

High Speed Rail

Partner or Competitor

Conference Paper

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HIGH-SPEED RAIL : PARTNER OR COMPETITOR ?

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High-speed rail (HSR): Partner or competitor ?

-2-

Table of contents

	Page
1. Introduction	
The context at the start of HSR services	3
2. The (fierce) <u>competitive aspect</u>	
quite at the beginning of the HSR services	4
3. Travel time and fare level on HSR	
both as (main) argument for point-to-point operating success	7
4. The inherent advantages/ constraints of HSR vs. Aircraft	9
5. The <u>complementary aspect</u>	14
5.1. Short-haul air transport vs. high volumes of transport	14
5.2. Inter-modality at airports and the role of medium-sized airports	15
6. Conclusions	21
Background	21
High-speed rail: Partner or competitor ?	21
Outlook	22
New high-speed lines in service in 2005	attached

High-speed rail (HSR): Partner or competitor ?

-3-

1. Introduction

The context at the start of HSR services

- The main features: Related to the period since last World War and on average, major improvements have taken place in economies, wealth, education, information and transport technologies, in trade exchanges and traveller cost reduction in real terms. At least for some large regions and for a part of the global population.
- The "global village": Development of air travel in size, due to major improvements in aircraft and navigation technologies, in safety and management, made it possible expanding public transport to overseas travel, with affordable means and close to the reliability records of rail transport, such as effectiveness, efficiency, punctuality and safety.

Global expansion is underlining the promotion of travel as a main social event, as illustrious persons demonstrated in the past and as the name given to the Salzburg airport shows.
- The example of Japan: Air transport developed also on domestic routes, even short-haul, matching higher air fares with short flight times where rail operations were provided.

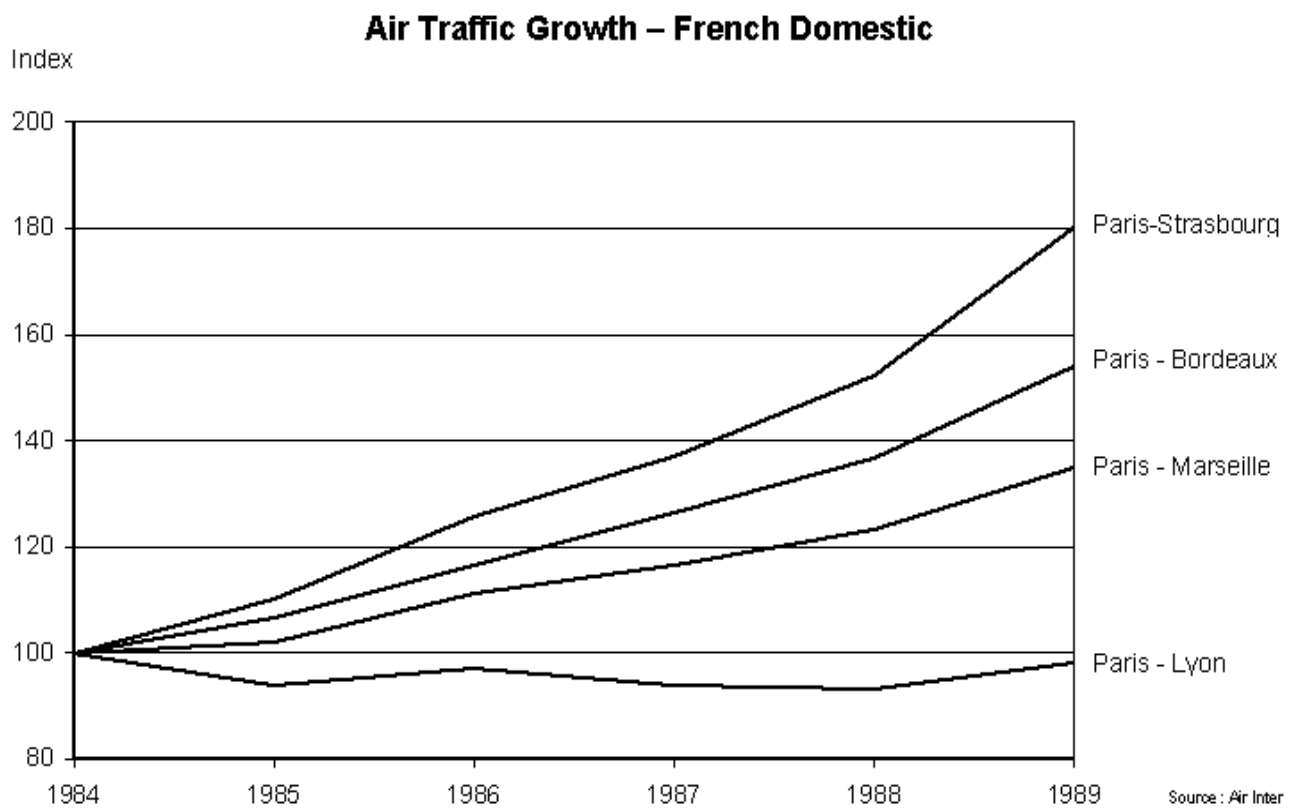
Rail response was first given in Japan by the "Shinkansen", a high-speed train service on the corridor linking the main cities along the East coast, confirming since 1964 that rail transport at high-speed is feasible.

The reaction of domestic air services to Shinkansen came later on, in particular with high seat-density "Jumbo Jets", trying to compensate the loss in travel time advantage over ground transport by lower fares and operational costs per available seat.
- The start in Europe: Europe too has a long tradition in rail services and mostly rail-friendly populations. Some aspects had come just in time to boost the decision-making process of building a high-speed track between both major economic regions of France, such as the (first) oil embargo (1973-74), the implementation of a nation-wide energy power programme, capacity constraints on the existing rail link. Last but not least, the "Train à Grande Vitesse" (TGV) started its operational life on the "ideal" distance (Lyon- Paris) to do better than air travel, in particular regarding city-centre to city-centre travel time.
- HSR is the challenger: One has to bear in mind that the context of a developed air transport system is already in place on links where high-speed rail and air passenger transport may offer services. High-speed rail transport is the challenger. Most of the shifts in passenger volumes from road transport occurred before in favour of air transport.

High-speed rail (HSR): Partner or competitor ?

2. The (fierce) competitive aspect quite at the beginning of the HSR services

The issue is limited to passenger transport, as high-speed rail does not include (for the time being) goods, with the exception of mail services. As a matter of fact, competition prevailed quite at the beginning of the HSR services¹.



High-speed rail transport is able to compete successfully with air transport demand and the diagram just above highlights this fact, showing between 1984 (introduction of the completed high-speed track between Paris and Lyons) and 1989 (introduction of the TGV-Atlantique) air passenger traffic evolution on main French domestic trunk routes. Air traffic point-to-point grew significantly as indexed, except on the Paris-Lyons, where air transport was already competing with high-speed rail.

¹ contrary to the TEE, Trans-Europe-Express network, which was developed after World War II and failed (except on the Brussels-Paris run), mainly because the rail infrastructure was not adapted to commercial speeds required for competing with air transport in Europe.

High-speed rail (HSR): Partner or competitor ?

