

INTERMODALITY FROM A PASSENGER PERSPECTIVE

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Abstract

Air and rail are not necessarily competing modes of transport. The complementary capabilities and characteristics of these two modes together can satisfy the principal requirements of the passenger transportation market. The objective of this study is to demonstrate the necessity and importance of High-Speed Train inter-modal connections between European airports. In particular it will focus on how passenger needs are addressed by inter-modal air-rail links. There are numerous advantages to this proposal, principally that it releases runway and ATC resources, offers immediate relief to congestion, reduces negative environmental impacts, and finally improves ground access to airports. "Inter-modality from a passenger perspective" investigates how to make inter-modality work by satisfying passenger needs, so that the passengers behaviour can be used to help to improve airport capacity problems i.e. use of High Speed Train links instead of short haul flights could release ATM and airport capacity for users that have no alternative transport. Passenger perspective is the key element; it is rather impossible to develop a well-organised and satisfactory intermodal interchange node with efficient baggage handling logistics and integrated ticketing if there is no passenger feedback.

1 Transport in Europe

1.1 Air traffic

Passengers are requesting fast, efficient and in many cases, environmentally friendly transport connections. Considering the recent situation in aviation, this requirement is very hard to fulfill, especially because of rising delays and congested airspace and airports. In 2002 the traffic in Europe decreased by 1.9% instead of the assumed increase of 5.3%. At the same time the average delay per flight was lower at 2.5 minutes than the 3.2 minutes forecast, In 2003 the traffic increased by 2.3% showing a fast recovery fostering predictions of a 4% traffic increase during 2004 [1].

ATFM delays are caused by regulations to protect either airports or en-route sectors from traffic overload. The contribution of the airports to the total delay, which has been around 22% during the previous 5 years, increased significantly in 2002 to 34% and further increased in 2003 to 46%. Also 66% of airport derived ATFM delays were caused by only 8 European airports (Frankfurt, Rome, Paris, London, Milan, Zurich, Amsterdam and Barcelona), yet these 8 airports handle only 19% of European traffic [1]. Based on these figures airport congestion is seen as a mounting problem and is already a limiting factor at many airports. Many of the international hubs are operating at their maximum throughput; some have already reached their operating limits as prescribed by physical and as well political and

environmental constraints. The use of such airports is heavily regulated and future traffic distribution patterns are likely to generate congestion at airports that currently do not experience capacity problems.

The European Union has undergone significant changes with the accession of ten new member states, bringing the population to approximately 500 million. The accession of these ten states to the EU will vastly enhance the potential mobility of their citizens, offering both new employment and leisure possibilities. As a consequence, significant regional growth in air transport demand can be expected shifting the main traffic flow from north-south dominated to a more east-west oriented pattern. Central and Eastern European airports might experience capacity shortfall for the very first time since most of the airports are not ready for dramatic traffic increase.

Travel distances in Europe are such that more than 50 % of European flights are of less than 370 N.M., a statistic heavily influenced by airlines' use of a hub and spoke operation. European airlines are operating fragmented networks. 10% of the city-pairs in Europe represent 50% of the air traffic.

