

# **Potential and Limitations of Air-rail Links – A General Overview**

**Andreas Eichinger und Andreas Knorr**

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Hrsg. von  
Andreas Knorr, Alfons Lemper, Axel Sell, Karl Wohlmuth

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Bezug: **IWIM** - Institut für Weltwirtschaft  
und Internationales Management  
Universität Bremen  
Fachbereich Wirtschaftswissenschaft  
Postfach 33 04 40  
D- 28334 Bremen  
Telefon: 04 21 / 2 18 - 34 29  
Telefax: 04 21 / 2 18 - 45 50  
E-mail: [iwim@uni-bremen.de](mailto:iwim@uni-bremen.de)  
Homepage: <http://www.iwim.uni-bremen.de>

## Abstract

Airports have always been multi-modal interchange nodes but their role dramatically changed in the course of air transport liberalisation. The air transport sector witnessed an average annual growth of 7.9% within the European Union between 1993 and 2000.<sup>1</sup> As more and more airports are congested, airport operators and airlines are increasingly turning their attention to connecting rail links in a quest to relieve airside congestion. There are numerous examples where high-speed rail connections have substituted flight connections. Furthermore, the construction of ‘feeder railways’ appears to be en vogue and, in most cases, highly successful. More than 70 airports world-wide now have some form of air-rail link. With regard to air cargo, a different kind of picture has to be painted. Freight air-rail links are scarce and rarely successful due to the different characteristics of the two modes of transport. Trucking still seems to be the preferred option for onward shipping of freight.

This paper examines the strengths and limitations of the different forms of air-rail links. In addition to this, the authors classify air-rail links and their underlying critical success factors. The paper also examines the consequences of the introduction of air-rail links with particular reference to short-haul links, regional airlines, and airports. Furthermore, the possible use of intercity air-rail links by full-service carriers as a means to counter the onslaught of low-cost carriers is discussed.

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<sup>1</sup> Cf. Tronet (2003), p. 2.

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# 1 Introduction

Airports have always been multi-modal interchange nodes but their role has dramatically changed in the course of air transport liberalisation. The air transport sector witnessed an average annual growth of 7.9 % within the European Union between 1993 and 2000.<sup>2</sup> As more and more airports are congested, airport operators and airlines are increasingly turning their attention to connecting rail links in a quest to relieve airside congestion, which negatively affects the quality of service, especially in terms of total travel time. Therefore, air-rail links can be regarded as a crucial tool for managing long-term airport capacity. There are numerous examples where high-speed rail connections have substituted flight connections. However, promoting air-rail links can also be an instrument for decreasing airport ground access congestion and to improve the ground access time reliability. Indeed, the construction of ‘feeder railways’ appears to be en vogue and, in most cases, has been highly successful. More than 70 airports world-wide now have some form of air-rail link, and around 140 more are in the planning process.<sup>3</sup> With regard to air cargo, a completely different kind of picture emerges. Freight air-rail links are scarce and rarely successful due to the different characteristics of the two modes of transport. Trucking still seems to be the preferred option for onward shipping of freight.

This paper examines the strengths and limitations of the different forms of air-rail links. In addition to this, the authors classify air-rail links and their underlying critical success factors. The paper also examines the consequences of the introduction of air-rail links with particular reference to short-haul links, regional airlines, and airports. Furthermore, the possible use of air-rail links by full-service carriers as a means to fend off competition from low-cost carriers is analysed.

## 2 Classification of air-rail links

Rail links are one of the several modes of ground access. Air-rail links are, therefore, defined as a fixed-route rail service which operates to stops or terminals at or near an airport on a scheduled basis, i.e. that airline passengers may use them prior to or after flights. Various types of air-rail links, such as tramways, light rail, underground and heavy rail connections, are currently operated world-wide.<sup>4</sup> Hence, the type of trains used also differs considerably. This is because air-rail links can, first of all, be classified by their intended purpose and can either be built to connect passenger or freight transport. Furthermore, passenger air-rail links can be classified according to the quality of the rail interconnection, i.e. the rail link may merely provide local connections or long-distance connections as well. Long-distance connections can either be provided by regular long-distance trains or high-speed trains. Local connections, by contrast, can be provided by regular local trains, underground trains or tramway and are often an extension from existing local rail

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<sup>2</sup> Tronet (2003), p. 2.

