INTERCONNECT

INTERCONNECTion Between Short- and Long-Distance Transport Networks

DELIVERABLE D5.1

IMPACTS OF IMPROVED INTERCONNECTIVITY ON A EUROPEAN SCALE

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EXECUTIVE SUMMARY

This deliverable provides an analysis of the outcomes of the case studies carried out in INTERCONNECT Workpackage 4 at a European level by investigating them in the light of EU strategic policies.

The analysis acknowledges that interconnectivity embeds several domains of intervention, which have been put forward in numerous EU policy documents and legislation. The development of the TEN-T networks, the increased technical interoperability, but also the deployment and adoption of integrated ticketing and travel information systems are major examples of themes where the Commission has undertaken important efforts towards the achievement of a more efficient, multimodal and integrated Europe-wide transport system.

The major goal of improving transport interconnectivity is achieved at two different levels: EU and national. Firstly, the EU has a key role in defining the policy objectives (which may become the basis for eventual legislation) and the technical standards that shall enable enhanced interconnectivity. Secondly, the Member States contribute to the extent they are asked to under the principle of subsidiarity, and adapt their own legislation and policies to the EU framework. All this has a direct impact on business and investment choices of the transport operators and, consequently, on the availability and quality of the services provided to travellers.

Importantly, the issue of interconnectivity should not just be viewed in the light of the long-distance journey only, but also to the first and last leg of a multimodal journey. Indeed, the coordination and integration of local public transportation with long-distance transport modes is seen by the Commission as crucial for ensuring the continuity of the whole journey.

The first part of this document maps out the relevant developments of the EU policy interventions in the domains related to transport interconnectivity that occurred over the last decade. Following a brief methodological explanation, the deliverable then provides a comprehensive review of the selected case studies in order to:

- Investigate to what extent EU policy objectives on interconnectivity have been translated into practice with the view of optimising the existing interfaces between transport networks and passenger target groups;
- Understand which approaches are most likely to meet the EU policy goals on interconnectivity;
- Identify major barriers in the legal, organisational and institutional environment;
- Make some final recommendations.

The review is organised around five main themes:

- **Network and infrastructure**, with the understanding that an interchange should be strongly interlinked (accessible) not only at a micro-level (regional/local network) but also at a macro-level (TEN-T network). This requires strategic planning in order to make sure that the quality of a transport link (along with the quality of the transport facilities and services) is secured. The focus is then on accessibility, for which an efficient infrastructure is a pre-requisite for securing the overall efficiency and sustainability of a transport system. Notably, the improvement of an infrastructure should be planned and developed in interplay between the infrastructure itself and the network to which it is linked.
- **Quality of the interchange**, which implies looking at the degree of interoperability of both infrastructure and services, by investigating the following key elements: integration of the different transport services (different operators) / modes (air/rail, rail-urban public transport), integrated timetables, quality of design of interchanges, quality of services for making interconnection workable and attractive to customers. Here major elements are: door-to-door information (pre-trip and on-trip), integrated ticketing and fares, integrated booking and payment systems, handling of luggage.
- **Integration of transport operators**, which implies investigating whether and to what extent local transport operators have established joint partnerships and voluntary agreements for offering their transport services under a common brand and organisational structure. It may be argued

that such type of integration may increase patronage and quality of services by optimising their provision.

- **Planning process**, which refers to the need to set up organisational structures that should ensure an integrated planning approach, so to make the interconnection between networks easier. This calls for the involvement of all relevant stakeholders, not only including authorities and transport companies traditionally responsible for the development and ownership of the interchanges, but also of other operators that could contribute to the further development of the interchanges.
- **Promotion of intermodality**, which refers to how interconnectivity is promoted and marketed. Key elements are here techniques for awareness raising and mobility management in order to encourage users to make use of intermodal trips (and consequently raising its market share).

Some recommendations emerge from the analysis of the case studies:

- The need to further optimise the interfaces between transport networks and modes, addressing aspects related to design of interchanges, planning and services;
- The need for interchanges to be a core and functional part of the network as a whole since accessibility itself is not enough;
- Voluntary agreements and/or cooperation schemes where operators see win-win situations might be formulae that allow different transport actors to achieve a common strategy although maintaining the possibility to act independently;
- The need for incorporating from the very beginning interconnections between short- and long-travelling distances and their related land-use developments at the heart of the planning approach;
- The need for securing consistency of timing and scheduling between the responses from the public authorities and the investment choices made by private actors.

Since the assessment of transport policies can benefit from the use of appropriate modelling tools, a final section of this deliverable is devoted to the possibility to improve the way European forecasting tools deal with the modelling of multimodal trips on interconnected networks.

Traditional transportation modelling approaches are in general not oriented to deal with interconnectivity and multimodality. Often the term “multimodal model” is used just because the model covers more than one transport mode, regardless of its capability of dealing with trips composed of different transport modes on multimodal paths.

Strategic models, characterised by large geographical coverage, have the general purpose to provide long-term forecasts of main mobility trends and to assess the impacts of transport policies at an aggregate level; thus their focus does not require necessarily the modelling of interconnectivity.

This assessment was recently confirmed during a workshop with major European transport modellers held in Brussels on March 2011, where it emerged clearly that, in general, passenger multimodality is currently not considered at European scale modelling; the usual practice is the development of separate uni-modal models.

Intermodality is present in a large proportion of long-distance passenger journeys, especially for journeys above 400 km. This confirms that European scale models should be able to deal with this aspect of passenger transport. Nevertheless, given the strategic nature of this kind of modelling, a certain distinction about the kind of multimodality that should be modelled has to be made.

At a general level, the recommended framework to enable the proper modelling encompasses:

- The use of a network-based representation of alternative routes and modes within the transport model, where the network model should employ appropriate multi-path algorithms to construct alternative routes through the network between origin-destination pairs;
- The transport model should employ some form of choice model which estimates the demand on each mode combination/route based on the generalised costs of the different alternatives;

- The generalised cost formulation used in the transport model should include an explicit representation of costs of modal transfer.

These requirements apply equally to models designed to assess the impacts both at European and local scale, but it is implicitly recognised that for highly strategic applications, where the geographical coverage and the possible alternatives heavily increase the complexity of the model, a certain kind of simplification of the problems to be investigated is needed.

Being aware of the complexity of modelling multi-modal trips at European scale, the INTERCONNECT project has chosen a simplified approach to investigate on interconnectivity at European level and has devoted substantial efforts in developing support tools for the analysis of passengers' multimodality. These satellite modules, to be used in parallel with existing traditional models, allow for the computation of indicators expressly developed to measure multi-modality and interconnectivity and are not intended to replace state-of-the-art models at European scale or to overcome all their weaknesses. Nevertheless they proved to be interesting tools to provide insights in the analysis of passengers' multimodality as witnessed by the modelling exercises documented in D5.2.

Apart from the theoretical requirements, the implementation of transport models requires the availability of data for both implementation and calibration purposes. Since intermodal passenger transport deals with door-to-door journeys, there is the need for door-to-door data. However, this data is generally not available: the modal structure of the passenger transport industry is reflected in the fact that most of the collected data is uni-modal.

The review of available statistics on long-distance travel indicates that very few surveys have recorded detailed information about multimodal journeys. Furthermore, when available, this data differs to a large extent from country to country as to quantity and level of detail and hardly contains information on travellers' characteristics.

This lack of data, reflected in the absence of relevant Eurostat statistics, poses strong limitations on the development of passengers' multimodal transport modelling at European level.

Even though it is recognised that in budgetary terms and terms of efforts the cost of collecting data is considerable, it appears anyhow essential to make national institutions more sensitive to the importance of this task.

In this respect the European Commission could play a relevant role both in harmonising the existing available information and publishing European level basic data as well as in encouraging future data collection at national level and drawing guidelines for harmonised surveys on long-distance multimodal trips.

Given their strategic nature, European scale models generally require a compromise between the geographical scope of the model and the level of detail of the modelling framework; this compromise generally leads to a simplification of the modelling framework in terms of demand segmentation, networks representation, transfers modelling etc.

Therefore, it can be expected that policies which have a very local nature could be not properly analysed by these applications and their (small) impacts would be hardly captured and reflected by European models results. In fact, even though a policy implemented in a certain interchange would lead to a substantial reduction of transfer times or costs, its local benefits are unlikely to change the European level results substantially.

Nevertheless, it can be expected that multimodal European models could be able to investigate the impacts of policies which are "massively" applied to all main interchanges all over Europe as witnessed by the modelling exercises performed in INTERCONNECT task T5.2 and documented in D5.2.

1 INTRODUCTION

This deliverable provides an analysis of the outcomes of the case studies carried out in INTERCONNECT Workpackage 4 at a European level, as one of the goals of WP5 is the integration of precise but disperse knowledge gathered through the case studies in a systematic way, in order to assess the impact of improving key local and modal interconnections at European level.

It is worth mentioning that in D4.1 "Factors affecting interconnectivity in passenger transport" the case studies have been analysed and conclusions have been drawn according to the potential solutions and the criteria for success outlined in M3.4 "Draft Toolkit".

The same criteria are assumed for the analysis of a number of test beds performed to investigate the effects of some of the potential solutions proposed in WP3, as documented in M4.5 "Case study reports per case study. Test-bed analysis".

In this deliverable the case studies results are mainly investigated in the light of EU strategic policies. Importantly, this deliverable also takes stock of the outcomes produced in Deliverables D4.1 and by the HERMES project, which in its D1 "State of the Art on Crossmodal Transport Arrangements" provides an overview of previous EU projects, EU transport policies and existing operational solutions that are relevant in the field of transport interconnectivity.

More specifically, the first part of the document begins by mapping out the relevant developments of the EU policy interventions in the domains related to transport interconnectivity. Special emphasis is on three major themes where EU policy work is ongoing:

- Infrastructure (TEN-T);
- Making the transport system more user-friendly, where integrated ticketing (urban transport and air / rail complementarity), integrated information and luggage handling and security are relevant examples in this respect;
- Rail technical interoperability.

The second part contains case studies reviews, where a qualitative assessment will look at the consistency with the EU interventions in the field of transport interconnectivity of the selected case studies, so to identify deficiencies, gaps and areas for future developments.

The deliverable then provides a comparison and analysis of the main findings, and explores areas where further intervention on transport interconnectivity could be advisable.

Since the assessment of transport policies can benefit from the use of appropriate modelling tools, a final section of this deliverable is devoted to the possibility to improve the way European forecasting tools deal with the interconnections of passenger trips. Building on the outcomes of T2.2 "*Forecasting and modelling tools"*, the deliverable draws conclusions about data and model requirements for improving the modelling of multimodal trips on interconnected networks and indicates if and to what extent the potential solutions suggested in WP3 can be modelled at a European scale.

2 DOMAINS OF EU POLICY AND ACTIVITIES IMPACTING ON INTERCONNECTIVITY

2.1 INTRODUCTION

It is widely acknowledged that facilitating connectivity among modes is crucial for:

- Making better use of the existing transport infrastructure;
- Relieving congestion; and
- Improving the overall quality of transport operations, thus increasing mobility and influencing passengers' choice.

The optimal and sustainable combination of different transport modes is the basis of the recently introduced concept of co-modality.

This is the reason why interconnectivity (and the related term interoperability) is a core theme in the development of the EU transport policy. Together with multimodality and sustainability, interconnectivity is a key word in the design of a comprehensive EU transport policy, which is supposed to ensure adequate and efficient accessibility at different levels, i.e. not only across Member States but also at regional and local level.