-5-

Modal Split TGV/ Air travel on the traffic corridor Paris-Southeast (in 1984)

that is Paris-Lyon on high-speed track and farther on classical tracks:

Rail link	Passenger volume daily ²	%-share on		Modal split TGV 1st Cl. and 2nd Cl. related to air travel	
		Air	TGV		
Paris - Lyon:	14'300	10	90	2.7	6.2
Paris - Valence:	1'570	9	91	2.3	8.3
Paris - Chambéry:	1'170	16	84	1.2	4.1
Paris - St-Etienne:	780	26	74	0.6	2.2

Paris - Geneva:	3'000	45	55	0.3	0.9

Paris - Montpellier:	3'130	46	54	0.2	1.0
Paris - Marseilles:	8'200	49	51	0.2	0.8
Paris - Nîmes:	1'380	49	51	0.2	0.9

Source: "Le TGV Paris - Sud-Est", "Transports", Dec. 1985.

The table here above shows distances of two orders of magnitude:

- Paris-Lyon, -Valence, -Chambéry, -St.-Etienne on the one side, and
- Paris-Montpellier, -Marseilles, -Nîmes, on the other side.

In the 1st distance group the high-speed rail traffic share was overwhelming.

In the 2nd group with longer distances (with TGVs using in 1984 classical tracks from Lyons southwards) the modal split was fifty-fifty to the close Mediterranean area.

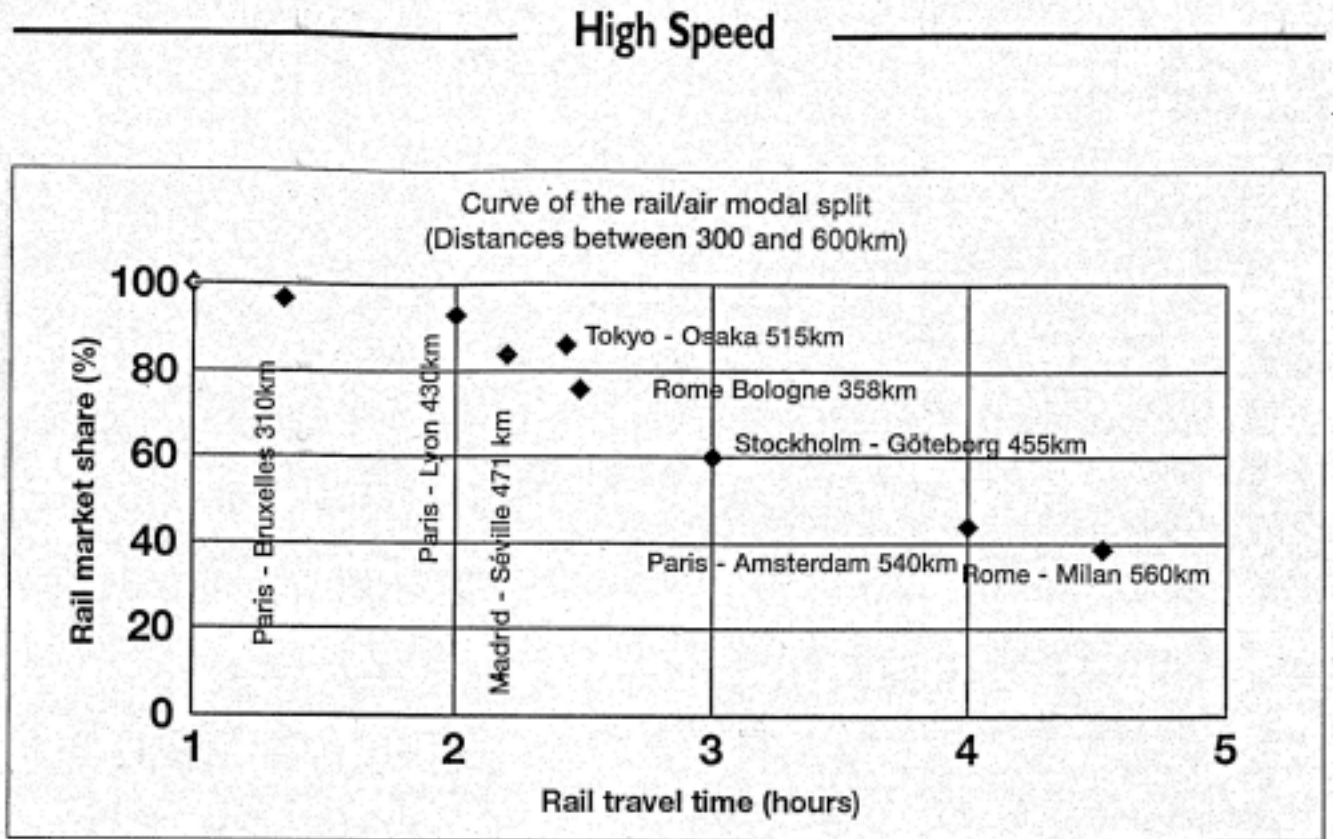
Although, according to distance, Paris-Geneva belongs to the 1st group, the traffic results show modal splits close to those of the 2nd distance group. A reason may be the influence of (wealthy) customers travelling between both areas and not willing to favour TGV on grounds of cheaper fares only.

In 1996 a shuttle-service ("La Navette") was introduced by Air France on air links such as Paris-Bordeaux and Paris-Marseilles with frequent flight departures (up to every half-an-hour in the rush time) and the share of air transport rose to 60%.

Rather than the distance, the following diagram shows the influence of time spent on the train and the limits in attracting air passengers. This is particularly sensitive to those people travelling on a one-day return journey.

² average daily passenger traffic volumes (in both directions).

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Since Summer 2001, the high-speed track from Paris to Lyon and Valence has been extended to Marseilles. Passenger rail traffic tripled since July 1st between Lyon and the French Mediterranean region.

TGV-Med runs from Paris to Marseilles now in 3 hours with a modal split rail/air similar to that of Paris-Bordeaux of 60% since last August and aimed at 66% in 2002.

Air France intends to match with the same frequent flight departures, but with smaller aircraft (A-318).

- The impact of high-speed on the rail network itself

High-speed rail services have begun to show an impact network-wide on domestic long distance rail links and on border-crossing rail links too (*see as attachment "New high-speed lines in service in Europe as from 2005" (Stand of 04.1998).*

TGV-services on the French domestic long distance rail network show the following results in terms of traffic volumes and revenues:

	Traffic increase in passenger-km year-to-year	Increase in revenues	Share of the domestic long distance rail traffic	Revenues of
2001	+8.9%	+12.7%	62%	58%
2002 (aiming at)	+10.7%	+12.7%	65%	61%

High-speed rail (HSR): Partner or competitor ?

-7-

On border-crossing rail links the impact of high-speed rail network-wide is illustrated by the "Thalys" services (between Paris, Brussels, Amsterdam or Cologne), the "Eurostar" services (between London, Lille, Brussels or Paris) and its high-speed rail crossing point at Lille (TGV-Nord).

3. Travel time and fare level on HSR

both as (main) argument for point-to-point operating success

The prior reasons seen in favour of high-speed rail are based on the city-centre to city-centre travel times and on the fare structure.

The first argument has to be tempered for large agglomerations, as airports are located at (far) outskirts with new business centres around them. In this case, at least for business people (on a day's journey), travelling by air rather than on high-speed trains may still make sense.

The most competitive impact on air transport lies currently within a 3 to 4 hours high-speed travel time on rail³. Within this range high-speed rail may have a lead, bearing in mind, the conditions discussed in the next chapter for operational success of a high-speed rail line are met, in particular that of a high volume of transport demand carried at a sustainable high-speed.

Over this limit air travel recovers in terms of market share, due to its inherent advantages, in particular for short journeys.