<sup>3</sup> Doke/Moxon (2001), p. 25.

<sup>4</sup> For a detailed overview of air-rail links in Germany see Bernhardt (2000).

service. If air-rail links are classified according to the aforementioned characteristics, the following list of European airport rail links can be compiled:

**Table 1:** Airport rail links within EU-15

Type of air-rail link	No. of airports	Airports
<b>Long-distance connections</b>		
<i>High speed trains</i>	6	Stockholm (ARN), Paris-Charles de Gaulle (CDG), Cologne-Bonn (CGN), Düsseldorf (DUS), Frankfurt (FRA), Lyon (LYS)
<i>Regular long distance trains</i>	7	Amsterdam (AMS), Birmingham (BHX), Copenhagen (CPH), Leipzig (LEJ), Manchester (MAN), Southampton (SOU), Berlin-Schönefeld (SXF)
<b>Regional connections/local connections</b>		
<i>Local trains</i>	19	Malaga (AGP), Barcelona (BCN), Belfast City (BHD), Brussels (BRU), Dresden (DRS), Rome Fiumicino (FCO), Friedrichshafen (FDH), Graz (GRZ), Hanover (HAJ), London-Gatwick (LGW), London-Heathrow (LHR), London-Luton (LTN), Munich (MUC), Milano-Malpensa (MXP), Glasgow-Prestwick (PIK), Pisa (PSA), London-Stanstead (STN), Stuttgart (STR), Vienna (VIE)
<i>Underground trains</i>	5	Paris-Orly (ORY), London-Heathrow (LHR), Madrid-Barajas (MAD), Newcastle (NCL), Nuremberg (NUE),
<i>Light-rail transit/tramways</i>	2	Bremen (BRE), Essen-Mühlheim (ESS)
<b>Under construction</b>	1	London-City (LCY) <sup>5</sup>

Source: European Commission (2003), p. 3.2.4, supplemented.

A study by Mandle et al. (2000) confirmed that the proportion of passengers using public transport varies depending on the airport's operational context, traffic type, traffic volume, airport design and also on the transport link characteristics. Hence, different airports require different kinds of air-rail links. It is noteworthy in this context, however, that airports with air-rail links, which provide high speed or long-distance connections, usually also provide local or regional connections, with the exception of Lyon-Saint Exupéry, which is currently only served by the French high speed train TGV. The Air Transport Action Group (ATAG) gives the following indicators of current best practice in choosing the appropriate air-rail link:

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<sup>5</sup> A branch of the Docklands Light Rail is currently under construction to London's City airport and is expected to be completed in late 2005.

**Table 2:** Indicators of best practice

	<b>TRAM</b>	<b>LIGHT RAIL</b>	<b>METRO</b>	<b>SUBURBAN</b>
Passengers/hour (000)	2-5	5-20	15-30	>25
Right of way	shared or dedicated	largely dedicated	dedicated	dedicated
Station spacing (m)	500-1,000	750-1,500	1,000-2,000	>2,000
Signalling	on sight	train protection	automated block	automated block

Source: Air Transport Action Group (ATAG) (1998), p. 96.

### 3 Critical success-factors of air-rail links

#### 3.1 Passenger services

Airports often generate a considerable volume of ground transport (passengers, employees and meeters/greeters), so that the construction of air-rail links will be profitable if a certain critical mass is reached. The demand of airport employees for reliable ground access is often overlooked but can reach significant volumes. Humphreys/Ison (2003) estimate that commuters, who work at the airport, represent up to one third of total ground traffic flows to and from commercial airports. However, they show that this proportion usually is higher at hub airports and other airline bases which require the presence of a large number of air transport-related businesses. These include including maintenance and catering facilities, air traffic control, the fire brigade, and groundhandlers as well as travel agencies, hotels, shopping outlets, rental car agencies, conference rooms etc.<sup>6</sup>