The Treaty of Maastricht has enabled the European Union to gradually enforce its institutional and budgetary role for promoting a common transport policy, and both long-distance transport and interconnectivity play a central role in this respect. However, initiatives from the Commission have to be respectful of the subsidiarity principle stated in Article 5 of the EC Treaty, which may imply some limitations in influencing national and urban systems, unless the Commission demonstrates that there is a real need for Community rules and common action before taking action on behalf of national and local authorities. Providing orientation and guidance for policy developments seems therefore to have been the *red line* of the Commission's approach, which to a certain extent might also explain why key levers of the Commission's intervention have been first of all policy (non-binding) tools (for instance the two White Papers or the various Action Plans) rather than legislative (binding) acts such as Regulations or Directives.

The purpose of this chapter is to describe how the Commission's intervention has been shaped over the last ten years, with a specific emphasis on those components of its policy that impact the most on the interconnectivity issues.

2.2 STRATEGIC POLICY OBJECTIVES

2.2.1 Major Policy Developments

The European Commission has put the concept of interconnectivity forward in several policy documents. The policy objectives have been addressed by the EU through an array of measures, including for instance regulations, funding, standardisation, research or the exchange of best practice.

The 1990s saw a gradual but significant development of the interconnectivity issue, which evolved into a major policy goal as stated by the **Green Paper on the impact of transport on the environment** (EC, 1992) which stressed the need to improve the linkage between the different components of urban journeys.

A later key development in this respect was marked by the **Green Paper on the citizen's network** (EC, 1995), where the Commission acknowledged that public transport had to be become more flexible and better suited to the needs of passengers. The latter had to be put at the heart of the decision making process at all levels, in order to achieve an interconnected long-distance and local network of public passenger systems which fit together, so that passengers can change easily between different transport modes (train to bus to tram, from car or bike to public transport).

In 1995 a Task Force on transport intermodality was created with the main goal of developing a consistent intermodal research and technological effort at European level. Central tenet of its work

was to elaborate a transport system that could work as an integrated door-to-door operation by encouraging the development of new approaches and concepts for improving both passenger and freight intermodal transport operations.

A breakthrough in setting the course of the European transport policy occurred in 2001 with the release of the White Paper on transport (EC, 2001). Interconnectivity and intermodality are viewed as priority aspects for easing travelling conditions and modal transfers, as travellers encounter serious impediments when using different modes of transport for single journeys, namely when the latter involve several transport companies or different means of transport. Moreover, the White Paper also concludes that transferring from one mode to another can be complicated by inadequate infrastructure. Within this framework, the White Paper identified a number of key issues to be addressed, such as:

- *Integrated ticketing*, e.g. encouraging the introduction of integrated systems between modes of transport (air - coach - ferry - public transport - car parks), which may also ensure a greater transparency of fares;
- *Baggage handling*, e.g. making it easier to check in luggage directly in a station without holding it during transfers to / from the airports;
- *Continuity of journeys*, which requires integration in land-use and transport planning.

These three key issues are of utmost importance because they inspired all policy and legislation efforts over the first decade of 2000.

Later, both the **Mid-term review of the White Paper** (EC, 2006) and the Communication "**A sustainable future for transport**" (EC, 2009a) have stressed the need to further encourage and coordinate actions and investments for making the EU transport systems more cooperative, co-modal and to ensure a better interconnection.

On the one hand, the mid-term review of the White Paper emphasises the structural developments that occurred at EU institutional level with the 2004 enlargement. The enlargement shaped as ever the EU dimension, and the extension of the TEN-T network emerges as valuable and strong determinant in creating more corridors and in linking Europe to its neighbours, while ensuring a Europe-wide internal transport market. Specific attention was paid to the rail sector, in order to review the technical and legal frameworks with the aim to tackle the remaining structural obstacles to the competitiveness of the rail industry, and in particular to remove those technical barriers that still prevented interoperability.

On the other hand, the Communication "A sustainable future for transport" emphasises that "*the optimal functioning of the transport system requires full integration and interoperability of the individual parts of the network, as well as interconnection between different (modal) networks*". Creating the ideal conditions for making interchanges easier and more accessible is here crucial. This applies to both passenger and freight transport, but it is with respect of the passenger side that the need for better integrating the different modes to make seamless journeys possible emerges with utmost importance. Indeed, besides the possibility to optimise passenger flows, "*the availability of multimodal stations where passengers can easily change modes, quickly access information, and feel safe, secure and comfortable will save time for users, thereby making public transport more attractive*", even in destination where users have to make use of urban transport systems that they do not know well.

A more holistic approach to the achievement of a single, interconnected and efficient transport system has been lined up by the EC in the new **White Paper on transport policy** (EC, 2011a), released in March this year.

Specifically for the issue related to interconnectivity, in the staff working document accompanying the White Paper (EC, 2011b), the EC stresses that "*The modal mix has to be better adapted to the particular needs of each journey and, in the case of passengers, to the overall travel experience. This will only be possible in a system that is highly integrated, and that is based on a continuous and ubiquitous exchange of information. The use of information technology to optimise all aspects of personal travel and freight transport is likely to become one of the most distinctive traits of future transport systems*".

Consistently with the strategic and policy approach developed over the last decade, the new White Paper not only affirms that the completion of a TEN-T high quality and capacity network remains a high priority on the EU transport agenda, but it furthermore recognises the importance of achieving a greater interconnection of the modal networks and modes (airports, ports, railway, metro and bus stations, car hire spots and parking areas).

This requires that such networks should be increasingly merged and conceived as multimodal connection platforms for passengers, whereas integration of information, management and payment systems should be viewed as key pre-requisites for integrating all means of transport and, consequently, facilitating multimodal travel by delivering better modal choices. Importantly, this particularly applies to the intermediate distances, which are less mature and where modal choices are fewer, but also where EU action might have the most immediate impact.

2.2.2 The TEN-T Network

The Trans-European transport network (TEN-T) is a further central tenet in the overall strategy of the European Union for:

- Achieving a smooth functioning of the internal market;
- Strengthening economic and social cohesion;
- Delivering accessibility, and finally
- Integrating all modes of transport.

Since its early beginning the TEN-T network has been providing the framework for creating the ideal conditions for promoting the interconnection and interoperability of national networks, as well as the implementation of projects of common interest.

The EU has the primary responsibility for developing the TEN-T network, whose legal basis is embedded in the Treaty on the European Union under Articles 154, 155 and 156. These articles state that the EU has a primary goal of promoting the development of Trans-European Networks as a key element for the creation of the Internal Market and the reinforcement of economic and social cohesion. In particular, Article 154 also states that "*within the framework of a system of open and competitive markets, action by the Community shall aim at promoting the interconnection and interoperability of national networks as well as access to such networks. It shall take account in particular of the need to link islands, landlocked and peripheral regions with the central regions of the Community*".

The concept of the TEN-T was defined for the first time in 1992 by the Maastricht Treaty, which also mandated the development of the Guidelines to encourage the creation of a single, multimodal network covering not only traditional infrastructure and equipment, but also the deployment of innovative and intelligent transport systems.

In 1994 a list of 14 priority (the so-called "Essen" projects) was defined, but it was only in 1995 that the first financial Regulation (2236/95/EC) for TEN-T was adopted and followed, in the next year, by the Decision No 1692/96/EC which set the Community Guidelines for the development of the TEN-T network within a time horizon until 2010.

1999 saw the adoption of Regulation 1655/99/EC, which amended Regulation 2236/95/EC in order to cover the period from 2000 onwards. The new Regulation also introduced the Risk Capital Facility (RCF), which was proposed as a facility to provide risk capital to projects that are (partly) privately financed through PPPs.

The Community guidelines were in their turn amended in 2001 through Decision 1346/01/EC, which also included seaports, inland ports and intermodal terminals into the TEN-T concept. In the same year Regulation 2654/01/EC was adopted as well, thus introducing the notion of Multi-Annual Programme (MAP).

The final developments of the TEN-T network occurred in 2004 and 2007, when **Decision No 884/2004/EC** on Community guidelines for the development of the Trans-European transport network,

and **Regulation (EC) No 680/2007** laying down general rules for the granting of Community financial aid in this field were adopted, respectively. Again interconnection is addressed as a key priority.

From the funding perspective, it is also important to mention that the TEN-T network is co-financed through an array of policy instruments, such as:

- Grants from the Trans-European transport budget (see Regulation 680/2007 mentioned above);
- Grants from the Cohesion Fund budget in the countries eligible for its intervention, and grants from the ERDF with priority on Convergence objective regions; these grants are managed by the Commission through the DG Regional Policy;
- Loans and guarantees from the European Investment Bank (EIB).

2.3 ONGOING POLICY WORK AT EU LEVEL

2.3.1 Overview

As recalled by the Commission (EC, 2009a), "*future challenges will require the integration of the different transport modes into a single system*", which is closely tied to a number of major policy objectives, such for example:

- Low carbon transport;
- Safe, secure and high quality transport;
- Multimodal and fully integrated networks;
- More environmentally sustainable transport;
- Innovative transport services and technologies;
- Developing the human capital;
- Smart prices.

Some policy work is already ongoing and some topics are already receiving a specific attention at EU level as they cover natural domains for strong European intervention. Such topics may be grouped as follows:

- Infrastructure (TEN-T);
- Making the transport system more user-friendly, where integrated ticketing (urban transport and air / rail complementarity), integrated information and luggage handling and security are relevant examples in this respect;
- Rail technical interoperability.

2.3.2 Infrastructure (TEN-T)

With the release in 2009 of the **Green Paper on TEN-T policy review** (EC, 2009b) the Commission looked at the TEN-T policy developments that occurred over the last 15 years, and which featured an array of significant structural changes that affected the economy, the geopolitical environment and the transport policy as a whole.

Box: Main contents of the Green Paper

The Green Paper entails two major components:

- The foundations on which future TEN-T policy should rest, and
- The issues at stake for future TEN-T development,

and outlines three options for the further TEN-T development:

- **Dual Layer**, i.e. maintaining the current structure (with some amendments) with the comprehensive network and priority projects;
- **Single Layer**, i.e. reducing the number of priority projects, but possibly extended and

connected into a priority network;

- **Dual Layer**, i.e. with comprehensive network and a "core network" comprising a – geographically defined – priority network (maps) and supplementary innovative infrastructure measures being consistent with the objectives of EU transport policy (tackling climate change, promoting innovation and new technologies, de-carbonisation of transport activities, safety and security, etc.).

Source: EC, 2009b

The Green Paper stresses the importance of ensuring an optimal interconnection of modes as well as an optimal integration of all infrastructures ("hard" and intelligent). In this respect, it may be said that the Green Paper recalls in its provision the priority objectives and fields of intervention outlined in 2007 by the Action Plan on ITS.

The contents of the Green Paper also provided the background for the launch of a public consultation in February 2009, through which the Commission aimed at gathering stakeholders' views about its proposals for reviewing the process of the TEN-T, before moving forward with legislative proposals and other relevant actions. As a major result, the consultation showed widely shared support of the European Commission's views regarding the general policy framework of the review.

On that basis the European Commission adopted a staff working document called "TEN-T Policy Review – Background Papers", which summarised the results of the consultation on the Green Paper published in February 2009 and pointed out its main conclusions.

Later on, the European Commission also decided to set up an expert group in order to prepare the methodological basis for its implementation, whose final report – in addition to the outcome of the public consultation – fed the working document **Consultation on the Future Trans-European Transport Networks** adopted by the European Commission in May 2010 (EC, 2010) and on which a second public consultation was launched in May 2010.

Such working document is the reference point for the revision of the Community Guidelines for developing a Trans-European transport network, for which the publication is expected in the first months of 2011. It still covers the three planning options outlined in the Green Paper, but highlights a strong support for the third option (dual layer, i.e. with comprehensive network and a "core network").

Importantly, together with multimodality and sustainability, interconnectivity is confirmed as a pillar in optimising the transport network and in improving the efficiency of all modes of transport (EC, 2010). Complementary to this, it is also worth highlighting that in the consultation document ITS services are viewed as major supporting components of the future TEN-T network. As commented by the Commission, "*travel and traffic information; traffic management and efficiency-related measure are applications interconnecting the modes and ensuring connection to public transport systems, freight and freight-related transport services*" (EC, 2010).

