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Do rail stations at airports allow a better distribution of passenger demand among airports?
paper submitted for presentation at the 80th Annual Meeting of the Transportation Research Board, Washington, D.C., 7-11 January 2001

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Key:

- City-centre
- Hub
- Medium-sized
- Regional airport
- Catchment area of the medium-sized airport by improving rail access

Widmer, JP and KW Axhausen

Do Rail Stations At Airports Allow A Better Distribution Of Passenger Demand Among Airports?

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Do rail stations at airports allow a better distribution of passenger demand among airports?

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ABSTRACT

The paper presents the results of a study on the effects of rail stations (and High-Speed Rail) at airports on the route and hubbing patterns of airlines. Background for the work is Action COST-318 (1), chaired by IVT.

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

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

In this situation, the idea arises, at least where the catchment areas of several airports overlap, in particular when airport (high-speed) rail access is provided, that users could shift to other, less crowded airports.

This process has not been observed so far. The issue was therefore studied using expert interviews based on the "Delphi" method (statement of personal convictions in several rounds, after having read the arguments put forward by the other experts during the round before).

Answers to the issue involve, among other things, the future of:

- Air traffic concentration and hubbing
- Improved technologies to cope with airport congestion
- Cost-effectiveness of hubs (considering also delays)
- People’s reaction regarding noise and air pollution
- Hub-by-pass development
- Airport choice by air travellers just as airline choice
- Rail stations at airports: a new way of distribution of air passenger transport demand at (medium-sized) under-utilised airports

KEYWORDS

1 INTRODUCTION

This paper deals with one aspect of the effects of rail stations (and HSR) at airports. The paper is based on the work of the European Union (EU)-supported research Action COST-318 (1), chaired by the Institute for Transport Planning, Transport Technology, Highway and Railway Engineering (IVT) at the Swiss Federal Institute of Technology (ETHZ) in Zurich. An Action within the European Co-Operation in the field of Scientific and Technical research (COST) is started whenever at least five European countries are committed to deal with an issue of common interest.

In Europe the provision of rail access to airports relies on the fact, that most of the commercially relevant airports are situated (within or) close to agglomerations. Furthermore, there is a large and often dense railway network within (Underground), around (main line railways) and between agglomerations and that train headways are good.

Rail stations are operational at several European airports. Rail stations at airports are at the centre of interest everytime when road access relief at airports is considered, as well as when considering rail and air passenger transport as complementary. The first examples started as shuttle services between the airport and the city centre, often the main railway station, where connections with the general railway network, as well as with the (under-ground) urban public transport system were offered (see Table 1). The concept of the airport rail link then developed as an alternative and a challenger to road transport as a whole. As a result, the airport stations were fully integrated as part of the relevant suburban and national railway networks. When enabling a stop of long-distance trains at the airport, such as, for example, at Amsterdam, Frankfurt, Geneva or Zurich, not only the airport vicinity is connected by rail, but also (with no change) the larger cities within the region or country.

In 1994, the first airport stations fully integrated into the national HSR systems went into operation (Paris-Charles de Gaulle (CDG2) and Lyon-Satolas). The next example of this type will be Frankfurt/Main airport, where a second rail station is operational and will be part of the high-speed rail link between Frankfurt and Cologne. HSR access primarily aims to extend the airport catchment area for a given acceptable access time.

The latter aspect is relevant. HSR services may be seen as an alternative and challenge to the regional feeder flights at the increasingly congested main airports as air transport liberalisation and competition lead Europe-wide to a concentration of air transport activities at some airports due to the development of hub-and-spoke systems by many airlines.
Airport rail access takes advantage of the specific advantages of rail transport over the car. These advantages differ for the various actors, such as the railway and airport operators, the air travellers, the airport employees and the general public. These advantages may be summarised as follows: high volumes of transport per time unit, which, associated with high frequencies, provide a large capacity reserve, with little need for (parking) space at the airport. Furthermore, timetable based service reduces time margins, which need to be accepted.

Moreover, rail transport has an acknowledged lead in terms of safety and in terms of air pollution over (private) road transport. There is also the expectation, that airport rail transport could reduce public subsidies for the railways at least in the long term.