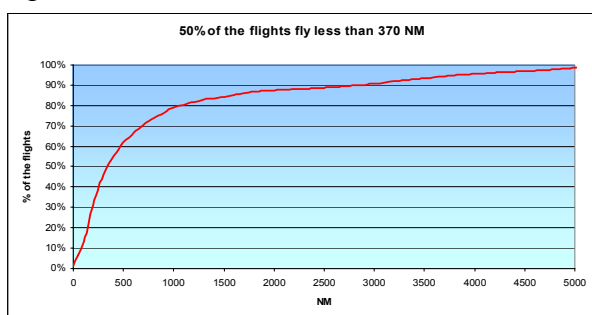


Figure1. Short-haul flights in Europe
Source: EEC, NCD data 2004

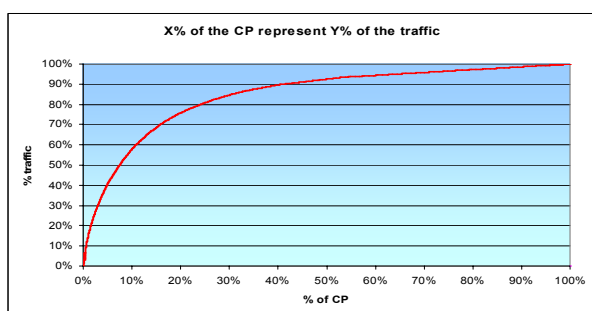


Figure2. City-pairs in Europe
Source: EEC, NCD data 2004

1.2 Hub airports

For many significant city pairs, transfer via a hub incurs a large time penalty. Replacement of direct flights by indirect flights via hub airports has resulted in a reduction in the average size of aircraft, because airlines prefer to run more frequent flights rather than have a more limited schedule using larger aircraft. Unfortunately, not only does this cause congestion on the ground; it also means that the task of controlling all the aircraft trying to use a limited amount of space becomes more complex. As air traffic is concentrated at hub airports, constraints arise such as long walking distances [2]. Passengers must wait at large hub airports for the connecting flight generally longer than it would be necessary in case of point-to-point transport, since the flight co-ordination is less efficient and minimum connecting time is higher, especially at main hubs like Paris CDG and London Heathrow. Large hubs have longer waiting times than the smaller ones (Frankfurt Main, Amsterdam Schiphol), even though one would expect shorter waiting times given the higher frequencies of services [3].

If air traffic evolves along the lines of recent predictions and the European Union accession results in significant air traffic growth operating under conditions of limited airport and airspace capacity while airlines' maintain a hub & spoke way of operating then soon the European air traffic management system will become an extremely saturated network facing congestion problems as never experienced before.

1.3 Passenger satisfaction

The central research theme of the thesis '*Inter-modality from passenger perspective*' investigates mutual satisfaction of two sets of needs – *how to make air-rail inter-modality work towards passenger satisfaction, so passengers can assist in releasing constrained airport and ATM capacity by using High Speed Train instead of short haul flights*. A shift in passenger movement from air to rail will ease the congestion problems in the air transport industry (which are expected to intensify). It can

release ATC and runway resources, have a positive environmental impact, allow the growth of airlines and airports (in passenger numbers) and bring to the rail industry the standard and skills developed in the airline industry, as well as other benefits. But most of all it will allow more passengers to reach their destinations, without facing difficult congestion constraints. Many questions in particular related to passenger perspective of intermodal transport remained unresolved.

2 High-speed trains in Europe

The development of high-speed train services has been seen by many as a forward looking objective of European transport policy. High Speed Train (HST) is the only mode of transport with a commercial speed that makes it possible to compete with air services on short haul routes in terms of journey time. It is important to remember that, almost regardless of any other advantages in shifting traffic from air to rail, it is the travel time feature that will determine the scale of any likely passenger shift. HST is not only increasing its operating speed but as well rapidly spreading its infrastructure all over Europe.

At the moment in Europe there are 3039 km's of high-speed lines in operation, 2556 km's under construction and another 1736 km's projected. If construction continues as projected there will be up to 10 000 km's of high-speed and upgraded lines in Europe by 2020. At the moment there are 9 countries in Europe who operate HST services (Belgium, Denmark, France, Germany, Italy, The Netherlands, Spain, Sweden and UK) with maximum speed of up to 350 km/h [4].

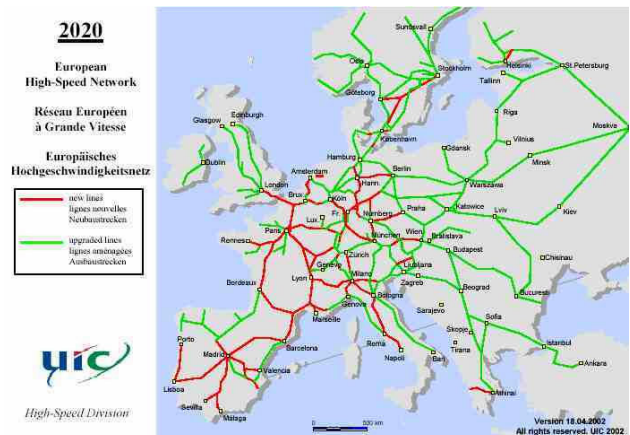


Figure3. HST infrastructure in 2020

Source: International Union of Railways

Based on experience from the European transport network the substitution of short haul flights by high-speed train services is not only a feasible solution but is often the airlines preferred way of operating. Instead of providing flight services on low or non-profitable routes airlines can orientate their market to more profitable long haul flights.

3 Passenger perspective of traveling

3.1 “Wasted” times

In the case of air travel passengers spend at least 3 hours in traveling to the airport, waiting at the airport and checking-in. Traveling by rail the time spent reduces to 1 hour 10 min. Airports are moving further and further from the cities they serve, a reflection that airports are not good neighbors, with noise and pollution being among the most significant problems. But the move away from city center's brings more problems – notably that of access. Different cities have different public transport and road networks. The time needed to reach an airport can be anywhere between 40 to 120 min in extreme cases (Paris CDG). For a particular city pair, even if the time spent on a train is much longer than the time spent actually in the air, due to the difference in wait and access times there is a threshold distance where the total journey time is shorter if the journey is undertaken by rail [5].