Promoting interconnectivity of ferry services

As part of the TEN-T network policy, the Commission pursues the development of sea transport, which should improve shipping links for islands and the points of interconnection between sea transport and other modes of transport.

In its Communication **Maritime transport strategy 2018** (EC, 2009c), the Commission presents water-based public transport as a key issue to promote and increase sustainable accessibility. In particular, with regard to ferry services the Commission pursues measures to further improve the framework for providing public maritime transport services that fully meet territorial continuity requirements, so to foster better connection of islands and long-distance intra-EU passenger transport through quality ferry and cruise services, and appropriate terminals.

2.3.3 Making the Transport System More User-Friendly

Integrated ticketing (urban transport and air / rail complementarity)

Since the adoption of the White Paper on transport policy (EC, 2001) the Commission has been encouraging the development and adoption of integrated ticketing schemes (which also cover integrated tariffs as these are a key prerequisite for introducing a seamless travel chain) between transport service providers of either the same mode or of different transport modes. According to the Commission, potentially allowing travellers to make a multimodal journey with a single ticket that is valid for the complete trip could facilitate the transfer of passengers between transport modes. The benefit would be twofold: on the one side, users would have a broader choice of transport services, while, on the other side, this would ensure better information on travel options.

Therefore, an important number of EU policy documents and pieces of legislation address this issue. Indeed, as mentioned in Section 2.2.1, the EU White Paper on transport policy (EC, 2001) indicated integrated ticketing as one of the priority domains where action is required for promoting a more intermodal passenger transport. Analogously, the Commission has reiterated in both the Mid-term review of the White Paper and the communication "Sustainable future for transport" that ICT innovation and ITS systems (thus including also integrated ticketing) are crucial for supporting a better management and integration of transport (EC, 2006 and 2009a).

Box: integrated ticketing and passengers' rights

The Commission's work on integrated ticketing is also closely related to the work undertaken in the field of passengers' rights. In fact, in its communication **Strengthening passengers rights within the European Union** (EC, 2005), the Commission notes that passengers' right to integrated ticketing is not yet fulfilled and that "*it should be a simple matter for passengers to combine several modes of transport in one journey, but the traditional method of organising transport by sectors constitutes a barrier to intermodality. The traveller is too often dissuaded from combining different means of transport for the same journey and encounters difficulties for example in obtaining information and ordering tickets where the journey involves different modes*".

Integrated ticketing is in particular one of the core themes covered by the **Action Plan for the deployment of Intelligent Transport Systems**. Adopted in 2008 (EC, 2008a) this Action Plan looks at the role ITS may play in: (i) achieving clean, efficient, safe and secure road transport, and (ii) accelerating and coordinating the deployment of ITS solutions, including interfaces with other transport modes. Specifically on interconnectivity, the Action Plan intends to pave the conditions for promoting:

- Traffic and travel information, and multimodal (door-to-door) journey planners, taking due account of public transport alternatives, and their interconnection across Europe;
- Urban-interurban interfaces, where the major goal is the definition of a set of common procedures and specifications to ensure the continuity of ITS services for passenger and freight in transport corridors and in urban / interurban regions.

A new legal framework for ITS has been set up with the adoption of **Directive 2010/40/EU**[1]. Specifically for integrated ticketing, the Directive calls for the "*definition of the necessary measures to develop an EU ITS Framework Architecture, addressing specifically ITS-related interoperability, continuity of services and multimodality aspects, including for example multimodal interoperable ticketing, within which Member States and their competent authorities in cooperation with the private sector can develop their own ITS architecture for mobility at national, regional or local level*".

Given the overall context illustrated head on, two areas are acknowledged by the Commission for the deployment of integrated ticketing systems: urban transport and long-distance journeys.

[1] On the 1st of April the European Commission has launched a two-month public consultation entitled "*Towards a European Multimodal Journey Planner*" aiming at collecting information and opinions about the vision, feasibility and possible technical/organisational implementation issues related to the set up of European and national multimodal journey planners. The consultation will also serve as first input to the elaboration of specifications for multimodal travel information foreseen under Directive 2010/40/EU.

Concerning urban transport, the **Action Plan on urban mobility** released in 2009 (EC, 2009d) creates a coherent framework for EU initiatives in the area of urban mobility while respecting the principle of subsidiarity. With the Action Plan the Commission proposes a comprehensive support package in the field of urban mobility, whose main objective is to provide local, regional and national authorities with a tool for helping to address the challenge of sustainable urban mobility and to facilitate their policy making.

Complementarily to the Action Plan for ITS, and recalling the contents of the Green Paper on urban mobility (EC, 2007a), the Action Plan on urban mobility also emphasises the need for:

- Multimodal information and journey planners;
- Interoperable smart ticketing across services and transport modes, including the use of smart cards in urban transport with a focus on major European destinations (airports, rail stations).

The second domain where integrated ticketing schemes may have a potential market is the one related to the integration of air and rail as the existing examples demonstrate.

As concluded by the Rail / Air Inter-modality Facilitation Forum that took place between September 2003 and June 2004, creating the appropriate conditions for enhancing the concept of integrated ticketing is a major facilitator of an increased integration between rail and air, which seems to have great potential in terms of services and passenger interest, notably in those airports that are already connected with High Speed Rail services. In some European countries, the main rail operators have started to cooperate with the airlines in order to provide passengers with an effective service by issuing an integrated ticket allowing the usage of rail and air. The successful results achieved by the existing examples of this integration scheme are the drivers for further implementation across Europe. The integrated ticketing between these two modes, in fact, has a considerable potential market in which a number of factors play an important role.

Airports serve as hubs both for long-distance and medium-distance passenger trips, therefore a more effective integrated ticketing system would allow passengers to have better information about rail access to the airports and to directly compare prices and travelling connections.

The integrated ticketing between air and rail allows in the most advanced application passengers to have a seamless multimodal journey by charging the airline with the responsibility for the whole transport chain as the trains are part of the airlines schedule. The baggage is checked-in at the air carriers' counters in the rail stations and it is delivered directly to the final destination and vice-versa.

Greater complementarity between air and rail transport has also been called by the **Action Plan on airport capacity** released in 2007 (EC, 2007b). Though the Action Plan recognises that air / rail inter-modality cannot be viewed as the only way to decongest airports, it considers however that such a higher degree of integration can be useful for achieving a greater efficiency of the transport system as a whole, and of airports in particular.

According to the Action Plan, at least three interfaces between air and rail exist which may bring specific societal, economic and environmental benefits:

- Links to the city with the resulting benefits of reduced road traffic congestion and better air quality around airports;
- Links to the region, where in addition to the benefits mentioned above, further benefits in terms of expansion of the airport's catchment area may be added;
- A link between the airport and major metropolitan areas through High Speed Rail, where to the benefits described under points 1 and 2, additional benefits include potential for short-haul slots to be freed for long-haul flights, which for airports and air carriers represent higher slot productivity.

The Community legal framework affecting integrated air / rail ticketing also entails a range of legislative acts that refer to both the air and rail sector.

For the air sector, **Council Regulation (EEC) 2299/89** (later amended by Regulations 3089/93 and 323/99) sets up a code of conduct for the so-called Computerised Reservation Systems (CRS/GDS – global distribution system) which have a twofold goal: (i) providing travellers with instantaneous information about the availability of air transport services and their fares, (ii) enabling travel agents to make immediate confirmed reservations on behalf of the consumers. The basic concept underlying this regulation is to promote free competition between airlines.

As CRS/GDS have become over the years outdated as a consequence of market developments and especially by the rise in alternative booking channels, the Commission has acknowledged the need to simplify the Code of Conduct and to strengthen competition and thus reducing distribution costs. For this reason, and following the outcomes of a public consultation launched in 2007 (EC, 2007b) a proposal for a new regulation has been adopted by the Commission in 2007 (EC, 2007c).

In the rail sector, Community legislation is more recent as far as distribution systems are concerned. Indeed, it is only in 2007 with **Regulation (EC) 1371/2007** on rail passengers' rights and obligations, included into the Third Rail Package, that the adoption of technical interoperability specifications (TIS) of telematics applications for passenger services is envisaged[2]. More specifically, Article 1 of the regulation states that rules are established "*as regards […] (a) the information to be provided by railway undertakings, the conclusion of transport contracts, the issuing of tickets and the implementation of a Computerised Information and Reservation System for Rail Transport*".

It is worth mentioning that Article 21b of the Code of Conduct set up by the Regulation (EEC) 2289/89 already foresees the possibility to cover rail services in the principal display of CRSs commonly used in aviation. Nevertheless, considering that railway tickets are on average cheaper than airline tickets, the currently existing rule of non-discriminatory fees imposes on railway tickets fees that are considerably higher than those on airline tickets, thus making the CRS bookings less interesting for rail services. As a result only a limited number of high-speed services are currently available on CRSs displays.

Finally, the 2005 **Communication on strengthening passenger rights** within the European Union (EC, 2005) also emphasised the need to achieve a voluntary undertaking from air carriers and railway companies to set up an integrated ticketing system to enable passengers to combine several modes of transport in one journey through integrated ticketing. In 2008 a public consultation was launched with the purpose to investigate organisational and technical opportunities related to the sale and promotion of integrated ticketing services and to open up a public debate on a voluntary engagement of the stakeholders concerned for the development of integrated ticketing as announced in the Communication on passenger rights and reaffirmed in the Communication on airport capacity, both mentioned earlier.

Integrated information

Besides integration of ticketing schemes, the Commission pursues a major goal of further enhancing integration of travel information among different transport modes. Again, the **Action Plans on urban mobility** (EC, 2009d) and **ITS** (EC, 2008a) are key pieces of policy strategy in this respect. Both consider the development of national multimodal door-to-door journey planners, which shall also cover public transport alternatives and their interconnection across modes, as crucial for fostering modal interchange at major hubs and transfer points. Finally, as pointed out by the Action Plan on urban mobility, a specific focus should be given to the main nodes in the TEN-T network and their local and regional connections.

Integration of travel information is also important as far as the complementarity between air and rail is concerned. In fact, the availability of easily consultable travel information on the various parts of the journey (backed by interactive reservation systems giving the possibility to make reservations for the whole journey) may be viewed as an important pre-condition for the introduction of effective integrated ticketing schemes.

[2] The TIS is being developed by the European Railway Agency (ERA) and once completed it will allow to manage information to rail passengers before and during the trip, the reservation and payment of tickets, the transport of luggage and the connections between trains (but not with other modes of transport). TIS – ATP will be a Commission Regulation which will oblige the sector to draw up a deployment plan of such telematic services. A draft of the specifications has been released in May 2010 (ERA, 2010).

Luggage handling and security

A further variable in the end-leg modal options for a seamless journey is luggage handling. Nevertheless, as shown in the report summarising the stakeholders' contribution to the public consultation on the development of integrated ticketing for air and rail transport (EC, 2008b) – which also covered the issue of luggage handling – the positions are quite patchy, though it seems that this service would be more useful rather than fundamental in satisfying customers' needs.

Moreover, a major aspect to be taken into account when reasoning about integration between air and rail in the field of luggage handling is the security of check-in luggage. Indeed, **Regulation (EC) 2320/2002** establishing common rules in the field of civil aviation security requires that luggage checked-in at the rail station complies with the aviation standards when screened before being loaded onto the aircraft, e.g. that the passenger is on the same flight and that the air / rail check-in process does not compromise aviation security protocol.