There are also some arguments against airport rail access: apart from no door-to-door suitability, infrastructure costs of course, and in particular the operating costs in case of low transport demand volumes, which may be the case at the start of the operation.

Due to EU-liberalisation, fierce competition, cost-cutting constraints, hubbing of major European airlines at their home base, airport catchment area extension 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. Once, saturation and fading trust through repeated and unpredictable delays in air transport could emerge.

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

Where the catchment area of several airports overlap, even more where airport (high-speed) rail access is provided, users have the choice to shift to other airports. See Figure 1 for the logic of this situation.
<table>
<thead>
<tr>
<th>Type of link</th>
<th>Conventional</th>
<th>High-speed rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>City-centre to airport</td>
<td>Brussels</td>
<td>Oslo-Gardermoen</td>
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<td>London-Heathrow</td>
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<td></td>
<td>Munich</td>
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<tr>
<td>Sub-urban and inter-regional rail system at airport</td>
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<td>Paris-CDG2</td>
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<tr>
<td></td>
<td>Geneva</td>
<td>Lyon-Satolas</td>
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<td>Airport to airport</td>
<td>Zurich to Geneva</td>
<td>Paris CDG2 to</td>
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<tr>
<td></td>
<td></td>
<td>Lyon-Satolas</td>
</tr>
</tbody>
</table>

Source: Widmer and Hidber, 2000, Table 1 (3)
Figure 1  Air passenger transport demand distribution between agglomerations

Key:
- Agglomeration boundaries
- Commercial airport location
- Airport catchment area

1. Extensions due to:
- better ground access (motorways, rail stations at airports)

2. much better ground access (high-speed railways at airports)

3. 

2 METHODOLOGY

As there are (still) no published statistics nor available data on the question whether rail stations at airports allow a better distribution of air passenger transport demand among airports, the issue is suited for an expert questionnaire (see Appendix) based on the Delphi method.

The Delphi-method helps to reveal:

- Expectations on issues, which have never occurred before.
- A statement based on stabilised opinions on what may happen

In case of expert statements, the participants have to be competent and reliable. This is a prerequisite, as the aspects involved in questioning, such as air transport liberalisation and airport access, hub-and-spoke systems and regional (hub-by-pass) air transport, air traffic concentration and airport congestion, environment protection, are evolving, according to technology improvements, economics, priorities set by the business world and by the society as a whole.

The survey is based on:

- A unique questionnaire for several rounds of questioning
- Statements made by each participant are consolidated in a further round by confirming or adjusting the answers given after having read a report on the previous round answers reflecting the views of all participants
- Statements are thought to be based on the knowledge about the issues, on experience close to the issue and are expected to reflect objectively the convictions of the expert
- The experts are expected to express a general synthesis on the matter that is out of a specific project context
- The survey proceeded from the general to the particular, starting with questions related to the wording, making sure that each of the participants understands the issue accordingly; then to questions related to the context/ back-ground, such as liberalisation, airport saturation prospects, etc. At last, with questions related to airport ground access, airport rail access in particular

Some questions were related to others, not least in order to have a chance for consistency checking. Each question is formulated in a chain of questions. If the respondents answered "no", the question "why?" emerges.

3 THE EXPERTS

Experts included the COST-318 Action's Management Committee members, as well as experts from the following professional areas:
• Research institutes/ universities;
• Chambers of commerce & industry;
• Air passenger organisations;
• Air transport organisations;
• Management of small-, medium-sized and large commercial airports;
• Airport authorities;
• Civil service;
• (National) air carriers;
• Charter and regional airlines;
• Railway companies operating rail stations at airports and/ or high-speed trains;
• Railway organisations;
• Travel agencies;
• Editors of topic-related technical or scientific periodicals.

The confidentiality of the answers was assured, meaning that no names were attached to to specific opinions. 58 experts had been invited to participate. 26 fully usable questionnaires were returned at the end of the 1st round. 21 experts took part in rounds of questioning and came from Belgium, the European Commission, France, Germany, Great-Britain, Italy, Netherlands, Slovenia, Sweden and Switzerland.