Furthermore, it is important to note that from the passengers' perspectives, the flight segment of their journeys itself is only one leg of the itinerary as a whole. This means that passengers must use other modes of transport to get to the airport in the first place and to travel on to their final destination. As a result, they have a modal choice for these feeder portions of their trips. Therefore, rail links not only have to meet the requirements and needs of potential passengers better than alternative ground transport modes, in particular local buses, taxis and private cars, in order to be able to gain a significant market share. Even more important, potential passengers also have to be aware of their modal options, i.e. information about the air-rail link is of paramount importance as is the general availability of tickets.

The single most important determinants of demand for passenger rail services are price, journey time, reliability and frequency, with rail services competing in any of these dimensions with competing modes of transport. However, with respect to intercity air-rail links, two more determinants come into play: their capacity to provide 'seamless travel', i.e.

<sup>6</sup> Cf. Humphreys/Ison (2003), p. 3.



a high level of integration into complex intermodal itineraries, and the availability of incentives such as frequent flyer miles.<sup>7</sup>

### 3.1.1 Price, journey time and frequency

The preferences and requirements of different groups of (actual as well as potential) air-rail link users differ considerably with respect to their willingness to pay and the service quality they desire. To begin with, it is generally accepted that business travellers possess a significantly lower price elasticity than leisure travellers (tourists or of the VFR – visiting friends or relatives – kind), especially if the former are on company expenses. By contrast, business demand usually shows a higher time sensitivity than leisure demand as well as a greater preference for more frequent and more rapid service so as to reduce overall trip time.<sup>8</sup> To meet this demand effectively, it is essential to reduce the number of intermediary stops and to locate stations of dedicated ‘feeder railways’ as close to innercity business centers as possible. Hence, a trade-off between stopping rail services with a naturally larger catchment area and non-stop rail services with reduced travel time exists. Considering the frequency of rail services Mandle et al. (2003) estimate that waiting times of no more than ten minutes during peak hours are preferred by a majority of potential rail users.<sup>9</sup>

Airport employees will only use the air-rail links as an alternative if rail services are also provided at the start and end of their working shifts.<sup>10</sup> Furthermore, compared to daily commuters, airline passengers are usually more time-sensitive and less cost-sensitive, tend to have more baggage, and use the transit system less often. Quite a few airline passengers are also more likely to use the system outside normal commuting hours in order to be able to both reach early morning departures and to return home after late night arrivals. Most operators of air-rail links in Continental Europe therefore provide alternative levels of service quality and/or comfort standards to cater for the different preferences and, hence, willingness to pay of business as opposed to leisure travellers. Some others, however, being influenced from the local culture – in case it is relatively egalitarian as for example in Scandinavia or Australia – abstain from introducing different classes.<sup>11</sup>

### 3.1.2 Reliability

Service reliability also plays a major role. Some operators of air-rail links offer reliability guarantees, e.g. if Heathrow Express trains are delayed by more than 15 minutes, the operator will refund the fare. Other operators, like e.g. Oslo’s Flytoget, even rebook customers on the next flight if they miss their flights due to their fault. However, a recent judgement of a German court, the Landgericht Essen (decision 13 S 142/02), is likely to undermine the attractiveness of the Rail & Fly offering, a special arrangement between Ger-

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<sup>7</sup> Cf. Cokasova (2003) and Vinois (2003).

<sup>8</sup> Cf. IATA (2003), p. 24.

<sup>9</sup> Cf. Mandle et al. (2003), p. 7.

<sup>10</sup> At London’s Heathrow airport 13.8 % of the employees use public transport to travel to work; 0.8 % use rail and 4.2 % underground; cf. BAA Heathrow (2003), p. 39.

<sup>11</sup> Cf. Air Transport Action Group (ATAG) (1998), pp. 32-4.

many's dominant intercity rail operator Deutsche Bahn AG and some airlines, which allows passengers to travel from any German railway station to their departure airport for a significantly discounted fare. The court ruled that a holder of a Rail & Fly ticket cannot claim compensation from neither the railway operator nor the airline if he misses a connecting flight due to a train's delay.

