST and HSL implemented, the characteristics of the HSR service, and the characteristics of served cities in different countries, the collective appropriation of the innovations encompassed by HSR services and the collective production of complementary service innovations are central elements in the link between HSR services and local economic development.

CONCLUSION

The service-based analysis that we have conducted shows that assessing the effects of HSR services requires taking into account four elements. First, an HSR service is a set of service innovations that vary according to the countries and cities that they serve. Second, the way these innovations are used can also differ from one country and city to another. Access to an HSR service is not enough: on its own, an HSR service merely opens up potentialities. Third, these innovations can be appropriated individually or collectively by the stakeholders of the cities in question. This appropriation depends on the will and the strategies of these local stakeholders. Fourth, collective appropriation is a major issue in terms of the impact of HSR on served cities.

All these elements must be taken into account in any evaluation of the wider economic impacts of an HSR service on local economic development. Consequently, an HSR service cannot be analyzed as having automatic effects on a city. These effects are largely coproduced in space and in time. Therefore, they cannot be used *ex ante* to justify the building a high-speed line.

This analysis integrates within a single framework the different characteristics that are likely to play a role in HSR effects at the macro-, meso- and micro-economic levels. This multilevel analysis is central to understanding why, in some cases, something happens following the launch of an HSR service, while in other cases nothing happens. Lastly, this conceptualization would appear to be useful in improving the evaluation of transport infrastructure. In particular, it seems especially important to create an evaluation methodology that incorporates both the magnitude of the various kinds of innovation present in different areas and the potential for their use in these areas. Appropriation is, by definition, difficult to take into account in an *ex ante* evaluation. We still need to develop relevant indicators capable of measuring stakeholders' ability to appropriate the various innovations linked to the arrival of an HSR service and their capacity to cooperate in a given area.

REFERENCES

Adler M. D. and Posner E.A. (1999), "Rethinking cost-benefit analysis", *The Yale Law Journal*, vol. 109, n° 2, p. 165-247.

Bazin S., Beckerich C., Blanquart C., Delaplace M., Vandenbossche L. (2011), « Grande vitesse ferroviaire et développement économique local: une revue de la littérature » *Recherche, Transports et Sécurité*. Vol. 27, n° 106, p. 215-238.

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° 56/2009, p. 37-61.

Bazin S., Beckerich C., Delaplace M. (2010), « Ligne à Grande Vitesse et marchés immobiliers résidentiels à Reims: entre attractivité, aménités et anticipations », *Revue d'Economie Régionale et Urbaine*, n° 2/2010, p. 313-336.

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.

Bazin S., Beckerich C., Delaplace M., Masson S. (2006), « L'arrivée de la LGV en Champagne-Ardenne et la nécessaire réorganisation des rapports de proximité, » *Les Cahiers Scientifiques du transport*, n° 49, p. 51-76.

Bellanger F. (1991), *Le TGV atlantique au Mans, à Saint-Pierre-des-Corps, à Tours et à Vendôme: opportunités, acteurs et enjeux*, Maison des Sciences de la Ville, Université de Tours.

Bertolini L. and Spit T. (1998), *Cities on rails: The redevelopment of railway station areas*, London and New York, E & FN Spon.

Bertrand J. (1997), « Pratiques ferroviaires », in Chevalier et al., *Le Mans, 6 ans après l'arrivée du TGV.* DATAR, OEST, Groupe de recherche en géographie sociale, Université du Maine, Le Mans.

Blanquart C., Delaplace M. (2009), « Innovation relationnelles, nouvelles offres de service et valorisation des nouvelles infrastructures de transport; Le cas de d'une plateforme multimodale et d'une desserte TGV », *Les Cahiers Scientifiques du Transport*, n° 56, p. 63-86.

Bonnafous A. (1980), « Rhône-Alpes, capitale Paris? Les effets prévisibles du TGV », *Revue de géographie de Lyon*, vol. 55, n° 3, p. 233-240.

Bonnafous A. (2014), Permanent Observatories as Tools for Ex-Post Assessment: The French Case Study, ITF-OECD Discussion Paper, n° 10, 32 p.

Campos J., de Rus G. (2009), "Some stylized facts about High-Speed Rail: A review of HSR experiences around the world," *Transport policy*, nº 16, p. 19-28.