4 RESULTS

The answers to the questionnaire was compiled and divided into the following categories:

• Clear statements with an overwhelming majority, if not unanimity;
• More contentious statements with a sizeable expert minority not agreeing;
• Unclear areas, where opinions are divided nearly equally

It is worth noting as a rough sensitivity test, that the range of the answers given by the experts participating within the Action COST-318 did not differ from overall range of answers.

The outcome (personal statements after both rounds and having read the arguments put forward by the other experts in the previous round) involves, among other things, the future of:

• Air traffic concentration and hubbing;
• Improved technologies to cope with airport congestion;
• Cost-effectiveness of hubs (considering also delays)
• People’s reaction regarding noise and air pollution
• Hub-by-pass development
• Airport choice by air travellers just as airline choice
• Rail stations at airports: a new way of distribution of air passenger transport demand at (medium-sized) under-utilised airports

4.1. QUESTION MEANING

There is a quite unanimous agreement among the experts that the wording suggests that air passenger demand could be distributed in another way than the one taking place nowadays. However, for a minority (which may be right), the wording does not suggest, that "there is a felt need of a better distribution of air passenger demand among (more or less close) airports". But when felt, quite unanimously the experts agree, that "rail stations at airports are beneficial to this need".

4.2. AIR PASSENGER TRANSPORT TRENDS

Considering air passenger transport trends, boosted in particular by European air transport liberalisation, "airport choice opportunities for users will increase (just as present airline choice opportunities)" as, unanimously stated by the experts, airports will be keen to offer new services according to flexibility and market opportunities (just as airlines are doing it), competing between them: this speaks for airport rail connection whenever feasible!

However, concentration in air passenger traffic will last (even up to saturation). A qualified expert majority is trusting the use of improved technology (surprisingly only one-third of those coming from research institutes and universities believe in an improvement), as well as the skills of airport and airline management, to be able to cope with more concentration without a saturation to intolerable levels”. Some experts are expecting concentration in air passenger traffic even without effects of hub-and-spoke systems operated by the airlines (on some airports). As large airports in Europe were generally served first by rail operations, this speaks (for the time being) against a new distribution of air passenger transport demand towards other airports (by rail).

Underlining this, it has been acknowledged as correct, that more traffic gives an airport the opportunity to be more cost-effective and more profitable. Passenger transport access by rail, first occurring at large airports, offers new service opportunities (advantages of rail transport, such as punctuality, transport capacity, car parking supply relief and in some cases, feeder air services alternatives) is capable to increase air passenger traffic concentration. That means that the actual situation will last to prevail at least for the (very) near future.
4.3. LARGE (HUB) AIRPORT CONSTRAINTS

As air passenger traffic is concentrating at large (hub) airports, constraints come up, such as long walking distances and delays. Until now, although often predicted, no lasting air passenger transport gridlock occurred in Europe, which should not mean that such an event is out of question. The experts think, that some shift between feeder flights and rail access should occur.

The facts however are that most (large) airport areas in Europe (a few excepted), some of them close to the city-centre, cannot be extended outside their present boundaries, due to (dense) urbanisation and environmental concerns. Moreover, only a slim expert majority think, that people from airport neighbouring communities will protest against more air traffic concentration, but finally accept, as they did in the past. Three quarters of the experts, who do not agree, believe they will (even) be able to stop the process (of air traffic concentration). This means that a potential reallocation of air traffic lies ahead (without or with air passenger transport liberalisation) to (more or less close) airports, which will have to be competitive (and rail access at the airport being, without doubt, one key element of attractiveness).

In this respect, it is confirmed, that airport access in general and air services supply are more important for people travelling for business purposes, whereas ground transport costs and air transport fares are more important for private purposes. Ground access time is more relevant than ground access distance.

4.4. AIRPORT CATCHMENT AREAS

A clear majority agrees that airport ground access by rail extends the catchment area of an airport and that this would not only be the case at major airports.

That means also that catchment areas of airports being linked by rail are extended, giving the opportunity of a more equal distribution of air passenger transport demand, at least within areas where the catchment areas of several airports overlap. See Figure 1 for the logic of this situation.