Organisational issues

As far as organisational issues are concerned, the Commission usually plays a moderating role for triggering dialogue among all relevant stakeholders. The purpose of the Commission's action is to complement its regulatory efforts, namely by encouraging operators to set up voluntary agreements for not only offering innovative solutions that can make journeys easier and more comfortable for users (for instance in the case of air / rail voluntary undertaking for setting up integrated ticketing systems), but also for strengthening the rights of all travellers even through commonly agreed complaint procedures and reporting mechanisms.

There are, however, cases where the Commission's efforts may produce an important impact at organisational level as well. This is the case, for example, with the Commission's proposals for tackling urban transport security. Here the Commission has set up in 2009 a Urban Transport Security Expert Working Group (EC, 2007e) to deal with issues like organisational measures, surveillance and detection, more resilient equipment and installations, and incident management. Once (and whether) these measures – or some of them – will be translated into legislation, they will certainly impact on transport operators' and authorities' organisational structure, as they will be asked to, for example, establish commonly agreed security criteria and benchmarks, or to carry out self-assessments or develop security plans.

Additionally, one of the Commission's core tenets is the promotion of an integrated approach in the design and development of transport policies. According to the Commission (see the Action Plan on urban mobility in this respect), an integrated approach seems to be the most suitable tool for addressing the complexity of the urban transport system. Nevertheless, it requires an adaptation in terms of governance and resources, setting realistic targets, planning organisations, cooperation between authorities and inside the authorities themselves. In the long-term, significant organisational changes may be essential to address the long-term challenges of urban mobility.

Finally, the green public procurement (GPP) method is also worth of being mentioned in this domain. Such method is voluntary, therefore authorities are free to apply a GPP policy within their organisation or not. Implementing a GPP policy requires a considerable effort at organisational level, since authorities must rely on legal and operational guidance, training and specific financial resources.

2.3.4 Rail Technical Interoperability

Additional examples of ongoing policy work refer to the standardisation and rail interoperability. Concerning the **standardisation activities**, CEN (European standardisation body CEN) has several technical committees that work on intermodal issues, such as for example:

- The technical committee on road transport and traffic telematics (CEN/TC 278) which promotes standardisation in the field of telematics to be applied to road traffic and transport;
- The technical committee on logistics and services (CEN/TC 320) which promotes standardisation of the transport distribution chain, such as activities and services undertaken in support of transport i.e. preparation, dispatch, transport, handling, storage / rest rooms, terminals, delivery / arrival of freight and passengers and the control and management of these operations;

- The working group on intermodal and interoperable transport (CEN/BT/WG 141), where the aim of the standardisation is to increase multimodality and interoperability in European transport, through the help of modern technologies and telematics, as well as to improve the effectiveness and efficiency in mobility of people and in freight transport.

In the field of **rail interoperability**, the Commission introduced its first Directive **(Directive 96/48/EC** on the interoperability of the European High Speed Rail system also referred as called "High Speed Directive) in 1996, which required Member States to make use of harmonised technical specifications for interoperability (TSIs) as the set of standards on which the TEN-T network for high speed links has to be built and renewed upon. A further step was the adoption of a second Directive (**Directive 2001/16/EC** on the interoperability of the European conventional rail system, also referred to as "Conventional Directive") which aimed at introducing the same principles to key conventional rail networks that are part of the TEN-T network. Both Directives have been repealed in 2008 in the new railway interoperability Directive (**Directive 2008/57/EC**). This new directive establishes the conditions to be met to achieve interoperability within the Community rail system, and ongoing policy work principally refers to the Technical Specifications for Interoperability for Telematics Applications for Passenger (TAP-TSI), including information, reservation and payment systems connecting trains with other modes.

2.4 CONCLUSIONS

Chapter 2 has summarised the most significant developments in the EU transport policies that occurred over the last decade and that, more importantly, have an impact on the interconnectivity issue.

It has emerged clearly that the Commission has primarily developed its intervention through non-binding policy documents, rather than formal authoritative pieces of legislation. Specifically for interconnectivity, the upshot is that developments and progress could be viewed more as side-effects of policies due to addressing other primary issues, and not the consequence of a direct regulation to improve interconnectivity.

The EU intervention has a clear added-value, and for instance its contribution may be viewed in terms of continuous efforts for:

- Improving travel time, namely by fostering ICT solutions to improve access to interconnections;
- Reducing the time spent on the last leg of long-distance journeys in order to reach the final destination in urban areas;
- Increasing the quality of services (for example: user-friendliness, reliability, frequency, provision of integrated ticketing and information systems) for linking long- and short-distance connections.

The analysis made in the previous sections has therefore shown that interconnectivity embeds several domains of intervention, which have been put forward in numerous EU policy documents and pieces of legislation. The development of the TEN-T networks, the increased technical interoperability, but also the deployment and adoption of integrated ticketing and travel information systems are major examples of the efforts undertaken by the Commission towards the achievement of a more efficient, multimodal and integrated Europe-wide transport system.

Importantly, the issue of interconnectivity should not just be viewed in the light of the long-distance journey only, but also to the first and last leg of a multimodal journey. Indeed, the coordination and integration of local public transportation with long-distance transport modes is seen by the Commission as crucial for ensuring the continuity of the whole journey. In the Commission's views, "*urban areas should provide efficient interconnection points for the trans-European transport network and offer efficient 'last mile' transport for [….] and passengers. They are thus vital to the competitiveness and sustainability of our future European transport system*" (EC, 2009d).

The following pages summarise the main EU contribution to the interconnectivity issue.

Table 2-1 Overview of EU contribution to the interconnectivity issue

DOCUMENT	YEAR	APPROACH	MODE(S) CONCERNED	ASPECTS OF INTERMODALITY CONCERNED
Working document for the consultation on The future trans-European transport network policy *COM(2010) 212 final*	2010	Strategy	ALL	Basis of reference for the revision of the Community Guidelines for developing a TEN-T network. Interconnectivity is confirmed as a pillar in optimising the transport network and in improving the efficiency of all modes of transport.
Directive 2010/40/EU on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.	2010	Normative	ALL	Specifically for integrated ticketing, the Directive calls for the "*definition of the necessary measures to develop an EU ITS Framework Architecture, addressing specifically ITS-related interoperability, continuity of services and multimodality aspects, including for example multimodal interoperable ticketing, within which Member States and their competent authorities in cooperation with the private sector can develop their own ITS architecture for mobility at national, regional or local level*".
A sustainable future for transport: Towards an integrated, technology-led and user friendly system *COM(2009) 279*	2009	Strategy	ALL	Interconnectivity further confirmed as strategic priority. Need for full integration and interoperability of the individual parts of the network, as well as interconnection between different (modal) networks. ICT innovation and ITS systems are viewed as crucial for supporting a better management and integration of transport.
Green Paper TEN-T: a policy review towards a better integrated Trans-European transport network at the service of the common transport policy *COM(2009) 44 final*	2009	Strategy	TEN-T	Stresses the importance to ensure an optimal interconnection of modes as well as an optimal integration of all infrastructure ("hard" and intelligent). In this respect, it recalls in its provision the priority objectives and fields of intervention of the Action Plan on ITS.
Strategic goals and recommendations for the EU's maritime transport policy until 2018 *COM(2009) 8 final*	2009	Strategy	MARITIME	As part of the TEN-T network policy, shipping links should be improved for islands and the points of interconnection between sea transport and other modes of transport.

Table 2-2 Overview of EU contribution to the interconnectivity issue (continued)

DOCUMENT	YEAR	APPROACH	MODE(S) CONCERNED	ASPECTS OF INTERMODALITY CONCERNED
Action Plan on Urban Mobility *COM(2009) 490/5*	2009	Strategy	LOCAL TRANSPORTATION	**Complementarily to the Action Plan on ITS:** As far as integrated ticketing is concerned, it calls for introducing interoperable smart ticketing across services and transport modes, including the use of smart cards in urban transport with a focus on major European destinations (airports, rail stations). As far as integrated information is concerned, it stresses the need for developing national multimodal door-to-door journey planners. These should also cover public transport alternatives and their interconnection across modes, as crucial for fostering modal interchange at major hubs and transfer points.
Action Plan for the Deployment of Intelligent Transport Systems in Europe *COM(2008) 886 final*	2008	Strategy	ALL, LOCAL TRANSPORTATION	**Complementarily to the Action Plan on urban mobility:** As far as integrated ticketing is concerned, it calls for introducing interoperable smart ticketing across services and transport modes, including the use of smart cards in urban transport with a focus on major European destinations (airports, rail stations). As far as integrated information is concerned, it stresses the need for developing national multimodal door-to-door journey planners. These should also cover public transport alternatives and their interconnection across modes, as crucial for fostering modal interchange at major hubs and transfer points.
Public consultation document on “Development of Integrated Ticketing for Air and Rail Transport of the European Commission services”	2008	Strategy	AIR & RAIL	Triggers a considerable debate on air / rail integrated ticketing. Key step for further EU action in this field.

Table 2-3 Overview of EU contribution to the interconnectivity issue (continued)

DOCUMENT	YEAR	APPROACH	MODE(S) CONCERNED	ASPECTS OF INTERMODALITY CONCERNED
Directive 2008/57/EC on the interoperability of the rail system within the Community (Recast)	2008	Normative	RAIL	Replaces former Directives 96/48/EC ("High Speed" Directive) and 2001/16/EC ("Conventional Directive") and establishes the conditions to be met to achieve interoperability within the Community rail system. Ongoing policy work principally refers to the Technical Specifications for Interoperability for Telematics Applications for Passenger (TAP-TSI), including information, reservation and payment systems connecting trains with other modes.
An action plan for airport capacity, efficiency and safety in Europe *COM(2006)*	2007	Strategy	AIR	Calls for a greater complementary between air and rail transport. It considers however that such a higher degree of integration can be useful for achieving a greater efficiency of the transport system as a whole, and of airports in particular. 3 levels of integration are identified.
Stepping up the fight against terrorism *COM(2007)649 final*	2007	Strategy	ALL, LOCAL TRANSPORTATION	Organisational impacts tied to the transposition into legislation of security measures once (and whether) it will occur.
Regulation (EC) No 1371/2007 on rail passengers' rights and obligations	2007	Normative	RAIL	Establishes passengers' rights in the rail sector. On integrated ticketing, Article 1 of specifically states that rules are established "*as regards […] (a) the information to be provided by railway undertakings, the conclusion of transport contracts, the issuing of tickets and the implementation of a Computerised Information and Reservation System for Rail Transport*".
Keep Europe moving - Sustainable mobility for our continent - Mid-term review of the European Commission's 2001 Transport White Paper *COM(2006) 314*	2006	Strategy	ALL	Interconnectivity further confirmed as strategic priority. Emphasis on the structural developments occurred at EU institutional level with the 2004 enlargement. Specific attention paid to the rail sector (review of the technical and legal frameworks for fostering interoperability). ICT innovation and ITS systems are viewed as crucial for supporting a better management and integration of transport.

Table 2-4 Overview of EU contribution to the interconnectivity issue (continued)

DOCUMENT	YEAR	APPROACH	MODE(S) CONCERNED	ASPECTS OF INTERMODALITY CONCERNED
Strengthening passenger rights within the European Union *COM(2005) 46 final.*	2005	Strategy	AIR & RAIL	Emphasis on the need to achieve a voluntary undertaking from air carriers and railway companies to set up an integrated ticketing system to enable passengers to combine several modes of transport in one journey through integrated ticketing.
Regulation (EC) No 2320/2002 establishing common rules in the field of civil aviation security	2002	Normative	AIR	Air / Rail integration: it requires that luggage checked-in at the rail station complies with the aviation standards when screened before being loaded onto the aircraft.
White Paper European transport policy for 2010: time to decide *COM(2001) 370 final*	2001	Strategy	ALL	Interconnectivity and intermodality are viewed as priority aspects for easing travelling conditions and modal transfers. 3 key issues have to be addressed with respect to interconnectivity: integrated ticketing, baggage handling, integration in land-use and transport planning (continuity of journeys).
Green Paper The citizen' s network - Fulfilling the potential of public passenger transport in Europe *COM(1995)601 final*	1995	Strategy	ALL	Commission acknowledged that long-distance and local network of public passenger systems have to be interconnected.
Council Regulation (EEC) 2299/89 on a code of conduct for computerised reservation systems.	1989	Normative	AIR & RAIL	Foresees the possibility to cover rail services in the principal display of CRSs commonly used in aviation, thus allowing integrated air / rail ticketing. Nevertheless, only a limited number of high-speed services are currently available on CRSs displays.