One illustration, which may be of interest, is comparing some examples of rail links at similar geographical locations within the borders of a small (Switzerland) and a larger European country (France), as follows:

on TGV	Travel time (at every hour)	on the fastest Swiss train
Paris - Bordeaux	3 hours	Zurich - Geneva
Paris - Lyon	2 hours	Zurich - Neuchâtel
Paris - Brussels	1 h. 15'-25'	quite Zurich - Bern

Bordeaux and Geneva are located at a "corner" of each country; Lyon and Neuchâtel play a regional role within the country; Brussels (EU) and Bern (Swiss Confederation) are the upper administrative capitals. Paris and Zurich are the main cities in both countries and travel times by rail to the city-pairs are about the same.

The comparison shows that for such travel times, rail transport fulfils the need of public transport demand, as there is no significant local air passenger traffic⁴ between the 3 national and 2 main regional Swiss airports.

³ as travel time is felt more important than travel distance. The study "Rail/Air Complementarity in Europe; the Impact of High-Speed Train Services" of ITA, Institut du Transport Aérien, Paris, on behalf of the EC Commission, stated that "from 350 km to 1000 km travel distance (as the crow flies): high-speed rail and air passenger transport compete".

⁴ except on Geneva-Lugano, where there is no real alternative in terms of travel time, due to topographical reasons

High-speed rail (HSR): Partner or competitor ?

-8-

Fares in Europe are traditionally in favour of railways⁵. Except a compulsory variable charge for seat reservation, the 1st and 2nd class fare structure on trains has been maintained for TGV-services quite at the start of operations.

Airlines have tried to keep flying parts of the passenger market by adapting partly to high-speed train fares, as shown hereunder between Geneva and Paris. This shows air transport attempting to match TGV fares in particular while applying a range of economy class rates (for the same level of service on board).

TGV:	Scheduled flight:
1 st Class : CHF 240.- ⁸	Business class : CHF 940.-
1 st Class ⁶ : CHF 180.- ⁸	Special Business class ⁷ : CHF 799.-
2 nd Class : CHF 160.- ⁷	Economy class : CHF 848.-
2 nd Class ⁷ : CHF 120.- ⁸	Special Economy class ⁷ : CHF 759.-
	Excursion fare ^{7 8} : CHF 679.-
	SUPERPEX ^{7 9} : CHF 476.-
	SUPERPEX ^{7 10} : CHF 381.-
	SUPERPEX ^{7 11} : CHF 307.-
	SUPERPEX ^{7 12} : CHF 278.-
	EURO fare ^{7 13} : CHF 219.-

⁵ **Return tickets** (without any restriction, nor reduction in price):

	Classical train (1 st class):	Flight (Business class):
Zurich-Stuttgart:	CHF 190.-	CHF 512.-
Zurich-Munich:	CHF 259.-	CHF 639.-
Zurich-Milan:	CHF 206.-	CHF 886.-
Zurich-Lyon:	CHF 298.-	CHF 780.-

⁶ Special return tickets with restrictions; in particular if a Sunday has to be included between outward and return journeys.

⁷ a reservation charge is mandatory; an extra charge is included for some trains on specific days (or hours). Final prices raise by CHF 24.- to 32.- in the 1st Class and by CHF 19.- to CHF 24.- in the 2nd Class.

⁸ by change of reservation without any retain on payment;

⁹ Retain on payment by change of reservation & valid max 6 months;

¹⁰ Retain on payment by change of reservation & valid max 3 months;

¹¹ Retain on payment by change of reservation & valid max 2 months;

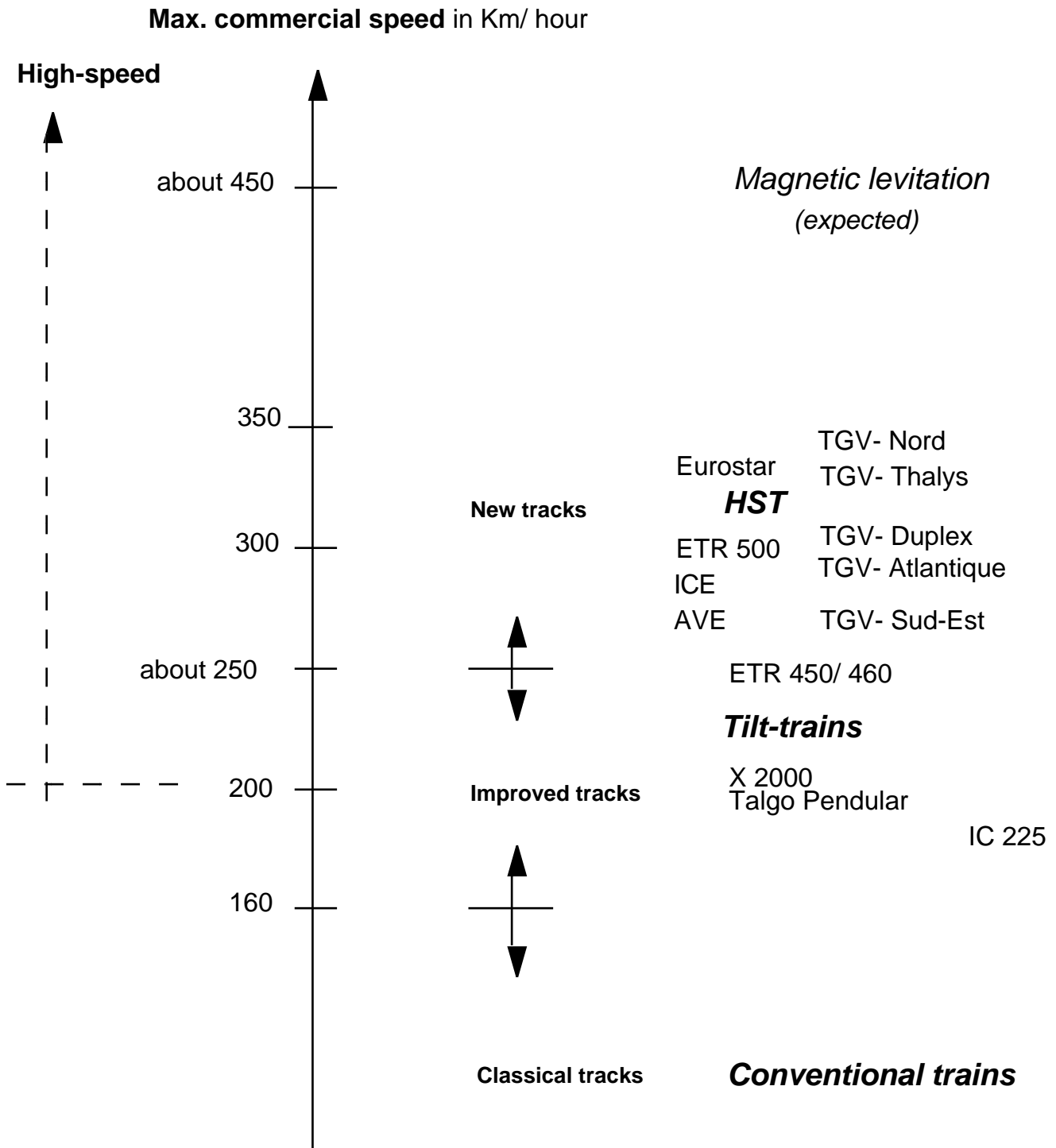
¹² Retain on payment by change of reservation & valid max 1 month;

¹³ Retain on payment by change of reservation & outward and return journeys have to take place at weekends or return journey only after the 4th day but before 2 weeks.

