15 OVERALL CONCLUSIONS CONCERNING FACTORS AFFECTING INTERCONNECTIVITY IN PASSENGER TRANSPORT

15.1 LEARNED LESSONS FROM CASE STUDIES

15.1.1 Rail Interconnections allow Frankfurt Airport to Become a Global Intermodal Hub

In 1972 Frankfurt airport was the first airport in Germany to be equipped with its own railway station. At that time it was served only by local trains on the Frankfurt – airport – Mainz – Wiesbaden line, but presently (since 2002) Frankfurt airport has a dedicated station exclusively served by long-distance trains, namely ICE high speed trains. At the same time domestic flights on certain routes have decreased, largely substituted by trains, and international and intercontinental flights have increased dramatically. Thus the combination of good interconnectivity and the presence of network carrier has led to these large growth effects of the airport, constituting a case of good practice.

Improvement of rail-airport interconnection resulted on increased rail demand. Connecting airports to the railway network and enabling long-distance services can cause significant changes in mode choice towards rail. Travellers may shift from both regional air services and cars or buses to rail. With time savings of up to 100 minutes caused by the new rail links passenger figures for long-distance trains at Frankfurt airport more than doubled within a few years and are at about 22,500 per working day, resulting in a modal share of more than a third for public transport for originating air passengers. In parallel passenger figures on short-haul domestic flights decreased by more than a quarter, which equals to 2.4 million per year, a development which is contrary to the trend of air transport in Germany in total, facilitating the specialisation of the airport in international and intercontinental flights.

Improvement of interconnection allowed for more efficient use of air and rail infrastructure (co-modality). The trend towards increasing demand for air travel did not stop even if domestic flight figures decreased, as the slots no longer needed for the feeder flights were immediately used by the network carriers for additional (long-haul) flights using the full capacity of Frankfurt airport. The use of each mode was therefore optimised.

Minimum passenger figures are required to justify investments. To justify the costs for both infrastructure and high frequency long-distance intercity rail services the airport should be competitive enough concerning the international and intercontinental destinations offered to attract passengers form a large catchment area to allow sufficient passenger numbers for the trains serving the airport. In addition the linkage of the airport to the rail network should allow trains to serve the airport without the effect of extended travel-times for non-airport related rail passengers. The successful experience of Frankfurt is therefore applicable to airports becoming hubs at global scale, and rail networks connecting large enough cities.

Intermodal services can be profitable for transport operators and managers. Besides a co-funding of the costs for the construction of the long-distance railway station and its linkages to the railway network from the Federal Government, all long-distances services offered are financially self sustainable and run by the train operators in co-operation with airlines. This profitability is possible because trains also serve non-airport related transport demand. Long-distance trains for exclusive use by air passengers have turned out to be loss-making in the past.

Improved ticketing schemes are needed for comprehensive ease-of-use. An accompanying system of through-ticketing solutions for intermodal travel with rail and air improves the effects outlined above. This especially applies for the full integration of the train segment into the air travel as implemented with the AirRail concept on the routes from Stuttgart and Cologne to Frankfurt, where at the latter the flights have been replaced fully by rail.

15.1.2 Rail Interconnection Aims to promote Barcelona, Girona, Reus and Lleida as an Integrated Airport Network

In recent years, large infrastructure investments in Spain have expanded the capacity of airports, passenger HSR and the motorway network. There is no capacity shortage in airports, passenger long-distance railways and motorways. Broadly speaking Spain's HSR network should be 5,000km

long before 2020. Spain's motorway network has grown from 2,000km to 10.000km between 1990 and 2010. These investments have been financially feasible in large part due to Cohesion and Structural Funds. Intermodal connections between these long-distance networks were planned in some cases, like in Barcelona and the other small airports in Catalonia. The goal was to create a network of specialised airports, with small airports located approximately 80 km from Barcelona being able to provide the capacity that Barcelona will lack sooner or later. But the interest and feasibility of these rail connections were always under debate and now they are just partially achieved. On the other hand, investments on local rail and road new links to airports were also planned and now (2010) are under construction.

Interconnections in long-distance terminals with relatively low demand require specific ad-hoc solutions to be economically sustainable from a social point of view. Rail-air interconnections must be carefully planned and managed according to the specific characteristics of each case in order to avoid overinvestment in infrastructure. Solutions often require specific public-partnership agreements and organisational schemes (i.e. bus shuttle services partially subsidised by local authorities, buses also serving metropolitan regular routes, people movers from nearby rail stations, extensions of already existing metro or tramway, etc).