### 3.1.3 Seamless travel

If airlines intend to substitute intercity air-rail links for short-haul flights, connecting air-rail links should not only be offered on a codeshare basis and fully integrated into their reservation systems to lower passengers' transaction costs and to increase their awareness of the availability of those services. What is more, the full operational integration of air-rail links with other modes of transport has also be ensured. This includes a sufficient availability of parking space at non-airport rail stations, so that passengers can leave their car at the rail station for the duration of their trip. Even more important, at least for leisure travellers, intercity air-rail link users should be offered some form of early baggage check-in service, i.e. that check-in desks need to be set up at (major) railway stations or in the case of 'feeder railways' at every train stop. However, the provision of in- and outbound baggage transfer raises tricky security issues, and at the time of writing was only provided nation-wide in Switzerland.<sup>12</sup> For this very reason, according to a study by Mandle et al. (2003) airports with a high proportion of business travellers are more likely to attract rail users than those serving tourist or leisure destinations: Larger (family) groups are less likely to use rail links compared to passengers with little or no baggage. One could argue that the amount of baggage almost determines the airport access mode used by passengers.

What is more, the attractiveness of air-rail links is certainly inhibited when passengers have to transfer to a second mode of transport in order to reach their terminal because the railway station is not integrated into the terminal building. Even if the necessary shuttle service is provided free of charge, such as the bus transfer from Birmingham International rail station to the airport (BHX) or between Berlin's Schönefeld airport (SXF) and Berlin Schönefeld station, the willingness of passengers to use this kind of air-rail links is still very low. Only about ten per cent of BHX's passengers use the existing air-rail links prior to or after their flight.<sup>13</sup> Thus, the integration of rail into the airport's infrastructure is also very important, as is the time and distance passengers are required to travel between the rail station and their respective gate. Most dedicated air-rail links offer more than one station at larger connected airports, e.g. Stockholm's Arlanda Express as well as London's Heathrow Express each offer two stops to serve different terminals. Furthermore, integration of the air-rail link into a comprehensive rail network, which serves a large catchment area, enables it to serve a larger potential market and provides passengers with more travel opportunities. For example, in case of the TGV station at Paris Charles de Gaulle Airport approximately 40 % of its users were from nearby suburbs.<sup>14</sup>

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<sup>12</sup> In Japan, courier services that provide for baggage transfer to hotels and homes immediately after arrival have long been extremely popular among travellers.

<sup>13</sup> Figures for Berlin Schönefeld airport are not publicly available.

<sup>14</sup> Cf. Bory (1999), p. 28.

Finally, the proportion of airline passengers whose journey begins or ends in the city centre plays a significant role, especially in case of local ‘feeder railways’, for example Heathrow Express or Arlanda Express. In analysing this factor considerable differences can be noted, i.e. at some airports the proportion of airline passengers whose journey ends in the city centre is comparatively high, but at most airports relatively low. Thus, the area directly served by the local feeder rail link only represents a small percentage of the total airline passenger market.<sup>15</sup>

### 3.1.4 Integration into airline loyalty schemes

The attractiveness of intercity rail links can be substantially enhanced if airline passengers are eligible to earn frequent flyer miles on the rail portion of their journey. In Germany, Deutsche Bahn AG recently introduced a code-sharing agreement with American Airlines (AA), which enables AA passengers to book internal German ICE- and IC-connections from 15 German cities to Frankfurt airport under an AA-flight number. AA passengers who take part in AA’s frequent flyer loyalty scheme ‘AAdvantage’ will receive 250 miles for these segments. When Lufthansa, in cooperation with Deutsche Bahn, introduced a high-speed rail link between Stuttgart and their Frankfurt hub three years ago, passengers who switched from the plane to the train were rewarded with up to 4,000 frequent flyer miles one way, four times as many as they would have earned on the feeder flights.