High-speed rail (HSR): Partner or competitor ?

4. The inherent advantages/constraints of HSR vs. Aircraft

- Technique (speed) A key to high-speed rail success is, whenever feasible, to build new tracks for maximum (commercial) high-speed.



High-speed rail (HSR): Partner or competitor ?

-10-

- Safety High-speed rail relies on the traditional safety record of rail transport.
- Network flexibility Even without a high-speed track built, high-speed rail services in Europe are able to operate border crossing and/or on the country's classical network^{14 15}.

The ability of current high-speed trains to operate on classical tracks gives a welcome opportunity to build (expensive) high-speed tracks step-by-step, a key for high-speed rail development success¹⁶. With more high-speed tracks being built, there is space for "seamless" high-speed inter-connections¹⁷

Network flexibility in air transport remains however "unbeatable", as we assume that a working "infrastructure" is given continent-wide (air, airports, air traffic control, aircraft leasing, and financial support). An air service can be introduced, developed, downscaled, re-routed or even terminated at a (very) short notice.

- Transport demand/ supply

Air transport is able to start operations and react immediately to new transport demand situations, whereas a high-speed rail line needs many years to be built.

Moreover, high-speed rail needs high volumes of transport¹⁸ to offer frequent departure frequencies and cover high investment. Traffic demand on high-speed rail may have to be concentrated into a traffic beam, at least partly¹⁹.

Air transport is able to develop on routes with poor transport demand, using adequate (small) aircraft (with frequent flight departures). In this case, the fate of high-speed rail operations is sealed, an exception being a location at a non-dedicated high-speed rail line, where the opportunity of a stop can be given²⁰.

Currently the air transport system in Europe consists of a relatively small number of congested (large) airports, while other (smaller) airports have a sufficient capacity. Most of the large (hub) airports can no longer be enlarged, due to urbanisation and environment protection issues, and have to cope with traffic issues within their current boundaries.

¹⁴ an opportunity for consecutive "end-of-the-line" distribution without change, such as to the French Alps from the HSR line Paris-Lyon (and where airport infrastructure is not as close).

¹⁵ except the AVE (Madrid-Seville) on the classical (wide-gauge) Spanish rail network.

¹⁶ This is not the case with a magnetic levitation rail system, where the whole point-to-point line has to be built before service.

¹⁷ such as the high-speed rail by-pass line connecting "seamless" the TGV-"Thalys", -"Nord", -"Atlantique" and -"Med" lines at the East of Paris, with more point-to-point services offered, such as Brussels- French Alps.

¹⁸ Minimum time separation between trains has come down to 3' even for high-speed technology, whereas a high-speed train not longer than 400m (standard platform length) offers 700-800 seats (1100 seats for double-deck TGV "Duplex" operating now between Paris and Lyon)

¹⁹ such as on the high-speed track of the TGV-"Atlantique" or joining those of "Eurostar" (to London) and TGV-"Thalys" (to Brussels and beyond) between Paris and Lille.

²⁰ such as at Paris-CDG airport on the HSR by-pass line East of Paris.

High-speed rail (HSR): Partner or competitor ?

-11-

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- Punctuality High-speed rail relies on the traditional punctuality record of classical rail transport. This is not as good the case in air transport.

 - Traffic congestion Air transport is (much) more sensitive to traffic congestion (and delays).

Air traffic is three- to four-dimensional and it is going to benefit from more improvements (new level separation criteria, satellite air navigation). However, the bottlenecks are expected to remain at existing airports having to cope with traffic issues within their current boundaries.

High-speed rail, as a challenger to air passenger transport, is able to release landing and departure slots at airports, providing a welcome congestion relief, or opportunities for air transport with no (working) alternative, such as for long-haul flights.

 - Environment protection (noise, pollution)

Rail transport is quoted as having a beneficial effect on environment protection. This is a sensitive political issue.

The noise impact comparison outcome between high-speed rail (along the line) and air transport (in the airport area) is especially difficult to establish.

Energy consumption and air pollution per passenger-km appear to be under the most positive effects of the high-speed rail introduction²¹.

 - Level of service The following chart shows statements given for business trips on the choice between the tilt-train "X-2000" and the SAS air service on the Stockholm-Gothenburg route (in 1994): it is worth-mentioning that statements on modal choice with regard to "total travel time" and "price" are almost balanced.

The improvement factors to travel time "door-to-door" are to include of course the consequences of departure frequency, schedule distribution, punctuality, proximity to departure/arrival terminals, parking opportunities.

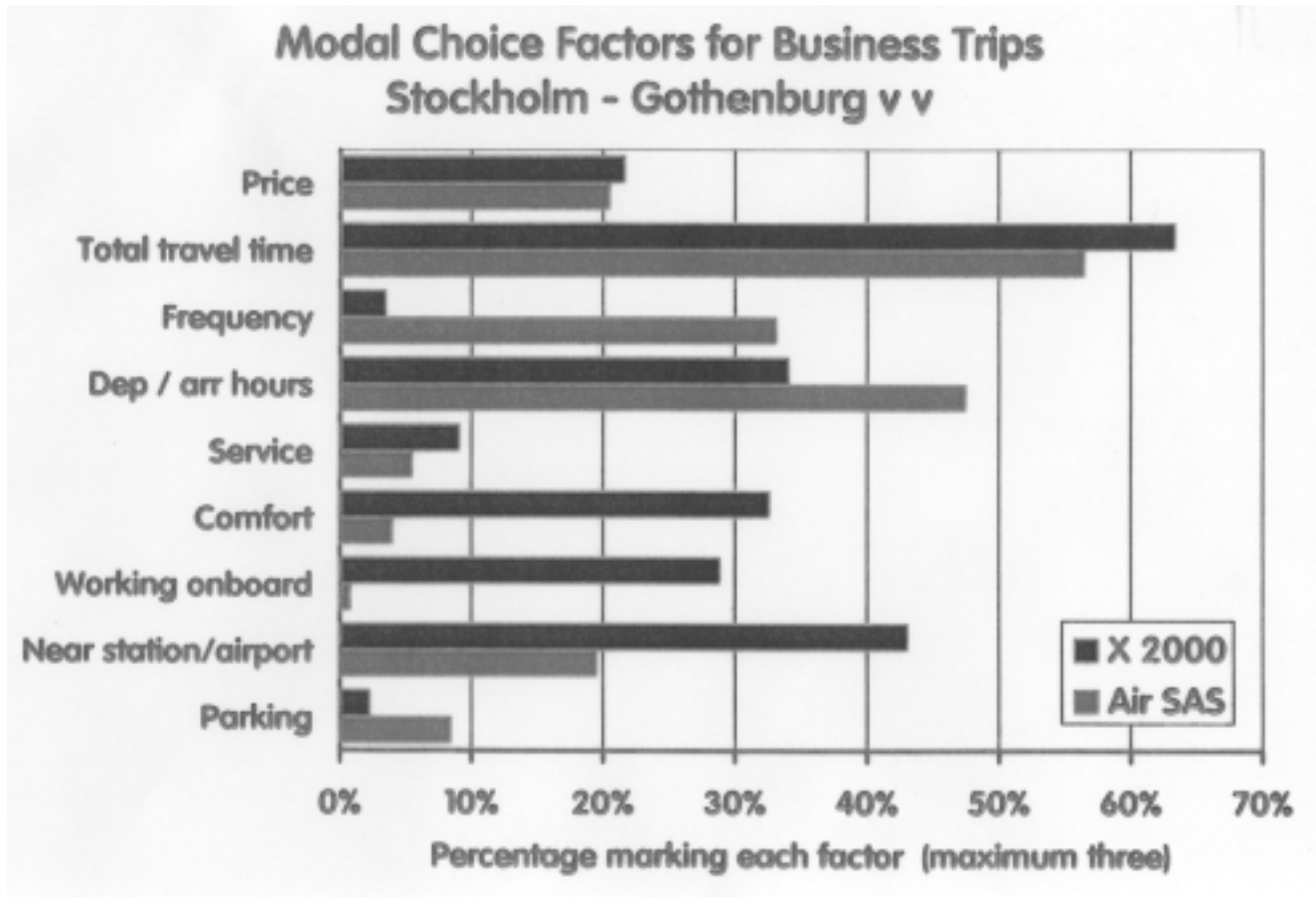
Air passenger transport strength lies in flight frequency effectiveness, in a distribution of (early) departure and (late) arrival hours, and in car parking opportunities at the airport.