Increased difficulties in planning optimal solutions. The lack of integrated transport and land-use planning processes lead to an extremely long process to plan complex interconnectivity projects in dense, heavily urbanised areas. The design of interconnections in Catalonia was to some extent addressed by the regional Territorial Plans, but co-operation between local, regional, and national institutions for planning and financing has never been easy.

There is a need to optimise the institutional framework to manage transport infrastructures. Organisational issues, especially when negotiation involves multiple stakeholders, can become very complex even if in Spain the airport and railway systems are managed from centralised public institutions. Strong political debate often results in cost increases and substantial delays in project calendars. New collaborative formulae involving all stakeholders in the planning and implementation process of infrastructure projects need to be considered.

HSR services to regional airports shared with other non-airport related services can pay for their operation. HSR access to regional airports in Catalonia is expected to be more competitive in terms of travel time than private car or bus, but only when times to access rail stations and to transfer from rail to airport terminal are competitive enough. Travel costs to users, according to current tariffs provided by the Spanish rail operator, would be within the same order of magnitude as bus service prices and private car travel costs.

Interconnections can provide positive territorial impacts beyond optimisation of travel times and travel convenience. Metro services connecting Barcelona to its airport are likely to encourage economic activity in municipalities close to the airport. HSR interconnection in Barcelona's airport is strategic for capturing trans-oceanic air routes, as it contributes to enlarging the airport's catchment area and thus increases demand. When passenger figures are likely to be modest it is important to take into account the long-term economic and territorial impacts expected from the investment. In order to make potential effects likely to happen, strategic socioeconomic development plans bringing together public and private institutions could be used.

15.1.3 Effective Interconnections for Airport Access in Milan cannot Exist without Careful Planning of Infrastructures and Services

Although it is more than 10 years since the opening of Malpensa airport, the completion of its land access routes is still the main issue when talking about the interconnectivity of the Milanese airport system. This is a consequence of the lack of adequate planning of infrastructures and services. In fact, the official inauguration of the new Malpensa 2000 came in 1998, when only two-thirds of the planned infrastructure was built and there was no railway link. Investment to guarantee surface accessibility to the airport, which was fundamental for the its performance, was neither part of the Malpensa 2000 project nor managed by the concessionaire. Infrastructures were financed later, by dedicated regional and national laws and plans and are not yet totally completed.

Given the high priority of the completion of Malpensa's access routes, the accessibility of Linate and Orio al Serio has been less of an issue, at least until the award of EXPO 2015. Though this can be

considered somehow true for Linate, which is located in Milan surroundings, it appears less straightforward for Orio al Serio, whose accessibility from Milan and the rest of the region is mainly by road (private cars and shuttle buses). The resulting impression is that in current planning, and planning related to EXPO 2015, does not properly focus on the growing role of Orio al Serio within the system

Missing rail connection to the main city station leads to poor air-rail interconnectivity. Airport accessibility by rail is an important feature to improve interconnectivity between networks, but this kind of connection is not financially sustainable for all airports given the high construction costs of rail links. Nevertheless it is a fundamental precondition of those airports that aim to become a strategic international hub like Malpensa. The current weakness of the Malpensa rail connection is evident since rail services connecting airports should always be available from the railway stations that are the central point of long-distance networks. This is not the case for Malpensa, whose unique rail connection ends in Cadorna station that is five underground stops from the main long-distance train station. The situation is planned to change in the future, when new connections with Milano Centrale and the HSR stations will be available. Frequency of the service should also be improved.

Need for reserved path infrastructure to connect airports located in congested areas by public transport. All the airports have shuttle bus connections to Milan and, with a very limited frequency, also to several other cities. The main weakness in this accessibility by road lies in the congestion that affects all the access motorways during the peak hours. Given their location close to the city centres, respectively Milan and Bergamo, accessibility by local public transport is available only for Linate and Orio al Serio airports, but these services are affected by congestion. Therefore, even if buses are a reasonable option to get access to small airports, when they are located in dense metropolitan areas segregated infrastructure for public transport is likely to be needed to make them more competitive.

Interconnecting airports by shuttle services is at the bottom of the agenda. Bus shuttle services connecting the three airports are available in the Milanese network even if the transfer between airports is a very marginal phenomenon.