## 3.2 Cargo services

Air cargo is usually perishable<sup>16</sup> or time-sensitive<sup>17</sup> and/or valuable<sup>18</sup>. General air cargo is concentrated in only a few hubs in Europe and the relatively low volumes of express cargo at other airports do not justify the investment in rail facilities. Furthermore, connecting hauls between airports and customers are very often only short distance hauls. However, the nature of this type of traffic fails to match the system-specific advantages of rail freight over other transport modes, which lie in bulk freight haulage over long distances.<sup>19</sup> Consequently, a lack of effective intermodal integration between air and rail freight is usually the case. Another major issue negatively affecting the commercial viability of freight air-rail links is that standard air freight containers do not fit on most traditional rail services. Therefore, standardisation of containers and cargo facilities at airports would be needed in order to enable the integration of air and rail freight. The use of modified rail containers rather than standard airline containers is sometimes suggested in order to overcome this issue.<sup>20</sup>

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<sup>15</sup> Cf. Mandle et al. (2003), p. 6.

<sup>16</sup> Such as e.g. foodstuffs and flowers.

<sup>17</sup> E.g. express documents and mail.

<sup>18</sup> Examples are electronics, photographic equipment, medical and pharmaceutical products, specialist machinery and telecommunications equipment.

<sup>19</sup> Cf. Aberle (2003), p. 18.

<sup>20</sup> Cf. Air Transport Action Group (ATAG) (1998), p. 11.

However, a few airports do indeed provide rail freight facilities and others are planning new rail freight lines, e.g. Leipzig/Halle airport in Germany. Historically, aviation fuel has often been the only rail freight to airports of economic relevance – being transported by rail or provided by pipelines from a nearby railhead, examples being Oslo Gardermoen (Norway) or Munich airport (Germany), where aviation fuel is brought in by rail.

## 4 Air and rail: competitors or complements?

The advent of high-speed rail travel in the past twenty years in Europe has so far had a significantly negative impact on the economics of some short-haul flights over a distance of up to around 600 kilometers.<sup>21</sup> For example, the introduction of the German ICE-services between Hanover and Frankfurt or the introduction of Eurostar-services between Paris, London and Brussels led to a substantial decline in passenger numbers for airlines on these routes.<sup>22</sup> Some city-pairs, such as Hanover-Berlin and Hanover-Nuremberg, were even completely abandoned by airlines.<sup>23</sup> And in France, which pioneered high-speed rail service in Europe in the late 1970ies, important city-pairs such as Paris-Lyon and Paris-Marseilles have been particularly affected. However, the full potential of high-speed trains as an airline competitor is as yet unclear. According to Lufthansa analyses, any air service within a time window of one hour can expect to experience fierce competition from high-speed trains, if the train trip does not take longer than two hours, the train fare is less than the flight's fare and the offered frequency at least the same.<sup>24</sup> Other studies point out that rail services are a competitive mode of transport over distances that may be covered in a maximum of three hours.<sup>25</sup>

This assessment, as well as the empirical evidence at hand so far, are owed to the fact that, albeit only for travel between city centers, rail services enjoy a considerable competitive (i.e. time) advantage, as main rail stations are, unlike most airports, generally located in the heart of the city. In other words, a time-consuming and costly transfer from an out-of-town airport to the final innercity destination of the journey is not needed. What is more, over short distances, aircraft use relatively more fuel than on longer flights, because a large share of fuel is consumed during take-off, i.e. the operation of short-haul flights usually is more expensive per route mile than of long-haul flights. Furthermore, landing fees as well as uncompetitive total trip times – including transfers to and from the airports, check-in time, security controls –, typically turn alternative transport modes into more attractive options.<sup>26</sup>

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<sup>21</sup> Cf. European Commission (1996) and Cokasova (2003), p. 14.

<sup>22</sup> The railway's share in the London-Brussels market increased from 24 % to 52 % between 1994 and 2001, and for London-Paris it has almost reached 65 % in the meantime. Cf. Doke/Moxon (2000), p. 27; Vinois (2003), p. 17.