Other criteria, such as service, comfort and opportunities to work while travelling, are potentially advantageous for rail transport, as it does not confront the same limitations with regard to space as passenger air transport²².

²¹ Referring to a study made on the Stockholm-Gothenburg the order of magnitude of the rail/air ratio lies by 1 (Tilt-train X-2000) to about 6 (MD-83) or 8 (DC-9/41) for energy consumption. This ratio is however to be expected less favourable to rail by higher speeds than those of tilt-trains or by longer distances by air, as take-off and landing phases are most energy consuming. The air pollution ratio resulting from the Stockholm-Gothenburg route study is much more in favour of high-speed rail, whatever the type of pollutant.

²² Significantly, a marketing argument for the A-380 is based on a "hotel"-like space availability.

High-speed rail (HSR): Partner or competitor ?



- Operating costs Air transport operates under an existing and working system, even if it should be improved. Air transport is more flexible in size (regional air transport) and is less depending on volumes of traffic to increase flight frequencies (according to market request). Any air link can be introduced or terminated at a (very) short notice without devastating consequences. On the contrary, this is not quite the case if a high-speed rail line does not work.

Rail transport needs not only an optimum commercial high-speed to challenge and be competitive with air transport and maximise rolling stock rotations on the one side, but to minimise the costs of energy consumption and material abrasion on the other side.

High (and bundled) traffic volumes are needed on high-speed rail lines in order to cover operating costs, to offer cheap train tickets as usual and frequent train departure opportunities for travellers.

The classical rail network will keep (high) maintenance costs, if not used by other (increasing) traffic, like goods transport, may suffer from under-utilisation due to passenger traffic diversion to the new built high-speed track network.

High-speed rail (HSR): Partner or competitor ?

-13-

Some (large) airports and companies are going to loose revenues from domestic air traffic diverted to high-speed rail. But some local air services (at "rock-bottom prices") may be too expensive to operate and less domestic flights are easing air traffic congestion or releasing much needed air traffic slots.

Under-utilised (medium-sized) airports are also to suffer from those air links loosing traffic to competing high-speed rail services²³, while regional smaller airports may benefit from the absence of any high-speed rail alternative.

- Airport vs. rail infrastructure costs

It has been stated that in particular most of the large (hub) airports can no longer be enlarged. This calls for a new airport at a new (remote) site, if feasible.

A comparison of costs for building and operating airports of different size in Europe shows that there is a (very) large financial gap between building a new and extending an existing airport. The extension of smaller civil airports or the conversion of former military airports is essentially less expensive.

Assuming that airports and rail stations, aircraft and trains, rail and air traffic control are given for any new line, the "remaining infrastructure air" is given too. Infrastructure for high-speed rail (depending on operations, topography and environment protection measures) has to be built (at high costs) with new tracks, equipment and rolling stock.

Rail transport needs new or at least improved tracks for high-speed. High-speed tracks are (depending on topography and environment protection measures) expensive to build²⁴. High (and bundled) traffic volumes are therefore needed to justify new high investment costs.

Whenever a (step-by-step) development of the national (and European) high-speed transport network is addressed, the best integration of high-speed rail and air transport has to be considered. The EU considered (in 1998) an extension to 2005 of the main rail European network with new built lines for high-speed rail as shown attached. Many links have been put into operation.

For other links outside the main links, the EU suggested in particular the development of regional air transport.

Many regional and smaller airports are under-utilised. Former military airports could be used as civil airports. Based on the existing air transport infrastructure in Europe, the enlargement of existing regional airports (for larger aircraft) could give an additional supply within a short delay and without high expenses.

In the short term, it seems, air transport could save investment and operating costs compared to construction and operating costs of high-speed railways. This statement cannot however be confirmed in the longer term.

²³ the airport of Lyons lost roughly 3 mio air passenger a year, due to the TGV.

²⁴ "TGV-Med", as a "TGV-Southeast" extension, was a km 4 -times more expensive to build. Issues on environment (landscape, noise) protection had to be carefully solved.

High-speed rail (HSR): Partner or competitor ?

5. The complementary aspect

If high-speed rail is not able to operate routes with poor demand successfully, whereas air transport is, so both modes are in this context complementary within the high-speed system as a whole.

High-speed rail transport replacing feeder flights and releasing airport slots as well as contributing to environment protection is complementary to the air transport system.

Where there are no feeder flights, high-speed rail transport replacing ground access by car is complementary to air transport too. As airport access time and not distance is of relevance, high-speed rail stations at the airport are extending the ground access catchment area of an airport significantly.

5.1. Short-haul air transport vs. high volumes of transport

Bearing in mind that high-speed rail is the challenging mode, the effects of air transport on high-speed rail underline the shortcomings of high-speed rail.

Potential high-speed rail users may be well served by air transport on links where (high-speed) rail is (still) not able to be competitive. This case is best represented by the booming regional air transport.

Consequently, (regional) air transport may have a limiting, at least a delaying effect on the HSR-network expansion.

Summing up the contributions within the high-speed transport system as a whole:

- For poor volumes of high-speed passenger transport:
 - Short-haul air transport applies
 - as point-to-point, hub-by-pass link
 - as hub feeder flight
 - HSR is optional if there is a high-speed line nearby²⁵
- For high volumes of high-speed passenger transport and HSR travel time of
 - four hours: air transport keeps the lead. HSR has still to gain²⁶
 - three hours: fierce competition air/rail is taking place²⁷
 - two hours: air transport has still a role as a feeder²⁸ and that of a point-to-point high-speed transport in a large agglomeration with several airports served²⁹
 - one-and-a-half hour: air transport has no chance, even for transfer air passengers³⁰