Missing passengers facilities at terminals reduce interconnection quality. Other weaknesses related to passenger interconnectivity can be detected in the current system mainly related to the lack of integrated ticketing for airport interconnecting services, adequate information to users at airports and lack of check-in facilities at railway stations.

Poor integration with HSR services is envisaged. As far as Malpensa's accessibility from HSR services is concerned, the interventions planned in the medium term do not seem to guarantee an appropriate position for the airport within the HSR system. In fact, the connection to an HSR line would be beneficial for any airport, but an important requirement is that the station must have direct links to a large number of destinations with services at a relatively high frequency. In most cases this requires the airport station to be a through station on a main line where most of the services passing through it stop, and not an end-of-the-line station, or a station on a branch line from a main line. In the envisaged solutions, Malpensa station still appears as a station on a branch line from a main line, not totally integrated with the HSR system.

The completion of planned infrastructures is affected by great uncertainty. Given the general complexity of planned infrastructures to improve airport accessibility (both for rail and road projects), the uncertainty about funding, and the frequent delays of execution times, it is not possible to predict real time horizons for the achievements of final network configurations. The same uncertainty applies also to some of the projects envisaged for EXPO 2015 whose timing can be considered as merely indicative since most of them are still only at the planning stage.

15.1.4 Integrated Rail Connections to Airports could Potentially Increase Public Transport Mode Share in Access to Scottish Airports

Although Scotland comprises a land area of nearly 80,000 km^2, its three main airports, Edinburgh Turnhouse, Glasgow International and Glasgow Prestwick are all within a 45 km radius. However, none of these airports is directly connected with each other with any form of public transport. Only Prestwick has a direct rail link; the nearest train station to Glasgow International is 2 km away and to Edinburgh Turnhouse 5 km away from the airport. All three have a number of bus connections.

Rail services may be profitable, but infrastructure costs are not likely to be recovered. A rail link from Edinburgh airport to the city centre would be profitable but a Glasgow airport-city centre link would not, according to available figures**.** The Edinburgh airport rail link project, EARL, estimated a demand of 9,000 passengers per day in 2020, allowing it to make it an operating profit, even if the initial infrastructure investment would have to be heavily subsidised. The Glasgow airport rail link, GARL, would have struggled to attract sufficient passenger numbers in order for the revenue to cover at least the operating costs. The chances to attract more passengers in GARL would have required direct connection not just to Glasgow Central station, but also to Edinburgh and the north of Scotland. In contrast, the rail link to Prestwick airport attracts 35% of all air passengers and, since the station is on an existing mainline, this creates little extra costs and a very substantial profit.

Good quality express bus services between city centres and airports can attract a large patronage. Both Glasgow and Edinburgh airports are connected to their respective city centres with excellent express bus services. Although both services are very frequent (one bus is often already waiting behind the one that is just filling up) passengers can be found queuing for them at most times of the day, and both are highly profitable..

Door-to-door demand-responsive bus services may be unsuccessful in the short-term. The demand-responsive Edinburgh Shuttle had to be abandoned in a tough economic climate because it could not build up a client base quickly enough to make it profitable, while the shared taxi system was not able to attract customers.

Discounts on intermodal tickets help attract users to bus and rail services from airports to city centres. As mentioned above, the train connection to Prestwick attracts large passenger numbers. This is certainly helped by the fact that rail passengers with an air ticket get a 50% discount for travel throughout Scotland, and if they are travelling on certain new air routes, even travel for free on the train. Furthermore, although user numbers are limited overall, the integrated bus and rail ticket for access to Glasgow airport undoubtedly helps the uptake of this connection.

15.1.5 The Impacts of Interconnections may be Difficult to Assess at Leeds Railway Station

Leeds train station is one of Britain's most significant railway stations and the past decade has seen a number of enhancements designed to, or having the effect of, enhancing interconnectivity via the improvement of access and egress.

Assessing the impact of improved interconnections in traffic increases is not easy. Passenger figures increased as enhancements at Leeds railway station were undertaken, but there is a lack of clear-cut evidence on the impact of the enhancements and possible links to the passenger usage increases. A number of further enhancements are at various stages of planning and implementation, and it is hoped that some greater attention will be placed upon assessing the impact of these as they come into effect. Nevertheless, access and egress problems continue to exist, with many bus services not properly linking up with the station and poor pedestrian facilities in the immediate vicinity of the station continuing to be a particular problem.