Almost unanimous is the conviction that the airport catchment area will extend surely much further when high-speed rail stops at the airport.

Additional effects of increasing catchment areas are cited as: increasing airline choice; direct flights; more competition between airlines; accelerating concentration at large airports and more air passenger flexibility.
4.5. **MEDIUM-SIZED AIRPORTS**

With regard to medium-sized airports, an expert majority thinks, rail transport access could provide them the same opportunities as to major airports. This statement implies among other things, that the airport catchment area being extended. Expert expectations are quite high, that airport rail access is going to cause a new distribution of air passenger transport demand from an agglomeration with a major airport to medium-sized airports. See Figure 2 based on Figure 1 for the logic of this situation.

4.6. **AIRPORTS WITHIN AN AGGLOMERATION**

Experts seem to trust, but less, in the adequacy of rail accesses to airports to cause a new distribution of air passenger transport demand within an agglomeration. The statement was surprising for some experts.

4.7. **REGIONAL AIRPORTS**

A reallocation of air traffic from large to regional (small-sized) airports (outside an agglomeration) would be expected by the experts to be slow; an overwhelming majority of them think, that there will be further a development in regional air transport, especially with "hub-by-pass" flights; but a clear majority think, it will not be relevant in terms of air traffic volume relief at major airports. A "better" distribution of air passenger transport demand among airports by the expected development of regional air transport, if better stands for relieving congested airports, is not lying ahead, according to a majority of experts.

4.8. **AIRPORT RAIL ACCESS FEATURES**

Rail ground access distance/time range suitability to airports set by the experts vary significantly from an expert to the other, as probably the background in their respective countries may be (quite) different: airport access up to 50 km by underground; up to 100 km by local train; by Intercity train up to 450 km; and up to 500 km by HSR (whereas the true substitution function of HSR (to air passenger transport) is quoted up to 800 km).

For new way of distributing air passenger transport demand between airports, all experts stress, it is important for an airport to be connected to high-speed rail. However, for half the experts, it does not make sense to have high-speed trains between airport rail stations. This would mean according to the expert majority, that no new distribution of connecting air passenger demand is expected (or even more wishful) between airports lying (too far) apart (in the present HSR distance range, this implies, for instance, that Lyons-Satolas airport can not to be considered as a potential reliever for the Paris airports).
A large expert majority agree that the traffic volume share of a given rail link to the airport has to be increased (by enhanced, compared to airport road access) by every possible mean (integrated rail-air services, improvement of transport supply and services (frequencies, quality, fares), profitability of rail links, framework of EU transport policy and long-term development).

Further enhancement conditions cited were: integrated supply of services; communication centres at airports; logistic facilities (check-in and luggage handling); more attractive rail stations; software issues. These are issues, which public transport should address.

Weights given to the access system characteristics vary significantly from one expert to the other, except for "frequencies" for business travel purpose, set thorough as "important" or "very important". As rail transport supplies a significant transport volume per unit time, this means that transport volumes by rail at airports have to be substantial in order to achieve high frequencies without empty trains.

Other quantitative and qualitative matters within the transport supply to look at are: transfer; check-in; reliability; punctuality, modal integration; time; information. These are aspects, that rail management should be able to manage successfully.

Figure 2 Air passenger transport demand distribution towards medium-sized airport

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<td>X</td>
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<td>X</td>
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<td>○</td>
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</tbody>
</table>
5 CONCLUSIONS

Due to the EU-driven liberalisation of the air transport systems, airport choice opportunities will increase, just as presently airline choice opportunities (expert ratio: 19 yes/2 no). Concentration in air passenger traffic (boosted by hub-and-spoke systems) will last (19 yes/1 no). A qualified majority of experts still trust the use of improved technology and management skills to cope with more concentration without saturation reaching intolerable levels (14 yes/6 no). Because of noise and air pollution, the experts’ belief is, that people will protest against more air traffic concentration, but (as they did in the past) finally accept (12 yes/8 no); if not, they will be able to stop the process (6 yes/2 no).