3 METHODOLOGICAL APPROACH TO THE REVIEW OF SELECTED CASE STUDIES

3.1 INTRODUCTION

This section of the deliverable aims at setting the basis for carrying out a comprehensive review of the selected case studies in the light of the description of the EU intervention in the interconnectivity-related transport domains in chapter 2. The purpose is here fourfold, i.e.:

- To investigate to what extent EU policy objectives on interconnectivity have been translated into practice with the view of optimising the existing interfaces between transport networks and passenger target groups;
- To understand which approaches are most likely to meet the EU policy goals on interconnectivity;
- To identify major barriers in the legal, organisational and institutional environment;
- To make some final recommendations.

This is embedded in a conceptual framework (see Figure 3-1), where it may be noted that the major goal of improving transport interconnectivity is achieved at two different levels: EU and national. Firstly, the EU has a key role in defining the policy objectives (which may become the basis for eventual legislation) and the technical standards that shall enable enhanced interconnectivity. Secondly, the Member States contribute to the extent they are asked to under the principle of subsidiarity, and adapt their own legislation and policies to the EU framework. All this has a direct impact on business and investment choices of the transport operators and, consequently, on the availability and quality of the services provided to travellers.

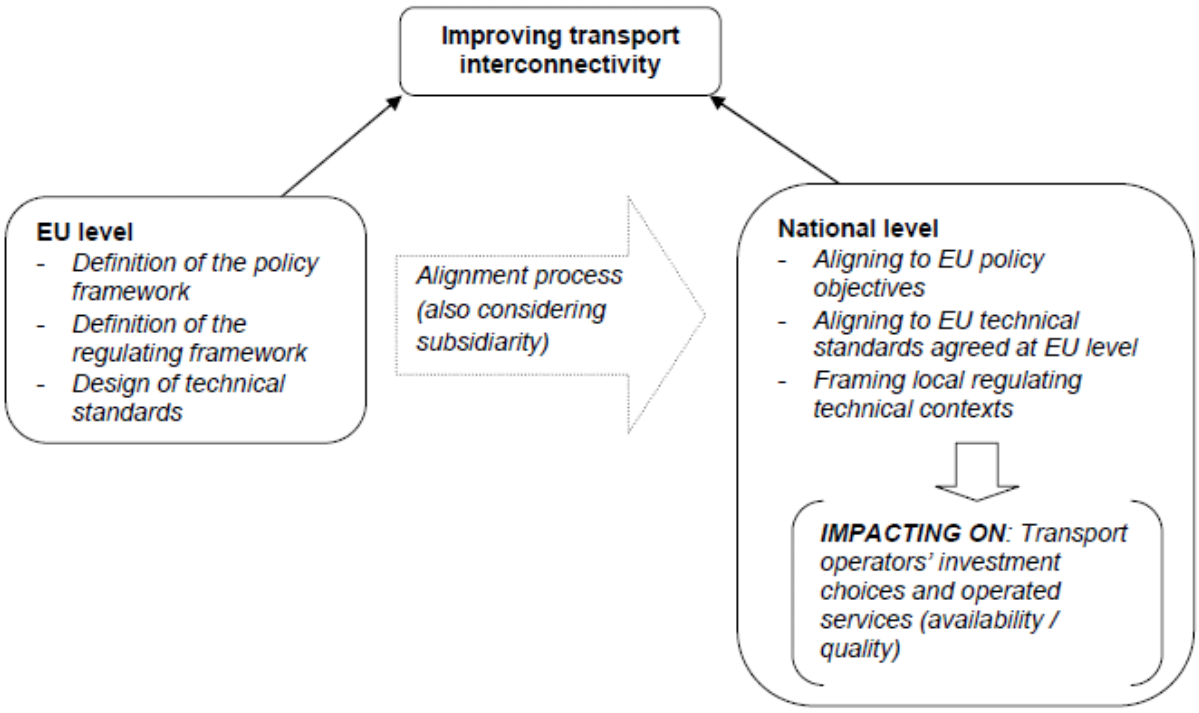

Figure 3-1 Impact levels for improving transport interconnectivity

The expected outcome is to carry out a qualitative assessment in terms of consistency with the EU interventions in the domain of transport interconnectivity of the selected case studies, so to identify deficiencies, gaps and areas for future developments.

3.2 METHODOLOGY

The review will be organised around five main themes identified for their relevance in the EU policy work in the field of passenger interconnectivity:

- **Network and infrastructure**, which implies understanding that an interchange should be strongly interlinked (accessible) not only at a micro-level (regional / local network) but also at a macro-level (TEN-T network). This requires to plan strategically in order to make sure that the quality of a transport link (along with the quality of the transport facilities and services) is secured. The focus is then on accessibility, for which an efficient infrastructure is a pre-requisite for securing the overall efficiency and sustainability of a transport system. Notably, the improvement of an infrastructure should be planned and developed in interplay between the development of the infrastructure itself and the network to which it is linked.
- **Quality of the interchange**, which implies looking at the degree of interoperability of both infrastructure and services, by investigating the following key elements: integration of the different transport services (different operators) / modes (air/rail, rail-urban PT), integrated timetables, quality of design of interchanges, quality of services for making interconnection workable and attractive to customers. Here major elements are: door-to-door information (pre-trip and on-trip), integrated ticketing and fares, integrated booking and payment systems, handling of luggage.
- **Integration of transport operators**, which implies investigating whether and to what extent local transport operators have established joint partnerships and voluntary agreements for offering their transport services under a common brand and organisational structure. It may be argued that such type of integration may increase patronage and quality of services by optimising their provision.
- **Planning process**, which refers to the need to set up organisational structures that should ensure an integrated planning approach, so to make the interplay between networks easier. This calls for a large involvement of all relevant stakeholders, not only including authorities and transport companies traditionally responsible for the development and ownership of the interchanges, but also of other operators that could contribute to the further development of the interchanges.
- **Promotion of intermodality**, which refers to how interconnectivity is promoted and marketed. Key elements are here techniques for awareness raising and mobility management in order to encourage users to make use of intermodal trips (and consequently raising its market share).

These themes will be evaluated on the basis of different criteria like:

- Presence of an integrated network and of interchanges that are conceived as a core and functional part of the network as a whole;
- Level of accessibility of interchanges both at macro and micro level;
- How passenger information is provided in interconnections between short- and long-distance transport networks;
- Degree of innovation in passenger focused information supply;
- How and to what extent principles of info-connectivity are used for optimising the existing interfaces between transport networks and passenger target groups;
- How and to what extent the integration of transport operators is achieved, and whether it stems from voluntary agreements or from institutional enforcement;
- How the planning process directly takes into account the need for integrated networks, or whether it is a side effect of different oriented approaches;
- How and to what extent the intermodality is promoted effectively to passengers.

Given the heterogeneous nature of the case studies to be reviewed, which differ to a large extent in terms of geographical coverage, transport modes involved, catchment areas etc., the proposed themes and criteria have been identified and selected for their broad occurrence in most of the investigated situations. These cross-cutting domains of assessment allow for a comprehensive common path of analysis through all cases.

4 CROSS-CHECKING THE CONSISTENCY WITH EU POLICY WORK ON INTERCONNECTIVITY

4.1 OVERVIEW

Based on the methodological approach described in Section 3, Section 4 will undertake the review of the selected case studies listed in Table 4-1 and will try to identify to what extent the elements outlined in the EU transport policies and related to interconnectivity are addressed in the different local contexts examined.

Table 4-1 Selected case studies for the INTERCONNECT project

Case study		Modes	Countries
1	Frankfurt Airport Interconnections	Rail, Air, Bus	DE
2	Catalan airport system interconnections: Barcelona, Girona, Reus and Lleida	Rail, Air, Tram, Bus	ES
3	Milanese airport system interconnections: Malpensa, Linate and Orio al Serio	Rail, Road, Air	IT
4	Scottish airport system interconnections: Edinburgh, Glasgow and Prestwick	Rail, Air, Bus	UK
5	Interconnectivity of rail at Leeds railway station	Rail, Tram, Metro, Bus	UK
6	The Milan railways node	Rail, Metro, Tram, Bus, Air	IT
7	The dual-mode railway system: the Karlsruhe model	Rail, Tram, Bus	DE
8	Train-Taxi and feeder bus services	Rail, Taxi (road)	UK, NL
9	Amsterdam ferry services	Rail, Tram, Bus, Ferry	NL
10	Lisbon ferry services	Ferry, Rail, Metro, Tram, Bus	PT
11	Helsingborg ferry terminal	Ferry, Rail, Bus	DK, SE
12	Rostock ferry terminal	Ferry, Rail, Bus	DK, DE
13	Tri-City Gdansk / Sopot / Gdynia	Ferry, Rail, Tram, Bus, Air	PL

The chapter is structured as follows; for each case study already presented in Deliverable D4.1 “Factors Affecting interconnectivity in Passenger Transport” a review against the EU objectives in the field of transport interconnectivity is provided.

In reviewing the case studies, their main background will be briefly introduced at first. This will be followed by the assessment of each distinct five themes identified in Chapter 3, which will be described in detail in a dedicated section. Finally the overall assessed consistency with the EU interventions will be summarised in factsheets together with a qualitative evaluation for each of the proposed themes. The main findings of the cross-comparison between cases will be presented in section 4.15.

4.2 FRANKFURT AIRPORT INTERCONNECTIONS

4.2.1 Background

The Frankfurt airport interconnections case study analyses the state of land interconnections at Frankfurt airport, how the airport is interconnected with urban, regional and long-distance rail services and with the road network. It especially deals with the fact that besides the rich interconnection with the highway network, the incorporation of the airport into the High Speed Rail system has been a big step forward to increase the intermodality at the airport, enabling the cooperation between air and rail operators for through-ticketing, thus constituting an element of good practice. The improvement of the rail-airport interconnection and operator cooperation has resulted in substantial rail demand at the airport, allowing liberation of slots from no longer necessary feeder flights to be used for long-haul flights, therefore improving transport co-modality. An important finding of the case study is that the infrastructure (here linking the airport directly to the High Speed Rail lines) is a prerequisite to enable market driven intermodal services which are successful and economically viable.

This case study was used in T4.3 as an in-depth test-bed analysis to check for transferability of findings from Frankfurt to Stuttgart airport. Stuttgart airport, although already connected to the rail network with a commuter line, has for the time being by far not the function of an intermodal transfer point like Frankfurt has today. So the test bed analysis points out what transport related changes would appear for Stuttgart airport concerning the demand side, if Frankfurt-style long-distance connections by rail would be applied for this airport.

4.2.2 Assessment against EU Objectives in the Field of Interconnectivity

The overall assessment against the EU policy actions and objectives concerning intermodality for Frankfurt Airport can be summarised as excellent. This is not surprising, as the case study of Frankfurt airport was chosen as an example for good practice in intermodality by the authors of the study. There are only a few minor fields left, where still improvements are possible or at least desirable, e.g. a bus terminal due to the liberalisation of bus services in Germany for 2012.

Network and infrastructure

The case study and especially the test bed for Stuttgart airport clearly point out which possibilities to implement intermodal transport chains exist, if the infrastructure of the specific modes is well connected to each other. “Well connected” in this context means that it is not sufficient to connect an airport just “somehow” with the railway network by a single line to the central station of the next city and to run separated commuting trains on this stretch, isolated from other railway services passing through the area. This concept of inter-linking the two modes allows assessing network and infrastructure against EU policy as high.