<sup>23</sup> While beyond the scope of this paper, it is highly doubtful that this modal-split shift could have been accomplished without the massive state aid doled out by most European member-states to their (state-owned) railways to build and operate these mostly unprofitable links. For details see The Economist (2001) and European Regions Airlines Association (2001).

<sup>24</sup> Cf. Doke/Moxon (2000), p. 27.

<sup>25</sup> Cf. González-Savignat (2004), p. 103.

<sup>26</sup> Cf. Doke/Moxon (2000), p. 24.

Airlines, as a result, often do not offer direct point-to-point flights below 300 kilometers because their cost structure and the competitive advantages of the other land-based modes do not allow them to make a sufficient profit on very short routes. However, they do still offer feeder flights over this distance which are usually operated by their regional affiliates using small turboprop aircraft or regional jets, for passengers connecting to longer international or even intercontinental flights. In Germany a couple of years ago Lufthansa even introduced new feeder services into its second hub at Munich airport from Stuttgart as well as from Nuremberg despite competition from the railways. These services cover distances of around 160 kilometres – 100 miles respectively. However, besides a local train service to the city centre of Munich, there are no rail services to and from Munich airport; the nearest DBAG train station Freising is 15 kilometres away and only regional trains serve this station.

Therefore, at least at those airports which are directly connected to the intercity rail network, in principle closer cooperation, especially in the form of code-sharing arrangements, between airlines and railways might give rise to a win-win situation, because of the substantial network economies that could be achieved through this type of air-rail link. This is especially true in Europe, where both extensive inter-city and regional rail networks do exist and some of the main airports are already connected to them (see table 1 above). Examples for code-sharing agreements between a full-service network carrier and a national railway are the aforementioned code-sharing agreement between the German DBAG and AA and the so called AIRail Service between Frankfurt airport and Stuttgart and Cologne; further city-pairs are intended to be added. This rail service already replaced some Lufthansa flights which have been offered on these city-pairs before. Furthermore, this service – which is operationally based on Lufthansa exclusively using some waggons on DBAG's hourly rail services to both cities – has been fully integrated into Lufthansa's frequent flyer programme. It also allows passengers to check-in and -out at Cologne or Stuttgart, i.e. in this case in- and outbound baggage transfer for all Lufthansa destinations other than Tel Aviv is provided.<sup>27</sup> Price and quality differentiation is also applied – first and business class passengers travel first class and economy class passengers travel second class. Similar agreements have been concluded in other European countries, irrespective of the usually strong competition of the former national carrier with domestic railways.<sup>28</sup> The AIRail Service is based on a memorandum of understanding signed by Lufthansa and DBAG in July 1998 to transfer certain short-haul routes from air to rail as soon as new high-speed rail routes are in operation.

The code-sharing agreement between AA and the German DBAG is also a good example to show how airline-railway cooperation may intensify competition among the local incumbent airline and its foreign competitors as a result. AA's customers had to use other airlines – more often than not Lufthansa – or other modes of transport before the conclusion of the agreement with DBAG. Now AA is able to offer 'direct' and through-ticketed connections to 15 German cities from its German hub Frankfurt, although it does not provide any domestic flights in Germany – due to the lack of cabotage rights – or the EU (AA is a member of the oneworld-alliance which does not have a sizeable presence on the German

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<sup>27</sup> Cf. Railway Gazette International (2001), p. 227.