²⁵ like in Dijon, Burgundy

²⁶ like TGV-"Med" at the Côte d'Azur

²⁷ for the time being on Paris- Bordeaux and -Marseilles

²⁸ such as to Paris-CDG

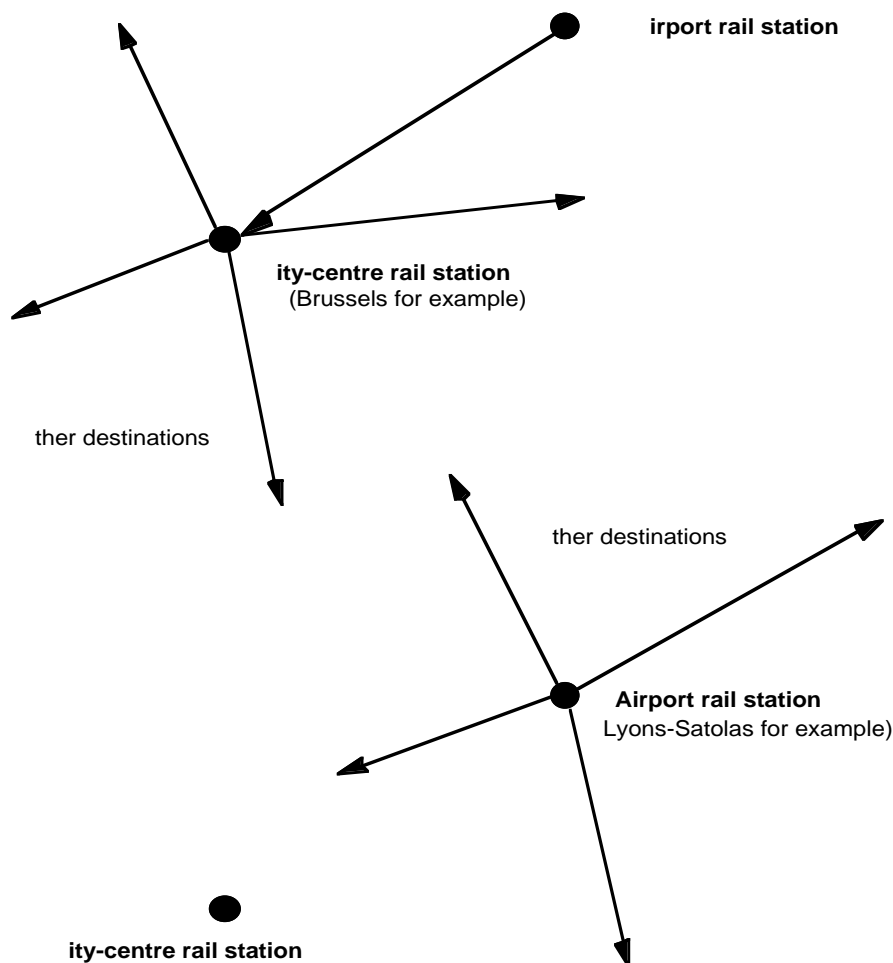
²⁹ such as Paris-CDG in the North and -Orly in the South

³⁰ Like between Paris (-CDG) and Brussels

High-speed rail (HSR): Partner or competitor ?

5.2. "Intermodality" at airports and the role of medium-sized airports

As (high-speed) rail and passenger air transport do not only compete, but have a welcome complementary aspect, rail stations at airports provide the right interchange. High-speed rail is able to expand the catchment area of an airport land-side significantly, bearing in mind that time, not distance, is the key aspect of airport access.



rail link to airports: illustration of the extremes

Rail as common public transport access at major and medium-sized airports makes sense from a point of view of national economy.³¹ As a matter of fact, railway stations at airports account for a high volume of passenger traffic. The question is whether the balance of a cost-benefit analysis, including environmental aspects as well as safety, is positive or not. Subsequently, an overall analysis of the results has been carried out.

³¹ see next page results of cost-benefit analyses on rail stations at airports in Europe, Final report on Action COST-318, "Interactions between High-speed Rail and Air Passenger Transport", EUR 18163, Office for Official Publications of the European Communities, Luxemburg, 1998, ISBN 92-828-3674-6

High-speed rail (HSR): Partner or competitor ?

-16-

Given the European background that provides a wide scope of operating systems, as well as a range of technology applications (non-conventional automated system (VAL), classical and high-speed trains), a qualitative assessment (based on the quantitative results of cost-benefit analyses) is hereunder arranged to progress from the left to the right, according to 7 case studies represented as rail operation systems from airport to city-centre, up to long-distance (high-speed) :

Item	BRU	ORY	STR	GVA	ZRH	FRA	CDG
Airport:							
Medium-sized			X	X			
Major hub	X	X			X	X	X
Hub for	SN	AF			SR	LH	AF
Type of rail link at the airport:							
City-centre shuttle service	X			(X)			
Non-conventional to close suburban rail station		X					
Suburban rail system			X		X	X	X
Inter-city rail system	(X)			X	X	X	
High-speed rail system						(X)	X

X: effective at the time of study

(X): development in progress since the study was finished

Item	BRU	ORY	STR	GVA	ZRH	FRA	CDG2
Investment costs	-	-	-	-	-	-	-
Effects on rail operations	-	+	+	+	+	+	+
<i>Effects on rail transport</i>	-	-	-	+	+	+/-	+
& on other public transport	+	-	-	-	-	-	-
<i>Effects on public transport</i>	-	-	-	-	-	-	-
User benefits	+	-	+	+	+	+	+
Avoided external costs	+	+	+	+	+	+	+
Total	-	-	-	+/-	+	+	+

+ : positive results

- : negative results

+/- : balanced results

Taking into account the range of the discount rates applied, the results can be summed up as follows:

Effects on rail transport are positive as far as the operating results are concerned, Brussels (BRU) excepted. While including the investment costs of the new infrastructure, the results are negative for the first 3 cases (Brussels, Paris-Orly, Stuttgart) with rail shuttle service only. The results are positive for the other cases where direct rail network access is provided at the airport, except in Frankfurt where they are balanced, which might be due to the delayed operations of national rail services.

Effects on other public transport services (except at Brussels airport for particular reasons), as well as on public transport as a whole (all public transport companies at the airport, including taxi and parking operators), show negative values. A main reason is that other public transport modes loose transport demand (earnings) to rail, without saving costs, as they continue to be provided at the same level of service.