The infrastructure (of rail) has to be designed in manner that long-distance trains directly serve the airport and connect it to numerous other parts of the country. Services which require a change between long-distance and commuter train or a (bus) shuttle service from the train station next to the airport by far do not reach the acceptance by the traveller which applies for through train services.

Furthermore, the infrastructure must be designed in a way that serving the airport neither implies any serious increases in travel-time for non-airport related rail passengers, nor that only trains specially dedicated for air passengers would allow a level of service required for the acceptance of rail transport as a feeder mode to substitute short haul feeder flights. Rail operating companies would not accept to serve an airport with their long-distance trains, if this would harm the competitive situation of rail travel on non-airport related travelling. From the Frankfurt airport case study one could also learn that special services for air passengers are not profitable for the train operating company, even when feeding an airport with more than 50 million passengers per year. The specific demand figures when broken down to hourly rail services from different directions are just too small to run such special airport trains in an economically viable way.

Connecting an airport directly to the High Speed Rail network and equip it with a railway station as happened at Frankfurt airport with its own long-distance railway station on the corridor 24 of the TEN-T

Rotterdam – Genoa allows serving the airport by multiple long-distances train lines 'en passent' meaning through-services to many parts of Germany and some neighbouring countries lead to impressive shifts of passenger demand from road and especially in the case of Frankfurt also from air transport towards rail as a feeder mode. But without a rail infrastructure concept as described these development would have not been possible.

Having in mind the passenger figures one should think about the lesson learned from the case study of Frankfurt Airport respectively the test bed when connecting Stuttgart airport to the long-distance rail network, for the definition and basic principles of future TEN-T projects promoted by the European Union. For the time being these projects usually deal only with the infrastructure of one mode, while interconnectivity for long-distance travelling is fairly unconsidered. The two examples of Milan Malpensa Airport (see also chapter 4.4) and the West Coast mainline project which are the two priority projects No 10 and No 14 of the 2005 TEN-T priority axis' list clearly point that out:

The project No 10, Milan Malpensa Airport, mainly dealt with infrastructure at the airport (Terminal, control tower, aprons cargo centre), the topic "improved airport access" was dealt with by building more car parking facilities and a express railway service to link the airport with Milan city centre, without any acceptable linkage to the Italian rail network. There has been no concept or planning or financial fund of the EU when setting up Milan Malpensa, as a TEN-T project to promote real interconnectivity between air and long-distance rail.

The project No 14, deals with the most important trunk route in the United Kingdom's rail network with some 2000 train movements per day. It links London with Birmingham/Manchester, as well as with Liverpool, North Wales, the North West, Cumbria and Scotland, covering a distance of 850 kilometres. While Birmingham Airport is already equipped with a railway station, which will probably be served by high speed trains running on this route in the future, there is no plan for connecting the airports of Edinburgh and Glasgow with that link. Even the busiest airport in Europe, London Heathrow, will just be linked to this line via an interchange in the north of London, where passengers from the north of England will be able to change for trains connecting London city with Heathrow airport. Although this is indeed better than today's' necessity to connect by London Underground between different railway stations in London City, this by far does not allow intermodal travelling in a quality and acceptance by the traveller as it applies for the Frankfurt Airport case. If at all, only in a later stage in this project, which is branded as "High Speed 2" in the UK, a direct connection to Heathrow Airport might be realised.

The lesson learned should be that from European Union a clear signal towards such projects has to be given, that infrastructure design from the beginning should deal with the intermodality air - rail also on long-distance travel to enable smart solutions which are widely accepted by the users.

Quality of interchange

The interchange between (long-distance) rail and air at Frankfurt airport is organised in a way that the airport has its own railway station, adjacent to terminal 1 and accessible within walking distance. Moving walkways and escalators assist passengers especially when carrying baggage with them allowing easy access to the airport from the station and vice versa. Check-in facilities and a baggage drop-off point are also available in the airports' railway station, so that check-in baggage has not to be carried to the terminal by the departing passengers. When arriving by plane it is also possible for passengers to collect their baggage at the railway station, if they booked this beforehand.

Therefore the quality of the interchange in the Frankfurt Airport case study can be considered as high, with regard to its layout that enables the operators of transport services for the different modes air and rail to cooperate in a way that is accepted by the market.

The infrastructure implemented allows the different operators to cooperate well and establish common products for seamless travelling, like the AIRail concept of Lufthansa and Deutsche Bahn as a partnership for real seamless travelling.

This starts with the **pre-trip planning**, where booking a flight and the corresponding feeder train trip, replacing a short-haul feeder flight, can be done in one go via the airlines' website, including travel itinerary, reservation and payment for all trip segments of the whole journey in one step, i.e. **through-**

ticketing and **integrated information**. Depending on the airline and/or the railway station where the journey starts or ends, variants of this procedure may apply concerning payment or information about the train segment of the trip. In contrast to the AIRail product those variants usually do not deal with an **integrated customer care** of one operator responsible in case any disruptions apply on one segment of the whole journey.

Unfortunately one item really desirable for seamless travelling, and which was already established, had to be ceased mainly due to security reasons: the through-baggage service between the railway station where the whole journey actually starts to the final destination to be reached by aeroplane.

Both aspects concerning the interchange, the 'hardware', i.e. the airports' railway station with its linkage to the rail network, and the 'software', the intermodal offers to the traveller like through-ticketing, make that the quality of the interchange can be considered as high.

Integration of transport operators and promotion of intermodality

All different forms of transport operator integration have in common that they were established market driven, i.e. there was no legal compulsion to set up such cooperation. In all cases their inauguration created a win-win-situation for the different operators: Deutsche Bahn can attract additional rail passengers choosing the train to reach the airport instead of using a car, while Lufthansa could replace some ultra short-haul feeder flights and make better use of the rare slots at the constrained airport. Other airlines, which are not a member of the STAR Alliance and for that reason can hardly rely on the domestic Lufthansa feeder flights to Frankfurt airport for their passengers, use the cooperation to attract more passengers from all parts of Germany for their own Frankfurt flights. In consequence of the existence of all this different market driven cooperations the promotion of intermodality is being assessed as high.

On the other hand this means that there are still some airlines or also tour operators left, who still have no cooperation agreement with the railway company concerning through-ticketing, as for the time being, they do not see any advantage for their own business in it. For this reason and due to the fact, that airlines and rail operators are still totally independent their integration is considered as medium.

Nevertheless it has to be stated that legal issues like taxation of short-haul flights, the structure of landing fees or regulations concerning slot allocation at constrained airports could further support the implementation of common intermodal products allowing seamless travelling. But when setting up regulations to promote intermodal travelling, one should always be aware that such legal requirements should always support intermodality instead of hindering it, e.g. too strict terms for customer care could result in a refusal of transport operators to establish any intermodal offers to the customer.

A real boost of intermodal trips organised by the traveller himself could be reached, if the responsibility would be reorganised when combining rail and air trips. At the moment neither the rail operator nor the airline takes the responsibility when delays occur and either the train or the air connection is missed. Travellers need a sort of secure transport chain so that they feel really confident in choosing such intermodal transport solutions. How to achieve this confidence by regulations or cooperation agreements is even not discussed at the moment. The risk is with the passenger although he has no influence on the transport system. Therefore as access mode to airports the more flexible individual car transport is chosen.

Another serious point is does make a lot of sense to include a long-distance train feeder in the travel options available at an airport, but the absolutely crucial prerequisite for this being established and actually widely used by the traveller is an adequate infrastructure, which must allow both: the implementation of intermodal offers in an economic viable way for the operators and from the travellers point of view characteristics of this intermodal transport offer, so that he favours it over an uni-modal alternative.

Planning process

It has already been mentioned in the infrastructure section that the planning process for new (rail) infrastructure should take care of intermodal opportunities concerning airports from the beginning. In the case of Frankfurt airport this has been done and the test bed concerning the future rail connections of Stuttgart airport also considers a planning where long-distance rail services can stop at

the airport. Especially in the Stuttgart case the original plan for the high speed link Stuttgart – Ulm which is a part of the TEN-T corridor Paris – Bratislava has been changed significantly. In the first plans for this link only a branch towards the South (to Reutlingen – Tübingen) from the high speed link was foreseen, bypassing the area around Stuttgart airport without any stop. When the planning was updated in the mid 90s, the reallocation of the Stuttgart central station was incorporated into the planning which allowed moving the routing of the high speed link more towards Stuttgart Airport, so that a connection of the airport with this link now became feasible. This linkage is in line with the principles which were applied when connecting Frankfurt Airport to the long-distance rail network:

- A direct connection to the High Speed Rail network, instead of just an commuter line to the towns' central station;
- The layout of the connection allows serving the airport by train services running anyway, i.e. no special (or additional) trains are necessary to serve the airport.

Relying on these principles the case study and test bed are assessed as high concerning intermodality in the field of the planning process, as only the consideration of these principles from the beginning allows implying excellent intermodal transport chains on an economic viable base for the operators and their wide acceptance by the travellers. And this consideration has to be done before one starts actually to build the infrastructure. Consideration in this context means, that it should be assessed if such a layout of rail infrastructure incorporating airports directly to the long-distance railway network is beneficial. For example Munich airport lacks such integration into the TEN-T corridor Paris – Bratislava as the planning process of the high speed lines in the vicinity has not been interrelated with the new airport location. A 'faux pas' which will cause problems in the long-term as just sub-optimal solutions with sub-urban trains can cope with this situation, hindering the airport to copy the leverage effects shown in the Frankfurt case study.

In addition when looking at the Spanish High Speed Rail link Madrid – Barcelona this becomes quite clear: the link, although the routing in the vicinity of Madrid is quite close to the airport, does not have any stop at Barajas Airport. Today, when this high speed link is already in service and its construction widely finalised, just a rail link in classical Spanish wide gauge will connect the airport to one of the central stations (Chamartín) downtown in Madrid. For long-distance rail travel from all parts of the country to Barajas this means that the intermodal option, i.e. using a train from Barcelona to Madrid airport in comparison to a feeder flight to connect to an intercontinental destination is quite uncomfortable. Even when assuming that there would be direct local commuter trains from the Atocha Cercanías Station which is adjacent to the Puerta de Atocha terminus of the high speed trains to/from Madrid, this still would require an additional train change with inconvenient footpaths, not to mention the different tariff systems which for the time being apply to Spanish high speed trains and local Madrid commuter services. One can imagine that airlines hardly want to rely on such an alternative for replacing any short-haul feeder flights. The latest development now shows that the planning will be updated to allow directly services to the Barajas airport by high speeds trains of the Barcelona – Madrid stretch. The realisation of this planning is difficult form the operational point of view and costly. Things which could have been avoided if intermodality would have been taken into account from the very beginning.

On the other side of the stretch in the Barcelona area, the intermodal aspect concerning long-distance rail and Barcelona's El Prat Airport is dealt with in a different way. For details please see section 4.3.

4.2.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: High
Comments Design and layout of the infrastructure enables the operators of rail and air transport to offer combined intermodal services in an economically viable and sustainable way allowing them to attract more passengers for their business and generate more profit. This was eased by the fact

Area of intervention: Network and infrastructure
that the airport has been fully integrated into the rail network, both for high-speed/long-distance services, and commuting services.

Area of intervention: Quality of interchange
Assessment against EU work: High
Comments The interchange itself allows implementing through-services combing rail and air to seamless travelling for the customer. This seamless travelling has been established concerning through-ticketing, check-in, baggage drop-off / collect and trip-planning.