3.2 Modal shift – but up to what distance?

The journey duration of each transport mode indicates that high-speed trains could replace flights of up to 750 km's [5]. Although this distance is considered to be short-haul in the aviation business, in Europe the catchment area of 750 km's can connect significant origin destination pairs as seen below. Out of the 20 busiest routes in Europe, 9 are above 1000 km, 3 routes are between 800-900 km and 8 are less than 800 km. In theory high-speed train can replace 40% of the 20 busiest routes. For passengers that are less cautious about time the percentage rises to 55%. Examples show that HST competes with air services on routes of 300-600 km distance. Naturally the shift to rail by passengers decreases as distance grows. Most studies talk about distance from 500 to 800 km [3], [4], [6], [7], [8], very much depending on passengers' sensitivity to different travel factors. However there is more to a journey than a simple equation of time, distance and speed. There is baggage to be transferred, tickets to be exchanged; quality of interconnection points, there is passenger comfort, safety & security and many other factors, becoming crucial deciding factors when it comes to passengers' choice of travel mode.

4.1 Research focus

Three different types of relationship can be identified in Europe between airlines and railway undertakings. First, there is competition between the modes on the same route, example of the Paris–Lyon connection, where the TGV is in competition with Air France and other airlines. Secondly, there are complementarities between modes, the rail services complement the air services by offering a connection from city airport to the city centre, it is also called feeder hub service and a good example is Stockholm Arlanda. The third type of relationship can be described as 'co-operation' where the rail services replace previous air services on short haul between city pairs. However even though the second example is an important feature in Europe it must be clear that in view of the need to concentrate on the specifics of air/rail competitive intermodality it is crucial to concentrate on issues concerned

with high-speed train connections between major cities, and long distance access to/from airports by rail. Initially this study will not consider "short distance" city centre to airport access rail services. There is a rather different set of perspectives and market factors tend to point towards a "modal split" of road/rail rather than rail/air. A key reason for this distinction can be understood by considering the effect of a new high-speed train access between Paris and CDG. This is in itself unlikely to have any significant impact on air traffic there will be no shift from air to rail, whereas a HSR link from Marseille to Paris or CDG, for example, has a significant impact on air travel demand because of the resultant shift in demand from air to rail. However, the effect of intermodality shifts on air traffic is not obvious. Most studies implicitly consider that airlines will co-operate with railway operators, however some airlines might decide to maintain their short-haul services and become a HST competitor by increasing flight services operated by smaller aircraft. Such a strategy might result in more aircraft flying over Europe with fewer seats on-board, increasing controllers' workload and causing en-route and airport congestion.

4.2 Objectives

One of the objectives of the research is to gain a sound knowledge of passenger requirements, determine the most important travel attributes related to intermodal transport and assign an importance to or rank each attribute. A general unknown in the field of intermodality is passenger behavior. We have undertaken a collection of first hand information from passengers traveling on board high-speed trains in order to better understand passengers' perception of the potential for modal change and their main requirements.

We plan several simulations to obtain a forecast of passengers' tendency to shift to different transport modes considering infrastructure network, in order to evaluate the potential air traffic reduction between certain city-pairs as a result of a modal shift. Intermodal passengers will help us to specify the most important

constraints of intermodal transport, point out the differences between providers' vision and user requirements. The main objective is to forecast the impact of intermodal transport on air traffic, considering passenger requirements, high-speed train infrastructure and transport operators' vision, as well impact of intermodal transport on airport capacity and airport development.

4.3 Understanding travel preference rules

Individuals choose to travel by a mode of transport that offers a preferred bundle of levels of attributes which are important in making the choice between available alternative transport modes. In determining travel preference rules, individuals implicitly attach weights to a set of attributes that influence their choice, and make a choice based on the available set. The challenge is to identify these weights and in so doing obtain knowledge of what attributes drive an individual's choice. An attribute with a very low weight would be unimportant. To complete the set of items needed to derive a demand function a questionnaire was designed to identify the homogeneity of passengers; main passenger groups and major travel attributes that most passengers find crucial when deciding between air and rail transport.

4.4 Thalys & Eurostar

The aim of the questionnaire was to address passengers exposed to air/rail competition, i.e. where a choice exists to undertake a journey by either high-speed train or airplane.