Market competition in the transport sector may not promote interconnectivity. It is not clear whether or not competition promotes interconnectivity or detracts from it. One side of the argument would run that competition allows market operators to respond to consumer demand and preferences, and if interconnectivity is important –like we think it is– then those operators who offer this will do well over those who don't. The counter-argument, however, would run that we know that market failure exists in network goods such as transport, and it is network benefits –such as interconnectivity– that markets fail to properly take account of; hence there is a need to allow, encourage or force market operators to co-operate with one another. In the end, it comes back to a question of whether, or perhaps how well, the market can deliver integrated transport. In practice, experience is mixed in Leeds: for buses there is little co-operation taking place in the market and many apparent failings; for rail there is a lot of co-operation, but most of it enforced from above (with relatively little evidence to demonstrate whether co-operation is beneficial and, assuming that it is, whether the law is needed to ensure this.

15.1.6 The Milan Railways Node needs Improvements in Integration between Long Distance and Local Services

Milan railway node is a very complex intermodal point and continuous efforts have been made to improve the interconnections with local public transport as well as with the underground network. All the main rail stations are in fact reachable at least by one metro line and by bus or tramway lines. Nevertheless local public transport seems to be under-dimensioned because of the increasing number of commuters and tourists reaching Milan stations every day. The extensions of the S-lines (suburban rail) and the increasing frequency of trains will enable more efficient connections between long-distance and short-distance services.

The lack of harmonisation between the services of the multiple providers is remarkable in Milan. No integrated timetabling between long and short distance trains exists. The high speed rail service started to be available recently but its services are poorly defined as new stretches are put in service every year. Consistent improvements of the suburban rail service are expected in the next few years.

Ticketing integration is not well developed. Ticketing integration is still at a minimum stage with respect to other metropolitan areas. Integration between railway and urban transport in Milan exists, but in general railway transport is not integrated with extra-urban local transport.

***Lack* of user information and scarcity of facilities to reduce transfer times at interchange points**. The intermodal facilities are scarce and poor in comparison with other European cities. No clear signs and no maps are provided at the main interchange points. The lack of multilingual information and pictograms that could facilitate the transfers at interchange points increases difficulty to foreigners. Many stations are equipped neither with Park & Ride lots nor with bicycle facilities.

15.1.7 The Dual-mode Railway System is an Efficient Solution for Interconnectivity in Medium-Sized Urban Areas: the Karlsruhe model

The dual-mode railway system of Karlsruhe is widely regarded as the model of a high-quality and well patronised local public transport system. The successful track-sharing experience of the various Karlsruhe rail systems has revolutionised urban and regional public transport: Karlsruhe trams run on the urban light rail system and on the heavy rail tracks of the German Railways.

Dual-mode railway may provide excellent cost-benefit ratios. The technical adoptions needed for track sharing of heavy rail trains and tramways are feasible and available for reasonable costs. These measures give an excellent cost-benefit ratio, much better than that which applies for completely new built lines.

Dual-mode railway is efficient in medium-sized urban areas with non-centrally located rail stations. The usage of vehicles switching between originally separated networks of (urban) tramways and railway lines qualifies best for an application in medium sized areas, especially when the very centres of towns are not reachable directly by rail.

Dual-mode system may provide important growth in passenger figures. The implantation of the dual-mode railway system has allowed Karlsruhe to experience continuous extension of an environmentally compatible transport system from the urban area to the surrounding region. Transport demand in some lines multiplied by four after implantation of the dual-mode system.

Diminishing exploitation deficits of public transport due to increased frequentation. Although the supply of public transport has increased strongly, the increased revenues from the tickets has resulted in a 20% reduction of the operating deficit. Taking into account the increasing passenger figures the deficit has fallen to below 14 cent/trip today from more than 25 cent/trip in 1994.

Catchment from private modes may be substantial. The TramTrain system has led to massive mode shift from individual transport modes to the public transport system, making transport easier and increasing mobility for all social groups including disabled persons. 40% of TramTrain users formerly used private car before implementation of the dual-mode system, and only 32% of users were previously already public transport users.

Increased comfort and convenience. The dual-mode railway abolishes the required change of vehicles at interchange points, meaning more comfort and shorter travel-times, leading to a dramatic increase in passenger numbers.

Increased attractiveness of the urban area. Revitalisation of urban life in the city centre has been achieved by supporting pedestrian districts and higher attractiveness of the area through integrated high frequency public transport services.