Area of intervention: Integration of transport operators
Assessment against EU work: Medium
Comments All operators still act independently, cooperations between rail and air transport operators apply, where both of them see a win-win-situation for their own core business. The confidence of travellers in intermodal air-rail services is limited, except for AIRail, due to a missing responsibility assignment to the overall intermodal travel chain in the case of delays by one or both of the operators.

Area of intervention: Planning process
Assessment against EU work: High
Comments Following the example of Frankfurt airport, the test bed dealing with (long-distance) rail connections to Stuttgart airport shows clearly, that intermodal opportunities rail <-> air should be considered from the beginning of the planning process. On the example of Madrid's Barajas airport, where the rail infrastructure of the high speed link towards Barcelona which might could have been connected directly to the airport, the difficulty to implement infrastructure which fits best to the needs of intermodal seamless travelling afterwards can be seen. When setting up TEN projects concerning rail or air the European Union could promote intermodal aspects stronger than before to avoid planning which neglects the linkage of different modes.

Area of intervention: Promotion of intermodality
Assessment against EU work: High
Comments All airlines and tour operators which cooperate with the rail operator Deutsche Bahn actively promote intermodality to increase their core business air transport for different reasons: some want to improve the usage of their slots at the constraint Frankfurt airport, while others use the trains of Deutsche Bahn as feeders for their (intercontinental) flights, as they lack a cooperating airline for short-haul feeding. And for the rail operator additional passengers to Frankfurt airport just mean more income and a better load for the trains they run anyway.

4.3 CATALAN AIRPORT SYSTEM INTERCONNECTIONS: BARCELONA, GIRONA, REUS AND LLEIDA

4.3.1 Background

The *Catalan airport system interconnections: Barcelona, Girona, Reus and Lleida* case study analysed the state of the many projects of interconnectivity planned for these airports with their surrounding urban centres, and between these airports and the major surrounding regional transport networks, mostly the High Speed Rail. This case study also takes the opportunity to make some general remarks on other issues related to the Catalan and the Spanish administrations' position in relation to interconnectivity enhancement in the several transport networks in service in the regional framework.

Reus, Barcelona, Girona and Lleida are only separated by less than 200 km pair to pair. The connection of airports to the HSR, planned at different time horizons but not yet in service, will improve access to regional airports from the Barcelona Metropolitan area (30 minutes from Barcelona to Girona and Reus, and 60 minutes to Lleida), and access to Barcelona airport from the rest of the Catalan region.

In Girona and Reus, these connections are conceived in the framework of future local tramway networks, while in Lleida the airport should have an in-terminal rail station. The implementation of these networks and links, however, is at most at administrative stages. On the other hand, the airport of Barcelona is connected to a suburban rail station, and soon will be also connected to the urban metro network and to the High Speed Rail network.

The hinterland of Barcelona airport in terms of population accessible in 2 hours by land modes (car and rail) covers today 8.2 million people; more than 80% of travellers are originated or bound for Barcelona (64%) or its Metropolitan Region (19%). The HSR line from Madrid to France will increase the hinterland by 11%.

In order to assess the capability of HSR lines to expand the Barcelona airport catchment area, a comparison with some airports in central Europe can be made. Köln-Bonn, Brussels, Amsterdam or Frankfurt have much bigger hinterlands with around 20 to 25 million inhabitants in a 2 hour reach. In addition, the increases in these hinterlands due to the implementation of the TEN-T rail projects are also much higher (around 200%) because the population density is much higher in central Europe. Of all major European airports, only the most peripheral like Helsinki, Athens or Stockholm would grow less than Barcelona. With all these factors, flows associated with the airport-HSR interconnection are expected to be relatively low.

Girona and Reus airports have experienced rapid traffic growths over the last 15 years. Girona has grown rapidly after the arrival of Ryanair, and Reus was expected to show similar growth over the coming years. Traffic in these airports are mostly dominated by tourists, representing 74% and 82% of global traffic respectively in Girona and Reus.

The evolution of traffic volumes in regional airports, especially the evolution of trips originated or bound for Barcelona, is a key element to be considered in the size of the interchanges between the HSR network and the airports. Most target users of these interconnections will be users originated or bound for Barcelona. The magnitude and concentrated nature of these demands made public transport especially suitable.

4.3.2 Assessment against EU Objectives in the Field of Interconnectivity

Network and infrastructure

During the last years, large infrastructure investments in Spain have expanded the capacity of airports, passenger HSR and motorway networks and there is no capacity shortage in any of these. Spain's HSR network should be 5,000 km long before 2020. Spain's motorway network has grown from 2,000 km to 10,000 km between 1990 and 2010. Six new airports have been constructed between 2003 and 2011, and most of the already existing airports have been upgraded and/or enlarged. These investments were financially feasible in large part due to Cohesion and Structural Funds.

Most of these new infrastructures, like parts of the high speed program or many new regional airports in the 2000 decade, were planned and developed looking forward to promote environmental sustainability (the need to promote the modal change towards rail) and territorial cohesion (promoting equal opportunities in all regions). In many cases, interconnections were foreseen between these different networks, but now most of the new infrastructures in Spain which were based on these premises are struggling to have minimum frequentation levels. The Spanish case leads to conclude that infrastructures and interconnections must be carefully planned and managed according to the specific characteristics of each case in order to avoid overinvestment in infrastructure.

In particular, for the Catalan airport system, the interconnection of airports with HSR has been an idea already since the 90s when the high speed network was being envisaged. Even if this idea was very seldom considered in the different sectorial transport master plans for Catalonia, more recently these connections have been made explicit in the Territorial Master Plans – in a working scale of 1:50,000). Considering that territorial plans were produced towards the end of the 15 year long economic expansion period in Spain, interconnections were foreseen according to very high growth scenarios: sustained increasing demographics (i.e. the Catalan population grew by 25% between 95-05) and sustained increasing mobility (e.g. global air traffic in Catalonia grew by 150% between 95-05 and tourism in Barcelona grew by 100% between 95-05).

Both in Girona and Reus the new High Speed Rail lines are being built within reach of the airports, even if not by the airport terminals. Interconnection of airports and the high speed network is foreseen in the mid-term in the framework of future local tramway networks, which are currently being planned. The future of these networks, however, will be very dependent on when recovery of the Spanish and the Catalan economies will take place, and on how strong this will be. In the short-term, ad-hoc solutions will be required to provide interconnections, most likely bus shuttles. Local access from nearby cities to Girona and Reus airports is currently being provided with bus services, with an hourly frequency from 5:00 to midnight.

In Barcelona, the connection of the airport to the rail network has been discussed for long time. The interconnection of the airport and the nearby High Speed Rail station, separated by no more than 5km, will be served in the short term by metro services (to begin operating by 2012) and suburban rail services (still requiring some infrastructure upgrading foreseen to be undertaken soon). This implies that in the short term, Barcelona airport will be connected to the high speed network, to the suburban rail network and to the metro, and to urban and interurban bus services. In the mid term, a new rail link is considered to bring some HSR services and some commuter services bound to Tarragona through the two airport terminals.

The planning process

An important planning effort has been undertaken by the successive regional administrations in Catalonia since the mid 90s, mostly through sectorial master plans - roads, railways, airports and public transport - and territorial master plans, and the Spanish administration has also developed infrastructure plans since the 2000s.

However, the lack of integrated transport and land-use planning processes makes the planning of complex projects in dense areas with heavy urbanisation stress an extremely long process. Interconnections between long-distance and short-distance transport – like airport to rail - have not always been at the core of this discussion.

Intermodal connections between air-rail networks were an idea in Catalonia since the early 90s. 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 would lack sooner or later. But the interest and feasibility of rail connections to them were always under debate and are now just partially achieved. The design of High Speed Rail and airport interconnections in Catalonia was to some extent studied by the regional Territorial Master Plans, but cooperation between local, regional and national institutions, responsible for planning and financing them, was never easy. The construction of the new HSR network was planned and executed prior to approval of the Territorial Plans with only vague considerations on airport interconnections.

On the other hand, interchanges among the different short-distance and mid-distance transport networks (e.g. metro to suburban rail, or between different suburban networks) have been object of specific planning and investment programs in Catalonia, especially in the Barcelona Metropolitan Region. Investments in local rail and road links to airports were also planned and are now (2011) under construction. There are specific sections and investment budgets for upgrading or construction of interchanges between regional rail, suburban rail, metro, urban bus and interurban bus systems in the several planning documents currently in force.

On another dimension, interconnections can provide positive territorial impacts beyond the mere optimisation of travel times and travel convenience for interconnecting users. The high speed interconnection with the airport can be strategic for capturing very long-distance passengers, e.g. trans-oceanic and inter-continental air routes, even if considering that high speed trains are likely to enlarge Barcelona's airport catchment area in a rather limited way for trips within the European air space. It seems relevant enough to take into account the long-term economic and territorial impacts expected from these investments. However, it is of most importance to foresee strategic socio-economic development plans bringing together public and private institutions to catalyse potential positive territorial and socio-economic effects.

Quality of the interchange

The quality of the interchange was not direct object of the *Catalan airport system interconnections* case study. However, the following considerations may be drawn about interchanges in Catalonia.

New interchanges built over the last 15 years in Catalonia have specifically taken into consideration most issues regarding easy and comfortable interconnections. In general, proper design of interchanges for easy interconnection between transport networks is a core element in the newly built infrastructures. Old interchanges are mostly being upgraded or are set to be upgraded to improve their functionality.

These actions have mostly involved proper and coherent signalling policies, physical design of interchanges to make transfers easier and adaptation of interchanges for adequate access of disabled people. While short-to-short distance interchanges and short-to-mid distance interchanges are in a fairly good condition in Catalonia, short-to-long distance interchanges are lagging somewhere behind but they are generally in the process of being upgraded. For example, the Barcelona airport rail station is being refurbished in the general process of upgrading rail access to the facility, which includes the suburban rail extension to the new terminal and the metro construction.

Integration of transport operators

The multiplicity of stakeholders responsible for different infrastructures in Spain is an element of rigidity in the process of planning and executing integrated co-modal networks. There is a manifest need to optimise the institutional framework to manage transport infrastructures in Spain in general and specifically in Catalonia. Organisational issues, especially when negotiation involves multiple stakeholders, can become very complex. Strong political debate often results in cost increases and substantial delays of project calendars. When interconnections take place in urban / periurban areas, difficulties can be even more important as territorial competences are very spread out. New collaborative formulae involving all stakeholders in the planning and implementation process of infrastructure projects need to be considered.

The debate on competence distribution for infrastructure between the Catalan administration, the Spanish administration and the wide range of public and private enterprises dealing with transport infrastructures and transport services is currently very active, and changes in stakeholders involved are likely in the short and mid-term.

- For the air mode, infrastructure management is split between different public stakeholders. Barcelona, Reus and Girona airports are managed by Aena, a public company of the Spanish Ministry of Public Works, while the recent new airport in Lleida is managed by the regional government. However, there are plans that Aena will become a public-private enterprise during 2011, but public and private participation shares are still unknown at this stage.
- Suburban rail services are being managed by the regional administration since 2010. Conventional regional rail services originated and bound within Catalonia are managed by the

regional government as well, but only since 2011. Regional high speed services within Catalonia are expected to be transferred to the regional competence, but no schedule has been presented. All other services and the rail infrastructure are managed directly or indirectly by the Spanish administration. Local services in metropolitan areas are managed by public consortia composed of the regional administration and local municipalities.

- The network of highways is managed by different public and private stakeholders depending on the links, with different systems (toll, shadow toll, free) in accordance with different historic reasons, rather than integrated mobility policies. The rest of the network is managed by different public administrations – national, autonomous (regional), provincial or local - in function of their hierarchic range.