The only way to collect a significant number of responses was to distribute the questionnaires on board high-speed trains. This method of approach to respondents ensured a high response rate, accurate sampling and a minimum of interviewer bias, while providing necessary background explanations (but not the interpretation of questions) and giving the benefit of a degree of personal contact. Two main railway operators were contacted during an early stage of the questionnaire design, Thalys International in Brussels and Eurostar in London. Two questionnaire versions have been

designed; one dedicated to leisure the other to business passengers. The response rate was around 70% for Thalys and slightly higher for Eurostar. 19% of the questionnaires were filled only partially and not valid for analyses. After eliminating incomplete and incorrect responses we have collected 260 valid questionnaires from Thalys passengers (Paris-Amsterdam, Amsterdam-Paris) and 276 valid questionnaires from Eurostar passengers (Paris-London, London-Paris).

5 Preliminary results (lessons learned)

According to analyses undertaken before [5] we have assumed that the most important travel attributes that influence passenger choice of air and rail were

- ticket price
- travel time
- access to airport or station
- schedule & frequency
- punctuality & reliability
- on-board comfort
- luggage handling

For more detailed analyses we have compared several categories of passengers, business with leisure passengers, frequent with not frequent passengers, genders and different nationalities. According to responses considering the entire sample population there are three major categories of importance that affect choice of transport mode. The first category of attributes that more than 60% of the population assigned as very important were; *ticket price, travel time, access to the airport or station*, The second category of attributes with certain significance were; *comfort on-board, schedule & frequency and walking & waiting time* and the third category of attributes that proved to have limited impact on choice between travel modes were; *on-board services and luggage handling*.

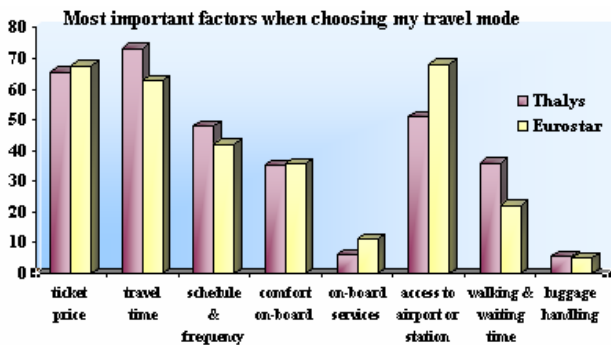


Figure4. The most important travel factors

There is a significant difference in travel factor preferences when comparing business with leisure or frequent with not frequent passengers (more than 87% of the frequent travelers were traveling for business). For passengers traveling only on few occasions a year *price* is a very important factor, as opposed to frequent travelers that assign more importance to *time*, *access to station* and *comfort on-board*.

Concerning travel preferences between genders the results resemble the difference between frequent and not frequent passengers. Women find price more important than men, they are ready to trade a reasonable ticket for a longer journey and slightly less comfort.

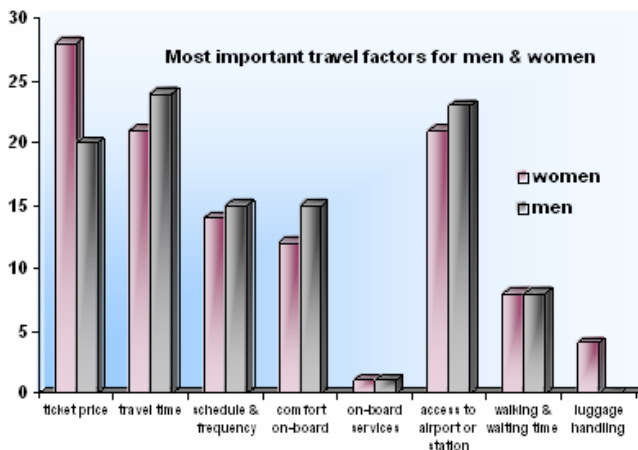


Figure4. Differences between men and women

A similar feature is identified comparing English and French customers, however in this case the difference in sensitivity of the ticket price is much more significant than in previous examples.