Remarkable regional effects. Due to the excellent public transport system the living standard increased and the population living in the area grew and as a result companies invested, taxes rose and the unemployment rate went down. For private households, the value of their properties went up due to the better accessibility by TramTrain.

15.1.8 Train-Taxi and Feeder Bus Services are a Solution for the Final Few Miles

A key barrier to train travel has been identified as 'the final few miles'. To address this problem in the UK the Train-Taxi concept provides detailed information about taxi services serving UK train and underground stations; a Dutch version of Train-Taxi provides specific Demand Responsive Transport (DRT) service which reduces the cost of taxi travel given that journeys are shared both to and from the train station and the fact that services are subsidised by local authorities; the UK concept called Plusbus offers an optional ticketing add-on when purchasing a train ticket, which allows a train traveller unlimited travel on the buses serving both the origin and destination urban area on the day of travel.

Train-Taxi systems provide a useful service at an affordable cost for the UK T-T concept. It is difficult to assess the impact of UK T-T concept even if it would appear that it provides a useful service at relatively low cost. The database it has constructed and continues to maintain provides input into a number of travel planning websites. The UK T-T concept has a purely information role.

High costs make Dutch T-T system difficult to sustain. A victim of the high cost of the service, the Dutch T-T concept enjoyed an initial period of success with 111 train stations being served in 1994 but suffered from budgetary pressures following the withdrawal of support from the national rail operator, and services were reduced to only 38 train stations in 2007.

Commercial viability without subsidies for Plusbus. The Plusbus concept exists without state subsidy and is a purely commercial concept. Unlike the Dutch T-T scheme, it is not subject to the financial vagaries that appear to have impacted so strongly upon it. The concept has been rolled out into 276 towns in Britain with a substantial growth in tickets experienced, particularly in recent years (280,000 in 2008/09 and expected sales in 2009/10 of 475,000).

***Large scale required in all systems to become attractive to customers*.** One of the key elements of Plusbus and the Dutch T-T scheme is the ability to purchase an integrated ticket for train-bus and train-taxi. Both schemes would benefit from a larger uptake in the concept across their respective countries to ensure that network coverage is at its greatest.

Lack of complementary information to service remains a concern. The scheme does not provide information on service schedules, itineraries, travel times or bus station locations at interchanges. It would be beneficial if train operators were able to market and provide the information about connecting bus services on their web sites and in and around train stations. An element of co-ordination between train and bus timetables would reduce time spent interchanging.

15.1.9 Integration of Ferry Services at Local and Intercontinental Level in Amsterdam

The Amsterdam case study focuses on the integration of ferry services at two levels, the integration of ferry services in the Amsterdam public transport system and the interconnection between the Amsterdam public transport system and the possible interconnection with intercontinental ferries from the port of Ijmuiden.

Fast Flying Ferry (FFF) provides suburban water service which has only recently been integrated in the Amsterdam ticketing scheme. FFF is operated by Connexxion, the largest regional bus operating company in the Amsterdam region. It provides a high speed service to

Ijmuiden (65km/h). The FFF is a regional service and with its use of the terminal at Amsterdam Centraal remains well integrated in the transport network. Further, the operating company has now integrated the service into the new ticket scheme and the OV-Chip card can now be used to purchase travel for the FFF.

The interconnection between the Amsterdam regional transport system and intercontinental ferries is rather limited and today only interconnection by bus is effectively the only possibility. Operators actually discourage other possibilities through their description and the FFF option, even though possible, is not even mentioned on the port's website. Further, multi-modal travel information systems do not even include the ferry port as an option. Therefore, the potential of interconnection is not being exploited. Consequently, the development potential is relevant, but given the operating structure will have to be driven by the private sector.

Free of charge inner harbour ferries well connected to tram, rail, bus and taxi. Two different kinds of ferries are part of the Amsterdam regional public transport system. The first ones are the local GVB operated ferries that serve the area in the inner harbour. These ferries are free of charge and have their central terminal right outside the Amsterdam Centraal Railway station. This location allows for quick interchange to other public transport modes (tram, bus, taxi), individual active travel modes (bicycle and walking), but also to regional and long distance rail services, which are both leaving from the railway station platforms. GVB ferry services also connect to the Fast Flying Ferry (FFF). Since these services are free of charge it can be argued that they allow for seamless travel in terms of charging and ticketing.