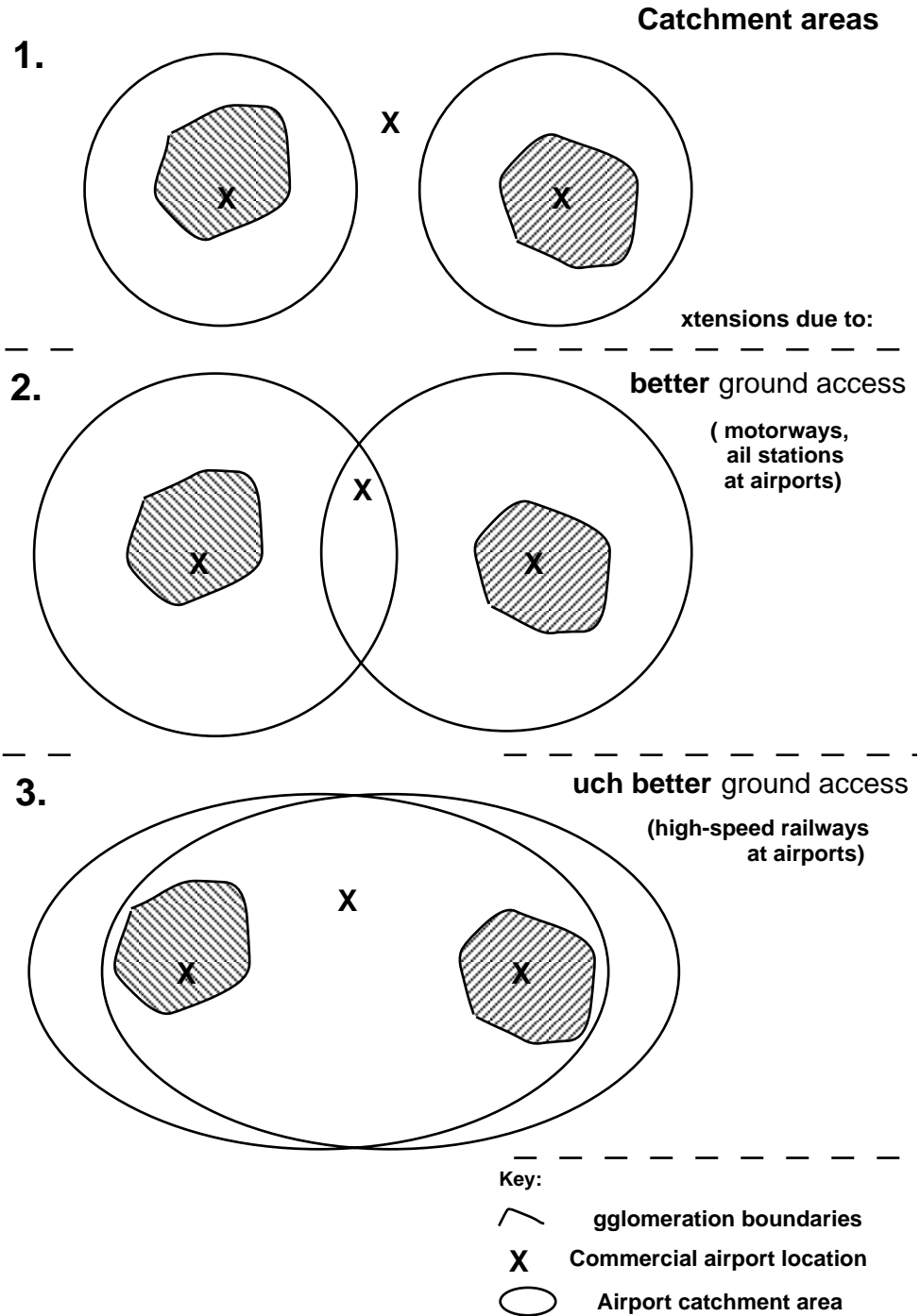
Users' benefits, at least those converted into monetary values (time and travel expense reductions) are positive, except for Paris-Orly (ORY) for particular reasons. Previous public transport users' surplus is more important than new public transport users' surplus. Time saving has a (much) more positive impact than cost savings. This is particularly the case at Paris-CDG2, where HSR (TGV) generates alone a high user benefit with 1,3 Mio passengers a year (1998).

Avoided external effects (air pollution, accidents) make, in line with the expected advantages of rail transport, welcome positive contributions, avoided accidents more so than avoided pollution (at current stage of knowledge).

Overall results: the outcome for the first three cases is **negative (shuttle services)**, the fourth is **balanced (rail network at medium-sized airport)** and the last 3 study cases show **positive overall results (rail network at major airports)**.

High-speed rail (HSR): Partner or competitor ?

Illustration of the expanding catchment area landside due to better airport ground access opportunities



High-speed rail (HSR): Partner or competitor ?

-18-

Long-haul air traffic, for which there is no actual alternative, is expected to increase anyway and hub-and-spoke system operations at large airports keep services improving for commercial reasons. Only few (large) airports have (much) space for enlargement. Adapting to the current locations is rather the rule.

Europe has a dense railway infrastructure and there is often a rail line operating in the neighbourhood of an airport, so a track diversion or the construction of a (short) dead-end line to an airport rail station is a real opportunity. Airport rail access is able to ease congestion and the threat of saturation at airports.

Rail stations at airports play a major role in the so-called "intermodality" in public transport, that is whenever parts of a single journey may be a sequence on both modes.

The impact of a rail station at the airport: public authorities, airport administrations, airlines, rail companies, air passengers and public transport users (employees) are expected to benefit from rail access at the airport.

Rail transport at airports may be seen as a welcome alternative to regional feeder flights without losing (much) connecting passengers, by airlines, due to the high operating costs, and by the airport administrations, in order to free (much needed) landing and departure slots at peak (and congested) traffic times. Furthermore, rail transport is (much) less sensitive to delays than air transport.

Rail transport has a beneficial effect on environment protection at large. At airports it is boosting public transport as a whole and easing road traffic at and parking access. Rail transport at airports can be seen as a public transport feeder from locations where no feeder flight is operating, or even a regional airport exists.

High-speed rail stations at the airport are extending the ground access catchment area of the airport significantly.

The following types of high-speed train services in connection with air transport are actually operating:

- airport access by high-speed rail from the city-centre³²
- airport high-speed rail access from one agglomeration to another instead of regional feeder flights³³
- high-speed rail instead of air links between agglomerations³⁴
- high-speed rail link between airports³⁵

³² For instance between the city-centre of Oslo and the airport of Gardermoen located almost 50 km North of the city and reached in 19 minutes.

³³ For instance, between Paris-CDG airport and Brussels city-centre, Air France is leasing for connecting air passengers at CDG two 1st class coaches on each of the 5 TGV-"Thalys" departures a day (travel time: 1h15'). Between the Northern French of Lille and Paris-CDG there are even much more rail link per day (up to 16). Check-in is possible in Lille, at least for Air France passengers.

³⁴ For instance, between the agglomerations of Paris and Brussels there are no more flights (since spring 2001). TGVs-"Thalys" operate instead very successful city-centre to city-centre services at every (half-an-) hour.

High-speed rail (HSR): Partner or competitor ?

-19-

A good commercial integration of air/rail has still to be implemented network-wide³⁶.

- the role of medium-sized airports

Up-to-now the air transport industry has recovered from any crisis and made up the trend development of the former years. This is worth mentioning today.

EU-liberalisation, fierce competition, cost-cutting, major European airlines hubbing at their home base, expanding airport catchment areas by existing (high-speed) rail access at most of the major European airports, lead to air traffic congestion, whereas a number of other (medium-sized) airports are under-utilised. In the future, saturation of demand and fading trust through repeated and unpredictable delays in air transport could emerge.

Moreover, most of the European airports cannot be expanded due to encroaching urbanisation and noise and air pollution concerns.

³⁵ For instance, the TGV-Med high-speed track passes at the airport of Lyon-Satolas (known now under the name of "Saint-Exupéry"). There is also a rail station at the Paris-CDG2 airport terminal on the TGV by-pass line linking the 3 main TGV high-speed lines out of Paris. It seems there is no reason connecting at both airports simultaneously, at least for the time being. The number of them should be irrelevant, as there is for the time being only one service a day stopping at both airports on its way from the Mediterranean area to the North of Paris and v.-v. The fare structures in place speak against such a traffic.

³⁶ A promising experience is "Railaccess" providing integrated air ticket with rail links, in particular between British and Scandinavian cities.

Some reasons for a dragging commercial integration air/rail of airport rail access services can be observed as follows, even if improvements are under way:

- in the tariff structure in the airline industry. Air passenger on feeder flights may be carried at "no-fare", provided the connecting flight fly them far enough; for instance, Lugano- Zurich- New-York at the same fare than Zurich- New-York "only".
- on point-to-point links, where rail transport and airline competition prevails, supply is not tight and flight departures and a seat may be provided for connecting air passengers at almost no additional costs.
- for rail companies, connecting passengers served at "rock-bottom" fares are not interesting; for airlines, full-fare rail tickets are not interesting either. Thus, there is room for flexibility.
- if to a full-fare paying air passenger rail as connecting opportunity is offered, there may be a good chance, that he will next time accept a competing offer with a feeder flight.
- rail transport is still not seen as a quite reliable partner in terms of business to many people (in more diplomatic terms there may be "differences of culture"). In fact there were in the past a string of mishaps, such as on Lyon - Paris-CDG; former "Lufthansa Express" (not to confound with the new ICE services from the new high-speed rail station at Frankfurt Airport to Cologne for instance); "Alitalia" train Rome-airport - Florence; Basle main rail station - Zurich-airport.
- luggage check-in at common rail stations is not always passenger-friendly, such as the (abroad) most praised air passenger check-in at country-wide Swiss rail stations have to be made hours before train departure and are costing Sfr. 20 a piece of luggage !