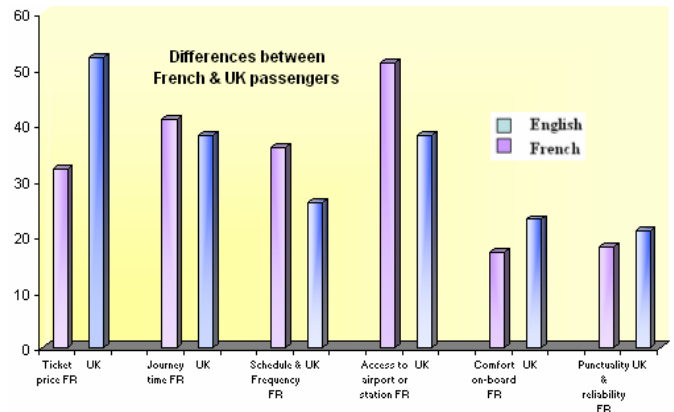


Figure5. Differences between French and English passengers

The questionnaire has revealed many interesting findings, for example only 7% of respondents would be willing to pay more for a train ticket than for the flight ticket, what might prove to be a burden especially in case of Eurostar where the rail ticket is often more expensive than air ticket. 64% travelers find connection issues very important and the same percentages of travelers are used to waiting at airports longer than 1 hour before the actual flight. Opposed to that 55% of respondents arrive at the train station less than ½ hour before the train departure and as much as 66% base their choice of transport mode on total travel time. Only 16% would be willing to pay extra charges if luggage was through checked at the train station before their journey (service exists in Germany) and 34% strongly denies willingness to spend money for luggage check-in at a railway station (service exists at Leipzig-Hale airport). 21% of respondents would pay an extra charge for luggage to be delivered to their domicile, after they conducted their journey.

In case of ‘not frequent’ travelers ticket price is the most important attribute and significantly influences passenger modal choice more than in the case of frequent travelers. One would think that frequent travelers should be more sensitive to price since they spend a larger total budget on traveling than passengers traveling only on several occasions. For frequent travelers it is the schedule & frequency and on-board comfort that decide their inclination towards certain mode. Luggage handling seems to be less important than it was assumed at the beginning of the

survey, however this characteristic might apply only to rail passengers. Airline passengers might be choosing air travel exactly for the purpose of the luggage transfer services offered by most of the airlines. These questions will be soon answered after undertaking the same questionnaire with airline passengers; most certainly it's inevitable to examine airline passengers' preferences in order to compare both categories of customers.

Conclusion (and the way to go)

In Europe 10% of the city pairs represent as much as 50% of the traffic. If high-speed train infrastructure continues to develop most of those, same city-pairs will offer fast train connections from city centers or airports.

To simulate a European transport network and possible modal split we will need to take into account passenger behavior, existing and forecasted high-speed train infrastructure and among many other things the situation in air traffic in relation to congested airspace and airports. Based on recent examples in Europe we assume that there is a high possibility in achieving significant en-route and airport capacity improvements, while satisfying passengers needs at the same time. Thanks to intermodal transport some congested hub airports will be able to free as much as 10% of their runway capacity. In Spain, the replacement of Madrid/Barcelona and Valence/Barcelona services by HST could free up to 19% of the runway slots at Barcelona.

However the future evolution of integrated transport networks will most likely depend on the airlines willingness to co-operate with railway operators. Examples show that some airlines will prefer to maintain air services on certain city-pairs (Madrid-Barcelona with 64 flights a day) while competing head to head with railway operators. In order to keep up with competition and attract more passengers airlines will need to operate smaller aircraft with higher frequency; resulting in more aircraft flying in the European sky each with less seats on-board. Needless to say this kind of outcome will put

more pressure on air traffic services and create additional problems in the future.

In order to better understand the impact of intermodal transport on air traffic different scenarios will have to be considered. The success of intermodality and hopefully the possibility of easing congestion will depend on passengers' willingness to experience new way of traveling, operators' willingness to co-operate and most of all the influence of low-cost airlines and their future evolution.

References

- [1] EUROCONTROL PRU Performance Review Report 7, Performance Review Commission 2004
- [2] European Transport Policy 2001, *Controlling the growth in air transport*
- [3] Rietveld, P. & Brons, M. (2001). *Quality of hub& spoke networks; the effect of timetable co-ordination on waiting time and rescheduling time*. Journal of Air Transport Management 7 (2001), p. 241-249
- [4] All about high-speed, *Definition of High Speed Train* (2002), <http://www.uic.asso.fr>
- [5] Cokasova, A., Final Thesis, *Modeling of Air Rail Intermodality from Passenger Perspective*, April 2003, University of Zilina & EEC.
- [6] Moore, P. (2001). *High speed rail as a solution to airport congestion*. Sierra Club - Loma Prieta Transportation Committee, California
- [7] European Commission -European Cooperation in the field of Scientific and Technical Research (1996). *Cost 308. Interaction between High Speed and Air passenger Transport*. April
- [8] Ellwanger, G. (2002). Successes for high-speed rail. Rail International, UIC September 2002, Brussels