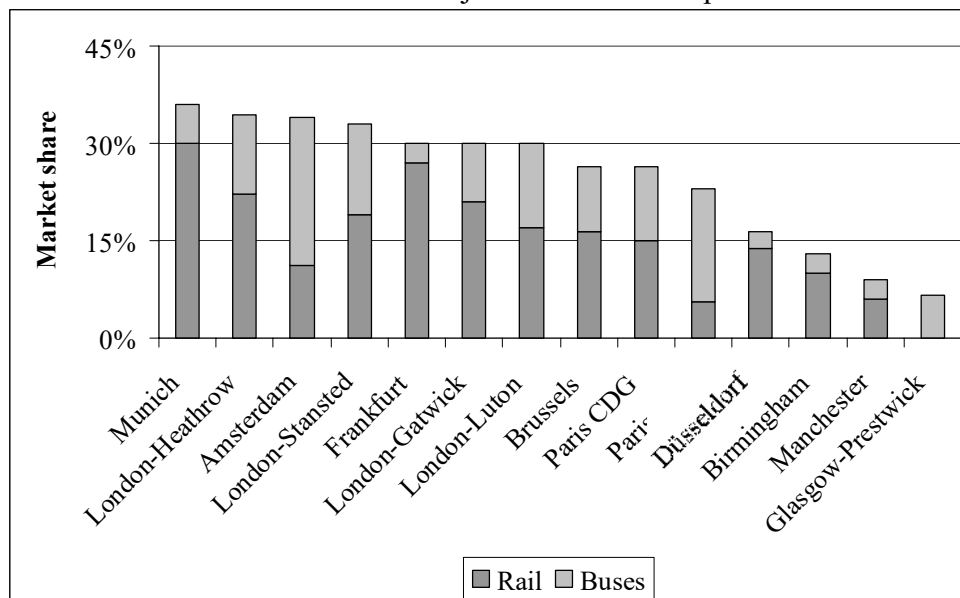
<sup>28</sup> Cf. Doke/Moxon (2000), p. 26.

market, but instead operates its principal European hubs in London, Madrid, Barcelona and Helsinki). Even if the concerned domestic market is largely closed to foreign airlines because of the still highly protectionist regulations governing international air transport, typically preventing them from servicing more than one or two airport in this market, their catchment areas and hence intramodal competition can be increased indirectly by concluding a code-sharing agreement with domestic railway companies.

What is more, competition among airports is also affected to a certain degree by the existence of air rail links to some of them, but not to others. In particular, as most regional airports have to do without them – local access lines ignored – the already dominant position of hub airports is likely to be reinforced.

Finally, according to a paper by Mandle et al. (2003) there appears to be a ceiling on the market for public transportation (incl. rail, bus, and shared-ride vans) at airports within the United States and Europe. They estimate that this ceiling averages out at 10 to 15 % in the case of airports within the United States and at about 35 % at European and Asian airports.<sup>29</sup> However, public transport market shares account for substantially more than 35 % at some airports, e.g. at Oslo’s Gardermoen airport.<sup>30</sup> The dominance of other modes of transport in case of smaller airports can be at least partially explained by a lack of critical mass in terms of traffic flows needed to justify the necessary high investments in air-rail links. The other reason is the lack of international or even intercontinental services from these smaller airports, which are often used for feeder services into larger hubs.

**Table 3:** Market share of rail and bus at major international airports



Source: Own compilation, based on information provided by airport management and airport websites.

<sup>29</sup> Cf. figure 3.

<sup>30</sup> Cf. Mandle et al. (2003), pp. 1, 8 and 15.

## 5 How air-rail links might enhance the competitiveness of network carriers vis-à-vis low cost airlines

With the rise of low-cost carriers, the airline industry is undergoing the most significant transformation in its entire history. Traditionally, airlines – with the exception of the US carriers and the European charter operators most of them state-owned and enjoying far-reaching monopoly protection due to restrictive ownership rules and bilateral air service agreements<sup>31</sup> – established a hub-and-spoke-model of air transport for all but a few high-density city-pairs. As a result, the majority of passengers in non-hub cities have traditionally been forced to change planes at least once on most itineraries and, as a result, to accept longer overall trip times. However, in return, passengers benefited from a choice of connections that would not have been economically viable from smaller airports. From the airlines' perspectives, the hub-and-spoke model usually implies a strong degree of cross-subsidization with the objective of maximizing the overall profitability of the network. Therefore, profitability of sole routes is not always of paramount importance. Consequently, the more profitable longer sectors cover the losses incurred on short-distance feeder flights.