As airport access time is more important than access distance (21 yes), a clear majority of experts agrees, that airport ground access by rail extends the airport catchment area not only at major airports (7 yes/12 no). This process applies of course much more with HSR (stopping at the airport) and leads to the extension of airport catchment areas with the attending overlap between airports (19 yes/1 no).

Experts’ answer to the question is, that rail stations at airports are expected to lead to a new way of distribution of passenger demand among airports, in particular from a major airport (hub) to other (medium-sized) airports:

- Rail as airport access suits very well: 19 yes/1 no
- A new way of air passenger distribution: 18 yes/2 no
- To a medium-sized airport: 13 yes/4 no

See Figure 2 based on Figure 1 describes this shift in the logic of the situation.

6 ACKNOWLEDGEMENTS

The authors wish to thank their collaborators within the Action COST 318 for participating. The team in Zurich included R. Schilling, whose contribution is gratefully acknowledged.

The authors want to thank K.W. Axhausen for his editorial support during the writing of the paper and his suggestions, which helped to improve the structure and presentation.

All remaining errors are our own.
7 REFERENCES


8 APPENDIX

Questionnaire as follows.
Do rail stations at airports allow a better distribution of air passenger transport demand among airports?

Name: Working with:

Part 1: About the wording

• Do you have something to add to the information provided?
  ____________________________________________________________________________
  ____________________________________________________________________________
  ____________________________________________________________________________

• Do you agree that the wording suggests:
  a) air passenger demand could be distributed in another way than the one taking place nowadays?  O  Yes  O  No
  b) do you feel there is a need of a better distribution of air passenger demand among (more or less close) airports?  O  Yes  O  No
  c) rail stations at airports are beneficial to this need?  O  Yes  O  No

• What else does the wording suggest to you?
  ____________________________________________________________________________
  ____________________________________________________________________________

Part 2: Considering airport authorities, airlines, air passengers and general public separately in the emerging European context (EU air transport liberalisation):

• Do you think airport choice opportunities for users will increase just as present airline choice opportunities?  O  Yes  O  No
  If no, why? ______________________________________________________________________
  ____________________________________________________________________________

• Due to EU-liberalisation, airports will be keen to offer new services according to flexibility and market opportunities just like airlines are doing it, competing between them?  O  Yes  O  No
  If no, why? ______________________________________________________________________
  ____________________________________________________________________________

• Will concentration in air passenger traffic last?  O  Yes  O  No
  ...due to hub-and-spoke-systems?  O  Yes  O  No
  Why? __________________________________________________________________________
  Are there other reasons? _________________________________________________________
  ____________________________________________________________________________

• Will there be even more concentration up to saturation at major airports (hubs)?  O  Yes  O  No
  Why? __________________________________________________________________________
• Will the use of improved technology, as well as airport and airline management, be able to cope with more concentration without a saturation to intolerable levels? O Yes O No

• How will people (airport neighbouring communities, etc.) react to more air traffic concentration with regard to noise and air pollution?
  - They will protest, but finally accept (as they did in the past)? O Yes O No
  - If no: they will protest and be in grade to stop the process? O Yes O No

• Is it correct that more traffic gives an airport the opportunity to be more cost-effective and more profitable? If yes, what prospects have medium- and small-sized airports?

• Will there be a further development in regional air transport, especially with "hub-by-pass" flights? Will it be relevant in terms of air traffic volume relief at major airports (hubs)? O Yes O No

• How important are the following factors of airport choice for air passengers? (Please give a value among 6 (very important); 5 (important); 4 (less important); 3 (no idea); 2 (not important); 1 (no influence)):

<table>
<thead>
<tr>
<th>Factor</th>
<th>For Business Purpose</th>
<th>For Private Purpose</th>
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<tbody>
<tr>
<td>Airport access in general</td>
<td>value: _____</td>
<td>value: _____</td>
</tr>
<tr>
<td>Ground access flexibility (rail vs. road)</td>
<td>value: _____</td>
<td>value: _____</td>
</tr>
<tr>
<td>Air services supply (destinations, frequencies)</td>
<td>value: _____</td>
<td>value: _____</td>
</tr>
<tr>
<td>Ground transport costs</td>
<td>value: _____</td>
<td>value: _____</td>
</tr>
<tr>
<td>Air transport fares</td>
<td>value: _____</td>
<td>value: _____</td>
</tr>
</tbody>
</table>

• Catchment areas are related much more to ground access time than to ground access distance. Do you agree with this statement? O Yes O No
  If no, why?