High-speed rail (HSR): Partner or competitor ?

-20-

The idea arises that air passengers could shift to other, less crowded airports, at least those from and/or to regions where the catchment areas of several airports overlap and in particular when airport (high-speed) rail access is provided (see former figure).

The example of air passengers in Brussels getting their flights thanks to high-speed rail access at Paris-CDG instead of Brussels airport shows that the idea is working. This process has not been observed so far to medium-sized airports

The aims are taken at more balanced traffic volumes between airports according to their capacity reserves and at a new air passenger traffic assignment thanks to airport rail access.

Such a development could mean further relief at congested airports. Major airports could concentrate on their core business, such as (connecting) long-haul traffic, stay at their current locations, close to (or within) the agglomerations.

Medium-sized airports could play their advantages over large airports³⁷. They have an opportunity to encourage hub-by-pass flights, as some low-cost carriers are doing in the US or introducing in Europe.

- rail stations at airports: a better distribution of transport demand among airports.

As no data was available, the issue was therefore studied within Action COST-318³⁸ and according to an expert survey based on the "Delphi"-method³⁹

The experts' final statement is: Rail stations at airports could allow a better distribution of air passenger transport demand among airports, in particular from a major (hub) airport to other (medium-sized) airports, although this has not been the case up to now.

For further details, please order a copy of the Final report ISBN 92-828-3674-6 (**EUR 18163 – COST 318 - Interactions between High-Speed Rail and Air Passenger Transport**) at the Office for Official Publications of the European Communities, Luxembourg.

³⁷ among others, point-to-point intra-European flights, departure opportunities, less delays and stress, even shorter check-in time and walkways. Most of the elderly people (as wealthy air travel customers) like regional airports.

³⁸ IVT-ETHZ, Report no 114 "Do rail stations at airports allow a better distribution of air passenger transport demand among airports?", July 1997, and Final report on Action COST-318 (1998).

³⁹ A survey according to the "Delphi"-method may be adequate to dealing with issues whenever no data are available. It is based on a set of same questions being asked in several rounds. Before the next round each participant will have to read a resume on the average of the anonymous answers of the former round, in order to modify or confirm his previous statement, up to the round where no change of mind is noticeable.

High-speed rail (HSR): Partner or competitor ?

-21-

6. Conclusions

- Background

Working air infrastructures are operational world-wide and an air link can be suspended, re-routed or even terminated at a (very) short notice. Air transport is also very flexible in aircraft size and less depending on volumes of traffic to increase flight frequencies (according to market request). Hub-and-spoke systems operated by airlines at most of the large airports⁴⁰ will last for commercial reasons. They are located in Europe mostly at the home bases of (former) "national" carriers, which are main European business centres too. Efficient hub-and-spoke systems require (for business people) frequent flights and short connecting times with as many (feeder) flights as possible.

Many (and most of the European) airports cannot be expanded, due to environment issues at large and a new airport to build is an issue too. Adapting to the current locations is rather the rule. Air traffic concentration and congestion are therefore expected to last at large airports. Long-haul air transport, for which there is no true alternative, is expected to increase anyway. New large aircraft (A-380) are expected to impact first on inter-hub air traffic at large intercontinental airports⁴¹

In the future, fading trust through repeated and unpredictable delays in air transport could emerge.

- High-speed rail: Partner or competitor ?

- As a matter of fact: both. The rail network is both complementary and competitive to the airlines.
- Competitive aspects: Air travellers on some busy short-haul air links are transferring to challenging high-speed rail services.

Rail transport needs tracks for high-speed and high volumes of transport demand in order to challenge and be competitive with air transport on short-haul flights up to 3 to 4 hours on current high-speed rail levels. Air transport keeps the lead on a contrary term.

- Complementary aspects: Competition between high-speed rail and air transport may be seen complementary for governments and taxpayers whenever a (step-by-step) development of the national (and European) high-speed transport network is addressed.

However the complementary aspect is seen more usually as a partnership whenever parts of a single journey may be a sequence on both modes. In this case rail stations at airports play a major role in the so-called "inter-modality" in public transport. Many airports are becoming intermodal transport hubs.

Rail transport at airports may be seen as a welcome alternative to the high costs of feeder flights, while releasing landing and departure slots, a welcome issue on congested airports.

⁴⁰ but also at some small to medium-sized airports, like "Eurocross" of regional airline Crossair EuroAirport Basle-Mulhouse Freiburg, less than 100 km away from Zurich, home base of the former Swissair, within the hub-and-spoke system of the now defunct Qualiflyer Group

⁴¹ Significantly Singapore Airlines intend to fly its A-380 as from 2006 to cities such as New-York, Los Angeles, Sydney, Tokyo, Hong Kong, London.

High-speed rail (HSR): Partner or competitor ?

-22-

Moreover, rail transport at airports can be seen as a public transport feeder from locations where no feeder flight operates, or even a regional airport exists.

Last but not least, rail transport at airports is easing traffic at airport road (and parking) access. It has a beneficial effect on environment protection, makes sense in terms of public transport policy and from a point of view of national economy for large (and medium-sized) airports.

High-speed rail stations at the airport are expanding the ground access catchment area of an airport significantly, as already experienced at major airports.

This development could also be the case at (under-utilised) medium-sized airports and represents an opportunity. A better balance of air passenger demand among the existing airport infrastructure is thus thinkable, in particular from/to areas where catchment areas of two or more airports overlap.

It represents an opportunity for the accessibility and development of the (European) regions, where regional (medium-sized) airports are located⁴². The challenge will be to keep in touch with environment protection and economic issues.

High-speed tracks are (depending on topography and environment protection measures) expensive to build. Therefore, high (and bundled) traffic volumes are needed to cover investment and operating costs, as well as frequent train departure opportunities for travellers.

A good commercial air/rail integration has still to be implemented or improved network-wide.

- Outlook

Attached is a map on new high-speed tracks in service in Europe in 2005. Some of them have just been put into service (TGV-Med); the construction of others should be about to finish (AVE Madrid-Barcelona; ICE Cologne-Frankfurt city-centre and airport) or has just started (TGV-Est). There is no doubt that the step-by-step network programs in Europe will progress, even if it is delayed at some parts. Connected HSR-lines within Europe are to produce welcome network effects.

Whether this trend will be followed elsewhere in the world is hard to say, but it is expected of course to be easier in traditionally rail-friendly countries.

The competitive aspect of HSR is underlined in Asia (Korea, Taiwan) for the main lines. A project based on magnetic levitation (something like "very high-speed rail") is under study in Japan to double the current "Shinkansen" HSR services.

A rail up-grade reaching high-speed level is taking place in the US Northeastern traffic corridor. The project of HSR lines in Texas linking (part-bundled) the 3 to 4 main cities failed to materialise, as did the idea of linking a new intercontinental airport for California with a HSR line between the San Francisco and Los Angeles areas.

IVT-ETHZ, 20/02/2002.

⁴² and are even still without (high-speed) rail access at the airport being praised by the emerging European low-cost carriers