Smart cards allow for more efficient ticketing schemes and transport system ITS optimisation. The Amsterdam city region eliminated all paper ticketing in June 2010 and replaced it with smart cards as part of the *Regional mobility and transport policy plan,* which follows a long term strategy. The introduction of the smart card is a move to increase the interoperability on all Dutch public transport services, to allow for more variable tariff design, but also to improve service management e.g. line operation (via GPS) data, vehicle occupation, passenger flows. Such data also allows for exact division of traffic revenues between operators. The introduction of the smart card will be a further step to ease the integration and interconnection between different operators and modes and has the potential to include further services and also to expand reach beyond the Amsterdam region.

Top-down approach in the service integration process in the Netherlands. The developments in Amsterdam are comparable to the findings in the Lisbon case study where ticketing is moving from a modal or operator-led approach towards a 'mobility' approach. However, the introduction of the new smart card in contrast to the Lisbon case is driven from a national perspective to integrate all public transport within the Netherlands, whereas in the Lisbon case the approach is a bottom up development that is now starting to be implemented in different regions and is aiming at integrating rail services at national level as well. The reason for this national approach was to avoid constraining the travellers with several different systems and smart cards; even under the constraint that such an approach results in the need for a synchronisation between large numbers of parties.

Further investigation is required to determine if optimal interconnectivity is compatible with competitiveness between operators. The sustainability of interconnection beyond integrated ticketing in terms of timetables and multi-modal trip information emerges as a new issue from the case study. How can a transport system be competitive and interconnected at the same time? As these two conditions are somewhat contradictory further investigation should look into tendering procedures for public transport services and the relevance and weight that is given to interconnection.

15.1.10 Cohesiveness of the Network Allows Ferry Services in Lisbon to Maintain Competitiveness even with New Bridge Connections Across the Tagus

This case study focuses on the interconnection of ferry services, rather than the level and quality of interconnection of the whole transport system in Lisbon. Ferry services in Lisbon have changed their role significantly in history. The ferry services historically fulfilled the role to connect long distance rail (northern and southern Portuguese rail networks), but this 'obligatory' role changed with the construction of the rail bridge across the River Tagus when ferry services became an 'optional' means of transport in Lisbon rather than 'obligatory'. However, a number of important solutions and efforts have been developed to improve the integration of the ferry network with the other modes and to improve their efficiency.

Improved technology on ferries to raise competitiveness of service. The physical geography of the Lisbon metropolitan area and the continuous extension of the city on the southern bank of the River Tagus have made ferry services one of the key travel options, besides using rail or road transport on one of the two bridges. In order to stay competitive with the competing travel modes the ferry transport operators embarked first on a technological strategy, by changing the structure of service supply, introducing high speed ferries and thus making the crossing time competitive with the other modes and at the same time using the advantage of different crossing options. This technological strategy improved services and travel time substantially

Improved terminals for easier interconnection to other means of transport. The redesign of ferry terminals with particular focus on improving the interconnection between the ferry services and other transport options is a strategy under development. Particular emphasis is given to improving the interconnection with public transport systems and active travel modes, but also to improving the potential of ferry terminals as an entry point to the public transport system by creating park and ride facilities. This renovation and redesign is already showing effects in increasing passenger numbers on certain routes, where the process has been concluded.

Towards a more sustainable integrated transport scheme. The interconnection of long and short distance travel in the Lisbon metropolitan area has progressed over the last few years. While the co-operation and co-ordination of the different transport operators was limited until a few years ago, efforts have been made where possible to improve the overall transport system and drive it towards a more sustainable structure.

Integrated ticketing starting in 1996. The implementation of integrated ticketing options (including multi-modal and combined ticket options) has been a gradual and expanding process in the AML since 1996. The ferry transport operators joined this development in 2005 and today various combined and multi-modal ticket options are available and further developed under the co-ordinating efforts from OTLIS (Transport Operators of the Lisbon Region). There is high acceptability of combined and multi-modal tickets as these make up for the biggest share of tickets used in the ferry services.

Co-operation of different operators thanks to OTLIS framework. The expansion of this effort is particularly interesting as competing transport operators have agreed to use the OTLIS framework to work in a co-operation environment. The success of non-formalised frameworks of negotiation stands out between state government and the private sector and between central government and regional or local interests. New initiatives are aiming at stronger integration. A key success factor was the existence of a supra-operator organisation to co-ordinate issues in each market to the successful implementation of an intermodal system. This is specifically crucial since the regulatory environment was not sufficiently developed to support this development and still lacks regulatory strength.