Chevalier J. (1997), *Le Mans 6 ans après l'arrivée du TGV, groupe de recherche en géographie sociale*, ESO – Espaces géographiques et Sociétés, Université du Maine, Le Mans.

Cohen W. M. and Levinthal D. A. (1990), "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly*, Special Issue: Technology, Organizations, and Innovation, vol. 35, nº 1, p. 128-152.

DAST (Direction des Affaires Stratégiques et Techniques) (2006), « Le TGV et l'avion: une complémentarité qui se développe », *Note thématique* nº 4, mars, p. 1-4.

Delaplace M. and Dobruszkes F. (2016), "Thinking beyond the cost-benefit analysis: The case of HSR' effects on local development" Introduction to the special issue, *Belgeo*, nº 3, p. 1-8.

Delaplace M. and Dobruzskes F. (2015), "From low-cost airlines to low-cost high-speed trains? the French case", *Transport Policy*, 38, p. 73–85.

Delaplace M., Pagliara F., Aguilera A. (2014), «High-speed rail station, temporary office space and mobile workers; A comparison Italy/France», *Transport Research arena*, Paris 14-17 April.

Delaplace M. et Dobruzskes F. (2013), « L'analyse du lien entre grande vitesse ferroviaire et territoires: un chantier scientifique encore ouvert », *Recherche, Transport et Sécurité*, Introduction au nº spécial « TGV et développement des territoires », vol. 29, nº 3, p. 155-160.

Delaplace M. et Perrin J. (2013), « Dessertes TGV et tourismes urbain et d'affaires: entre attentes dans les villes de France et renforcement de la double centralité parisienne », *Recherche Transport et Sécurité*, vol. 29, nº 3, p. 177-191

Delaplace, M. (2012), « TGV, développement local et taille des villes; Une analyse en termes d'innovation de services », *Revue d'économie régionale et urbaine*, nº 2/2012, p. 265-292.

Djellal F., Gallouj F. (2001), "Patterns of innovation organisation in service firms: postal survey results and theoretical models", *Science and Public Policy*, vol. 28, nº 1, p. 57-67.

Djellal F., Gallouj F. (2006), « Un modèle d'analyse de la dynamique de l'innovation dans les services: Le cas des services de types architecturaux », *Economies et Sociétés, Série EGS*, nº 7, p. 1973-2010

Dosi G. (1982), "Technological paradigms and technological trajectories" *Research Policy*, 11 (3), p. 147–62.

Dupuis M. (2007), « L'innovation commerciale Concepts et mesures » INSEE Division Commerce, Mai.

Freeman C. (1995), "The National System of Innovation in historical perspective," *Cambridge Journal of Economics*, 19 (1), p. 5-24.

Gallouj F, Weinstein O. (1997), "Innovation in Services", *Research Policy*, vol. 26, nº 4-5, p. 537-556.

Gallouj F., Djellal F. (2015), Introduction to "services and innovation", Cheltenham, Northampton, Edward Elgar publishing, p. 13-33.

Gallouj F., Rubalcaba L., Windrum P. (eds) (2013), *Public-Private Innovation Networks in Services: the dynamics of cooperation in service innovation*, Cheltenham, Northampton, Edward Elgar Publisher.

Garmendia M, Urena J-M, De Ribalaygua C, Leal J, Coronado J. (2008), "Urban Residential Development in Isolated Small Cities That Are Partially Integrated in Metropolitan Areas By High Speed Train", *European Urban and Regional Studies*. vol. 15, nº 3, p. 249–264.

Givoni M. (2006), "Development and impact of the modern high-speed train: a review", *Transport reviews*, vol. 26, nº 5, p. 593-211.

Givoni M., Banister, D. (2006), "Airline and railway integration", *Transport Policy* nº 13, p. 386–39.

Haddon L. (2011), "Domestication Analysis, Objects of Study, and the Centrality of Technologies in Everyday Life", *Canadian Journal of Communication*, vol. 36, nº 2, p. 311-323.

Howells J. (2010), "Services and innovation and service innovation: new theoretical directions," in Djellal F., Gallouj F. (Eds), *The Handbook of Innovation and Services, A Multi-disciplinary Perspective*, Cheltenham, Northampton, Edward Elgar, p. 68-83.

Insee analyse (2017), « L'infrastructure TGV est-elle un facteur de compétitivité pour les entreprises? » nº 31, février.