Low-cost carriers by contrast, in general only provide point-to-point services. Although they also established some bases – such as London-Stansted and Frankfurt-Hahn in the case of Ryanair, or Cologne in case of Germanwings – they do not offer connecting flights to their passengers. Those customers who nevertheless do wish to change planes at one of these bases, do so at their own risk: Their baggage will not be checked through automatically to their final destination, i.e. passengers will have to reclaim it at the base after arrival and to check it in again for the next flight; they may also be denied boarding without compensation if their inbound flight is delayed. Most important, low-cost carriers do not maximize network profitability. By contrast, every single route is operated on a stand-alone basis – if it proves unprofitable it will be abandoned.

The sources of the low-cost carriers' significant cost advantages over traditional network carriers have meanwhile been discussed at some length in the literature.<sup>32</sup> Accordingly, low-cost airlines derive their cost advantage vis-à-vis network carriers from three highly interdependent sources: lower input costs plus simplified, and hence less costly, product and process design. To be more precise, on the cost side, the low cost carriers competitiveness largely results from much lower distribution costs (internet booking, paperless tickets), higher daily aircraft utilization, excellent staff productivity, fleet standardization, a one-class cabin, and a preference for uncongested and cheaper to serve secondary airports (which offer faster turnaround times as well as lower landing and passenger charges).

However, it should not be overlooked, that low cost carriers were also extremely successful in unbundling the typical airline product. Essentially, the ticket price includes only the basic transportation service, while frills – such as advance seat assignment, on-board meals

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<sup>31</sup> For details see Doganis (2002).

<sup>32</sup> See, for example, Doganis (2000), Williams (2002), Lawton (2002), Knorr/Arndt (2002) and Holloway (2003).

etc – are either unavailable or must be purchased at an extra charge. In other words, low cost carriers were able to transform some of the traditional (full service!) carriers operating costs into additional revenues. Most importantly, but so far completely overlooked by analysts and researchers alike, low cost carriers do not incur any costs for feeding traffic. While offering (frequently unprofitable) feeder flights from smaller airports into their hubs still is a crucial pillar of the traditional network carriers' business model, low cost carriers have managed to completely shift these costs to their passengers in return for their much lower base fares. It is obvious that improved air-rail links – if they do meet all requirements stipulated earlier in this paper – would be a very effective tool for the traditional network carriers to maintain, or even expand their own catchment areas at much lower costs compared to maintaining much costlier feeder flights while at the same time freeing valuable slots for more profitable routes. At least for distances below 300 kilometers, a reduced overall trip time would be another advantage from the passengers' perspective.

## 6 Conclusions

The substitution of short-haul flights with rail services can be regarded as a promising means to free slots and airspace at congested airports and may in some cases even lead to environmental benefits, especially if the freed slots are reallocated to more profitable and unsubstitutable long-haul flights. Air-rail links can also improve ground access of airport, if the respective airport suffers from road congestion. Furthermore, air-rail links can be used as a tool to increase an airport's catchment area. In Europe they often serve as feeder connections to long-haul flights, much as short-haul flights connect to long-haul flights in the United States.<sup>33</sup> The prerequisite is high-quality ground access, which is reliable and comfortable, as well as an important factor in customer satisfaction with the overall journey. However, the substantial investments necessary for constructing dedicated air-rail links, especially when the rail link has to be integrated into an existing airport, have to be considered. A thorough cost-benefit analysis is an essential tool in order to establish the economics of such an air-rail link. Obviously, there is a business case for air-rail links only at major airports or, in the case of smaller facilities, if an already existing line could be extended at little expense. Finally, a significant lack of customer awareness could inhibit the success of air-rail links. This gap in perception, particularly by car users, means that on the one hand the cost of public transport journeys – including the opportunity cost of travel time – is usually overestimated, while on the other hand, the speed of public transport journeys is usually underestimated.<sup>34</sup> If the aforementioned critical success factors are met and obeyed, air-rail links will indeed provide an attractive modal choice.

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<sup>33</sup> Cf. Mandle et al. (2003), p. 5.

<sup>34</sup> Cf. Air Transport Action Group (ATAG) (1998), p. 105.



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