Smart cards to overcome complex fare systems. While efforts are positive and aim at including further transport operators and regions in time, the existing fare system is still complex and not necessarily transparent to the user. Key success factors for integration success are the adoption of smart cards that fit the highly complex existing fare system and all networks.

Multi-modal transport information platforms are available for the AML (TransporLIS) and also at national level (TransPOR) and these offer a wide range of information and also allow for route calculation including intermodal options. However, at this point in time some errors in the calculation and precision of given multi-modal options are prevalent in the system. Therefore these tools are not 100% reliable.

15.1.11 Integrating Two Former Train Stations and the Bus Terminal in the Helsingborg Ferry Terminal

The ferry terminal in Helsingborg is part of the multi-modal hub ‘Knutpunkten’, which integrates two former train stations and the bus terminal in one location at the port. The opening of the Øresunds Bridge resulted in a marked decrease in the number of passenger crossing the Helsingborg-Helsingør passage by ferry, but the response to the increased competition was to increase the attractiveness of the HH-link. Investments in the interconnections between the different modes of transport, has ensured that all modes of public transport are linked directly to one another thus reducing travel times and removing barriers to interconnectivity.

Institutional co-operation is possible if common interest is important. 10 different institutions and private companies collaborated together to make the Knutpunkten intermodal terminal in Helsingborg a reality.

Design focussed on interconnection. From the very beginning the Knutpunkten terminal was planned so as to make interchange as easy as possible, with open spaces and clear axes throughout the complex, making navigation between the different modes of transport quick and efficient.

Shared exploitation of ferry services by different companies. The two major ferry companies bring together their ventures at the central berth at Knutpunkten and for the passengers this relocation will be perceived as an increase in the service frequency and a more straightforward process, as there is only one ferry berth and they only have to consult one table of departures.

Improving interconnection to ensure ferry services' sustainability. The case of Helsingborg shows that success can be achieved by careful planning, co-operation and continued attention to changes in the prevailing choice of means of transport, and requirements for modern facilities, even when competition is important (Øresund Bridge).

15.1.12 Rostock Ferry Terminal Interconnections Could Improve Non-motorised Passengers Accessibility

The case of Rostock is an example of a harbour where non-motorised passengers largely have been left to their own devices. As the majority of passengers travel by car or bus no investments have been made to improve conditions for the non-motorised segment leading to further decline.

Good interconnections with road modes. The ferry port is well connected to the European highway network as the E55 links directly to the pier, making the quality of the interconnection good for passengers travelling by bus and car, but the interconnection between the ferry services and other land-based modes of transport for the non-motorised passengers however is poor.

Poor interconnection for non-motorised travellers. The case of the port of Rostock demonstrates how the lack of focus on interconnections for certain groups of travellers has led to an unsatisfactory situation, making Rostock an unattractive destination for non-motorised travellers. The share of foot-passengers on ferries is only about 12% in Rostock.

Bus services from ferry terminal to city centre and rail station. A shuttle bus link connecting the passenger terminal with the city centre and the Hauptbahnhof is planned. The shuttle bus will save the non-motorised passengers at least 20 minutes of travelling and waiting time. It will run during a trial period proposed to start on May 1st 2011 and most likely running until the end of December 2011. A joint ticketing scheme will be in place with one ticket valid for the ferry and the buses on both sides.

15.1.13 Plans for New Interconnections in the Tri-City Region of Gdansk / Sopot / Gdynia

The transport system of Tri-City area shows different degrees of integration of various services. Due to Poland's economy being transitional advancement of transport integration has not progressed as far as in many countries where this process was completed step by step over decades. The current situation is not overly optimistic with only some integrated services, mainly in short distance (city) routes. Integration of passenger services is currently one of the major objectives of local and central authorities.

Passenger interconnectivity was long neglected in Poland but is a priority of local and central administrations. While it was never a priority in the past in transport system development, and as little interconnectivity existed before and during the economic transition period, recent development strategies both on central and local levels show increased interest in the problem. In particular, local development plans for metropolitan areas call for this type of integration.

Need to improve services to increase regional attractiveness. In metropolitan areas not only internal integration is sought but integration of public city transport system with external long distance links is necessary. The case of Tri-City shows potential for such integration for example with increased improved tourist movements and attracting of people and investors to the region. But generally integration is considered because of local needs and the improved mobility of people within the region is the primary objective in network integration.