• Do rail stations at airports, that means airport ground access by rail, extend the catchment area of an airport:
  a) at every commercial airport? O Yes O No
  b) only at major airports? O Yes O No
  c) surely much more when high-speed rail stop at airports? O Yes O No
  d) if yes, is there an extension of the airport catchment area to be expected, if there are high-speed rail services from an agglomeration without a rail station at its airport? O Yes O No

• What about the area where the catchment areas of several airports overlap:
  a) will the area extend even more when airport access by rail is provided? O Yes O No
  If no, why?
b) is there an increasing demand in air transport in areas where the catchment areas of several airports overlap:
   1) between agglomerations? O Yes O No
   2) within agglomerations? O Yes O No

- Are there additional effects of increasing catchment areas to be expected? O Yes O No
  If yes, which ones are important?

Part 3: Considering the advantages and constraints of rail transport

- Will railways lead to a new way of distribution of air passenger transport demand between airports? O Yes O No
  Due to: __________________________________________________________

a) Do you think rail transport suits very well for ground access to airports? O Yes O No
  Due to: __________________________________________________________

b) Do you think rail transport access to airport could provide the same opportunities to medium-sized airports as to major airports? O Yes O No
  Why? __________________________________________________________

- Is rail access to airport going to cause a new distribution of air transport demand between airports:
  1) within an agglomeration operating more than one commercial airport? O Yes O No
  2) from an agglomeration with a major airport (hub) to another major airport? O Yes O No
  3) from an agglomeration with a major airport (hub) to a medium-sized airport? O Yes O No

In which ground access distance/time range to airports are the following types of rail links best suited:

a) Underground? from km________ to km________ from h:min________ to h:min________

b) Local train? from km________ to km________ from h:min________ to h:min________

c) Intercity train? from km________ to km________ from h:min________ to h:min________

Any comments? __________________________________________________________

- Within which ground access distances/time to airport(s) has high-speed rail a complementary (feeder) function to air travel? from km________ to km________ from h:min________ to h:min________

- Within which city-centre to city-centre distance/time has high-speed rail a substitutional function to air travel? from km________ to km________ from h:min________ to h:min________
• Is it important, whether the airport is connected to high-speed rail? O Yes O No
Why?
_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

• Does it make sense to have (possibly non-stop) high-speed rails between airport rail stations?
Why?
_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

• Ground access to airports by rail has to be enhanced compared to airport road access.
Given a rail link to the airport exists or is feasible, its traffic volume share to the other airport ground
access modes has to be increased; by every possible means. Do you agree? O Yes O No
If yes, which are the most influent factors aiming at achieving this goal?
_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

Anyway, which transport policy measures do you consider as appropriate to expect changes by users
in favour of public transport?
_______________________________________________________________________________
_______________________________________________________________________________
_______________________________________________________________________________

• Are there - besides transport aspects - further thematical areas and subordinate conditions to be found
in the background and which may play an important role when considering an airport rail station?
_______________________________________________________________________________
_______________________________________________________________________________
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• How important are the following characteristics for the choice of the transport system from/to the air-
port? (Please give a value among 6 (very important); 5 (important); 4 (less important); 3 (no idea); 2 (not important); 1 (no influence)):

<table>
<thead>
<tr>
<th>Characteristic</th>
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<tr>
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<td>comfort</td>
<td>value:____</td>
<td>value:____</td>
</tr>
<tr>
<td>fares</td>
<td>value:____</td>
<td>value:____</td>
</tr>
</tbody>
</table>
| what about other quantitative and qualitative opportu-
  nities within the transport supply?                 |                       |
_______________________________________________________________________________

• Special remarks: 
_______________________________________________________________________________
_______________________________________________________________________________

Thank you so much, indeed!