Jong De M (2009), "European high-speed train station area: the renaissance of the railway station", www.etcproceedings.org/paper/download/3918

Kamel K, Matthewman R (2008), "The non-transport impacts of high-speed trains on regional economic development: a review of the literature", in Locate in Kent p. 1-10.

Klein O. (2001), *Les horizons de la grande vitesse, Le TGV, une innovation lue à travers les mutations de son époque*, Thèse pour le doctorat en Sciences économiques, Mention économie des transports, Lyon 2.

Klein O., Claisse G. (1997), *Le TGV-Atlantique: entre récession et concurrence*, in Études et Recherches, LET, Lyon.

Mannone V. (1995), *L'impact régional du TGV Sud-est*. Thèse de Doctorat de Géographie, 2 tomes, Université de Provence Aix-Marseille.

Mannone V. (1997), « Gares TGV et nouvelles dynamiques urbaines en centre-ville: le cas des villes desservies par le TGV Sud-Est », *Les cahiers scientifiques du transport*, nº 31, p. 71-97.

Menerault P. (1997), *Processus de territorialisation de la grande vitesse ferroviaire: le TGV et les régions: Le cas du Nord-Pas de Calais*, INRETS, 102 p.

Nash C. (2009), « Quand investir dans des lignes à grande vitesse? » International transport research symposium-Madrid, OCDE, FIT, *Discussion Paper* nº 16.

Nelson R. & Rosenberg N. R, (1993), "Technical Innovation and National Systems," in Nelson R. (ed.), *National Innovation Systems, a comparative analysis*, Oxford, Oxford University Press, p. 3-21.

Nelson R. and, Winter S. (1982), *An evolutionary theory of economic change*, Cambridge Mass, The belknap of Harvard University.

Pagliara F., Delaplace M., Cavuoto R. (2016), "Mixed High-Speed, conventional and metro central rail stations as places to work: the case study of Naples", *Open Transportation journal*, nº 10, p. 108-118.

Porter M. (1998), "Clusters and competition: new agendas for companies, governments, and institutions" in Porter M. *On competition*, Boston, Massachusetts, Harvard Business School Press, p. 197-299.

Quinet É., (2010), *La pratique de l'analyse coût-bénéfice dans les transports: le cas de la France*, Document de référence, Nº 2010-17, OCDE/FIT, 29 p.

Sanchez-Borras M., Robusté F. and Criado O. (2011), "High-Speed Railways in Spain: Example of success" Communication at the Transportation Research Board 90th Annual Meeting, Washington DC, 23-27 January.

Sands B-D. (1993), *The Development Effects of High-Speed Rail Stations and Implications for California*, Institute of Urban and Regional Development University of Berkeley. *Working paper.*

Speck K. (2003), « Système national d'innovation et TGV: Ce qu'une grille de lecture de l'économie de l'innovation peut apporter à l'analyse des évolutions d'un système technique… et réciproquement », *Recherche, Transports et Sécurité*, nº 78, p. 33-41.

UIC (2017), High Speed lines in the World, UIC High Speed Department.

Urena J., Menerault P., Garmendia M. (2009), "The high-speed rail challenge for big intermediate cities: a national, regional and local perspective", *Cities*, 26, nº 5, p. 266-279.

Vickerman R-W (1997), "High-speed rail in Europe experience and issues for future development", *Annals of Regional Science*, 31 (1), p. 21-38.

Vickerman R. (2015), "High-speed rail and regional development: the case of intermediate Stations", *Journal of Transport Geography*, vol. 42, January, p. 157-165.

Vries De E-J (2006), "Innovation in services in networks of organizations and in the distribution of services", *Research Policy*, 35 (7), p. 1037–1051.

Willigers J, Floor H, Van Wee B (2005), "High-speed rail's impact on the location of office employment within the Dutch Randstad Area, *45th Congress of the European Regional Science Association"*, Amsterdam, August 23-27.

Windrum P., García-Goñi M., Fairhurst E. (2010), "Innovation in public health care: diabetes education in the UK", in Djellal F. Gallouj F. (Eds), *The Handbook of Innovation and Services, A Multi-disciplinary Perspective*, Cheltenham, Northampton, Edward Elgar, p. 129-152.

Wolkowitsch M. (1987), « Le développement du réseau mondial des lignes à grande vitesse: réalisations et projets », *Annales de géographie*, vol. 96, nº 535, p. 273-291.