Integration is more easily achieved under one organisational structure. The Tri-City case shows that fragmentation of management and local rivalries are often crucial obstacles in integration policy. The integration level is also very mode sensitive. It is much easier to combine public city transport than long distance air and rail modes. The creation of co-ordinated timetables is particularly difficult because the long distance mode will as a rule not bend to the timetables of city public transport – the opposite will take place. It is also difficult to integrate maritime mode to other modes due to their high dependence on port capabilities.

Financial requirements are the most important barrier to integration. The Tri-City case study shows a number of barriers in integration, of which the most important are financial (lack of infrastructure which has to be created) and organisational (different and contradictory responsibilities, inadequate legal framework). Financial support from the European Union through the Cohesion Fund and structural funds can be successfully used for the development of the projects aiming at improved interconnectivity. Within several existing and envisaged solutions, these EU funds are one of the sources of investment.

15.2 CONCLUDING REMARKS ON INTERCONNECTIVITY

These conclusions have to be considered as working hypotheses to be validated later. Evidence supporting these hypotheses comes from strategic studies conducted at national and European level, as well as from case studies conducted.

15.2.1 On Infrastructure Planning: the Low Economic Profitability of Many Interconnections.

Interchanges between long-distance rail and airports are effective in large international airports with large catchment areas and can be financially sustainable and reinforce co-modality. Interconnections need to be well designed to minimise travel time increases to other rail users with non-airport related trips. The **cost and complexity of implanting new rail connections to airports** from city centres makes them difficult in small and medium sized airports, except if properly planned, managed, and positive network effects can be achieved. New and upgraded rail connections to cities tend to be effective for large airports, but involve complex planning decisions because of intensively occupied urban and peri-urban areas (e.g. Barcelona, Malpensa). New rail interconnections between airports within a region have a marginal interest, even when involving large airports (e.g.. Scottish, Catalan and Milanese airports).

There is a need for building segregated public transport infrastructure (bus platforms, metro extensions) in dense metropolitan areas with congested motorways, in order to make public transport more efficient, even if demand is relatively low. The infrastructure cost is unlikely to be recovered in the case of investments related just to provide missing interconnections.

15.2.2 On Service Management: Favouring Co-modality

Interconnections are to be served with most efficient travel modes in each case. The use of rail, tramway, bus, or demand-responsive solutions in interconnections needs to respond to specific demand requirements in order to be economically sustainable in their operation. Heavily subsidised systems are vulnerable to general economic cycles (e.g. Dutch T-T concept). Bus services are more flexible to manage than other heavier services.

There is a need to find specific solutions for different cases. Dual-mode rail solutions provide excellent cost-benefit ratios when heavy rail and tramway infrastructure is already available (as in Karlsruhe) in medium sized cities. The usage of vehicles switching between originally separated networks of urban tramways and railway lines qualifies best for an application in medium sized areas, especially when the very centres of towns are not reachable directly by rail. On the other hand, long-distance to short distance interconnections need to be well conceived in order to avoid **the 'final miles barrier'** effect. Transfer times in interchanges and access times to terminals from trip origin / destination locations are to be minimised (e.g. at the Helsingborg ferry terminal). Imaginative service operated systems to improve access from and to transport terminals have been attempted in many places but making their cost compatible with relatively low and dispersed demand is still a challenge in Europe.

15.2.3 On Organisational Issues: Institutional Complexity and Conflicting Stakeholders Goals

Organisational issues in planning interconnections, when negotiation involves multiple stakeholders, can become difficult. Strong political debate on this kind of project results in cost increases and substantial delays in project timings.

Integrated transport systems can provide frameworks for different kinds of **co-operation among transport operators**. In Lisbon, where the regulatory framework was not sufficiently developed, the OTLIS framework provided a supra-operator organisation to co-ordinate issues in each market to the successful implementation an intermodal system. In Helsingborg, the two ferry operators co-operated to provide a more efficient service to compete with the Øresund bridge link. The Tri-City example, however, shows that financial requirements are often an important barrier to integration.

ITS can provide effective tools to improve interconnectivity and service quality. In Amsterdam, smart cards allow for more efficient ticketing schemes, encouraging the use of public transport and increasing the interoperability on all Dutch public transport services, but also improving service management e.g. with line operation (via GPS) data, vehicle occupation, passenger flows. In Lisbon, smart cards have helped to overcome very complex fare systems.

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