The current debate about airport management systems in Spain involves the determination of competent administrations for each infrastructure, but also the amount of autonomy each facility should gain. The increased autonomy for airport management is supposed to increase market competition in the air sector, basically to allow airports to properly compete for air routes, very especially for intercontinental routes. The management system for ports in Spain is usually regarded as a good practice example to be transferred to airports, with each Port Authority being a public entity with sufficient autonomy to make their own development strategy in the mid and long-term.

Promotion of intermodality

The Catalan administration is concerned with efficient public transport services and clear public transport information to users. The Public Transport Master Plan includes as explicit objectives the bus-rail network interoperability and an integral information system for the whole network covering both rail and bus. Through an integrated mobility internet site (http://mou-te.gencat.cat/), it is launching a program to improve information to users on how to plan journeys taking place within Catalonia with public transport, even when involving multimodal transport chains. This initiative is being developed as public transport ticketing is being integrated all over the regional territory through a system of concentric rings with confluences in the four provincial capitals (Barcelona, Tarragona, Girona and Lleida).

Ticketing integration has been in service for the Barcelona Metropolitan Region since 2001 allowing travel on all public transport modes: metro, suburban rail, urban buses and suburban buses. The airport station is integrated in this scheme. However, as single transport tickets are not integrated (only multiple travel cards are), most visitors do not benefit from this integration.

4.3.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Medium
Comments Many new infrastructures in Spain were planned with the objective of promoting environmental sustainability and territorial cohesion, resulting in many rail and airport infrastructures in areas with low demand levels. Others have been planned and promoted in the context of a continuous 15 year long economic expansion period, and have been designed according to very high growth demographic and mobility scenarios. The Spanish case leads to conclude that infrastructures and interconnections must be carefully planned and managed according to the specific characteristics of each case in order to avoid overinvestment in infrastructure. However, residual investments to interconnect already existing infrastructures may be relatively low and bring important network effects.

Area of intervention: Quality of interchange
Assessment against EU work: Medium
Comments Overall, it may be said that new interchanges built over the last 15 years in Catalonia have specifically taken into consideration most issues regarding easy and comfortable interconnections. While short–to-short distance interchanges and short–to-mid distance interchanges are in a fairly good condition in Catalonia, short–to-long distance interchanges are lagging somewhere behind but they are generally in the process of being upgraded.

Area of intervention: Integration of transport operators
Assessment against EU work: Low
Comments There is a manifest 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 of projects. If interconnections take place in urban / periurban areas difficulties can be even more important. New collaborative formulae involving all stakeholders in the planning and implementation process of infrastructure projects need to be considered.

Area of intervention: Planning process
Assessment against EU work: Medium
Comments An important planning effort has been undertaken by the successive regional administrations in Catalonia since the mid 90s, mostly through sectorial master plans - roads, railways, airports and public transport - and territorial master plans, and the Spanish administration has also developed infrastructure plans since the 2000s. However, the lack of an integrated transport and land-use planning processes make the planning complex projects, especially in dense areas with heavy urbanisation stress, an extremely long process. Interconnections between long-distance and short-distance transport – like airport to rail - have not always been at the core of this discussion.

Area of intervention: Promotion of intermodality
Assessment against EU work: Medium
Comments In general terms, the Catalan administration is in favour of promoting interconnectivity of public transport networks in the regional framework, efficient public transport services and clear information to users. The Public Transport Master Plan includes as explicit objectives the bus-rail network inter-operability and an integrated information system for the whole network covering both rail and bus. There is a website providing full travel details for public transport between municipality pairs within the region, currently being adjusted to increase its functionality. The integrated ticketing scheme is also advancing in its implementation, but not fully operative in all the Catalan territory.

4.4 MILANESE AIRPORT SYSTEM INTERCONNECTIONS: MALPENSA, LINATE AND ORIO AL SERIO

4.4.1 Background

Milan's airport system is made up of three airports:

- **Malpensa airport**, which is the biggest airport in the Lombardy region. Originally built between the end of the 1950s and beginning of the 1960s, the upgrade of the airport was included in 1993 by the Christophensen group in the list of the TEN-T priority projects, and therefore eligible for EU funding;
- **Linate "Enrico Forlanini"** airport, which serves as city airport and mainly with a business vocation thanks to its favourable position only 15 minutes away from Milan's downtown;
- **Orio al Serio** airport, which was chosen by low-cost airlines due firstly to its geographical position central with respect to the Lombardy region, and secondly to a vast array of advantages such as the proximity to a major motorway, absence of air traffic congestion and fast terminal operations. This explains the dramatic growth in the number of passengers Orio al Serio has been experiencing since 2002.

Accessibility is always a key issue for all the airports, and this especially applies for Malpensa which was kicked-off when only two-thirds of the infrastructure was built and the railway link was yet on a planning stage. In fact, the investment to guarantee surface accessibility to the airport, which was fundamental for the project performance, was neither part of the Malpensa 2000 project nor managed by the concessionaire. Access infrastructure was financed later, by dedicated regional and national laws and plans.

As a consequence of this approach, despite more than 10 years from the kicking-off of Malpensa airport, the completion of its land accessibility is still the main issue concerning the interconnectivity of the Milanese airport system.

The accessibility of the airport system is mainly secured by road connections (motorways), while rail services connecting the airports to Milan's downtown do exist for Malpensa only. Nevertheless, the latter are not completely satisfactory as shuttle trains stop at Cadorna station, thus five underground stations away from the central station. Only recently new services have been operating from Milano Central railway station where high speed and long-distance trains stop.

Besides the infrastructure-related analysis, the performance of the Milan's airport system is not satisfactory as far the integration of services is concerned. For instance, integrated ticketing (both air/rail and between the bus services connecting the airports) is missing, and improvements would be needed in the domain of integrated information to passengers, as this is not adequate either. Facilities such as check-in or luggage handling at rail stations are generally not available, whilst integration of operators serving the airports is fully missing.

4.4.2 Assessment against EU Objectives in the Field of Interconnectivity

Based on the assessment's results, it may be pointed out that the consistency of this case study against the priorities at EU level in the domain of interconnectivity is not completely satisfactory, namely when the integration issue is investigated.

As previously mentioned, accessibility is still a major priority issue when investigating the Milanese airport system. This is confirmed by the specific care that has been paid to planning and implementing interventions for improving infrastructure links and connections between the three airports and their respective catchment areas.

Accessibility to the Milanese airports is mainly secured by road. Road connections are eased by the fact that all airports are located along major motorways. This helps understanding why use of private car is the preferred access mode, followed by taxi (essentially to Linate airport, for which a direct local public transport line is also available) and shuttles services (to Malpensa and Orio al Serio). Since

congestion seriously affects the motorways, specifically during peak hours, planned road interventions are primarily intended to offer alternative routes to the existing ones.

Major weaknesses are, however, in the intermodal offer and the possibility to reach the distinct Milan's airports by non-road transport modes. This firstly applies to rail accessibility, where the high construction costs are obviously not financially viable for all airports. The upshot is that only Malpensa airport is also accessible by rail.

For years Malpensa was connected to Milan's downtown via the Cadorna station only, which is five underground stops from the main long-distance services train station (Milano Centrale). New services from Milano Centrale railway station to Malpensa airport are operating since December 2010; the current system allows for having connections with Malpensa every 15 minutes, i.e. two of them starting from Milano Centrale and two from Cadorna station. Furthermore twice a day high speed trains stopping at Milan Centrale rail station continue their trip to Malpensa, thus providing seamless journey to the airport for a certain part of long-distance passengers.

Nevertheless, despite this recent considerable improvement in Malpensa's accessibility, it may be noted that Malpensa airport is still far from the best practices existing in other parts of Europe. The main reason for that is that the train station at the Malpensa airport was conceived and designed not as an integrated part of a wider interconnected network but, on the contrary, as a terminal for a branch line of a main line, instead of a through-station on the main line. This resulted in a lack of direct, frequently operated links to a significant number of destinations (both short- and long-distance). Even the interventions planned in the mid-term do not seem to guarantee an appropriate position of the airport within the rail system, as Malpensa station will still not be totally integrated; however, other interventions (new construction or upgrading) planned in the long-term are expected to improve accessibility across the Lombardy region to Malpensa airport.

As outlined before, accessibility to Linate is essentially satisfied by car mode (private cars, taxi services) or by local public transport. With the view to the EXPO2015 the construction of a new metro line (M4 line) to the airport has gained particular attention. This intervention (planned to be completed by 2015) will provide an important extension of the current metro system and is expected to improve accessibility to Linate airport considerably by providing a direct connection between the city and the airport.

With regard to Orio al Serio airport, two major planned interventions may be highlighted. The first refers to the construction of the Pedemontana Lombarda, a new 87 km long motorway system that will be crossing five provinces of the Northern Lombardy territory. Its main purpose is to provide an alternative route to the highly congested A4 motorway alongside which the Orio al Serio airport is located. The second one is a rail link connecting the Bergamo and Orio al Serio airport. This project is still in a preliminary phase, and therefore it is hard to assess its potential impact on the long-distance rail connections.

Given the above, it may be observed that most interventions concern improvements in the infrastructure, where dramatic efforts have been made to primarily improve accessibility so to overcome existing critical situations.

Even though the completion of the infrastructure programme is understandably the main concern of public bodies, some other weaknesses related to passenger interconnectivity can be detected in the current system, especially when compared to the policy work and developments at EU level (EC, 2009a; EC, 2009d; EC, 2008a; EC, 2008b). They are 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.

The lack of **integrated ticketing** is of first concern, since integration does not exist either between air and bus shuttle services, or between shuttle buses and the local public transport services. Passengers travelling from Malpensa airport to destinations in the city of Milan are forced to hold different tickets: one for the rail shuttle and one or more for using the local public transport network. Like rail shuttle services, tickets of shuttle buses do not cover the local public transport network either.

As far as Linate airport is concerned, and due to its proximity to the city centre, it is served by public transport lines and passengers may use only one ticket for their trip. Nonetheless, in the case when passengers opt for bus shuttle services, they are required to purchase additional tickets to continue their trip by local public transport.

Some integration has been achieved for Orio al Serio airport, where the local public transport operator of Bergamo city provides travellers with various types of tickets covering also access / egress to the airport by using local public transport.

Similarly, **air and rail ticketing systems** are not integrated, although it is air and rail integration as a whole that does not adequately perform as confirmed by the fact that Cadorna and Milano Centrale rail stations are not equipped with self-service machines for check-in operations. Check-in at Cadorna station is possible, but the service is only available for three airlines and only at the ticket vendor counter, and thus only during office working times.

A slightly more positive evaluation may be done with respect to **integrated information**. Travellers are essentially able to get information about their interconnections on the airports' websites, which provide comprehensive information for pre-planning of a trip. Additionally, information can also be obtained on the local transport operator's and shuttle bus companies' websites as well.

However, although on-line information for pre-planning purposes proves to work in a good fashion, surveys undertaken within the INTERCONNECT project show nevertheless that 35% of passengers still have a need to collect additional information at their arrival at the airports.

Going further, a deficiency also emerges regarding the **integration between transport operators in terms of partnerships**. This is particular true for shuttle bus operators, which do not only operate the same service but apply the same tariffs. The absence of joint partnerships poses strong limitations on the pre-selling of connecting services: travellers are not encouraged to buy tickets on board of planes because they are not aware which company will made the earliest run towards their destination. Therefore, some kind of integration would be recommended for improving quality and reliability of services.

Finally, the **planning process** seems not to have had a comprehensive approach for the development of the entire airport system, thus not securing its adequate cohesiveness. Efforts have been essentially concentrated on Malpensa airport, but the enduring discussion about its land accessibility shows that interconnectivity was poorly considered at the time of its construction. Accessibility-related issues for Linate and Orio al Serio seem to have been largely ignored, at least until the award of the EXPO2015.

4.4.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Medium
Comments The accessibility of the airport system is mainly secured by road connections (motorways), and future planned interventions aim at overcoming the adverse impacts of congestion by offering alternative routes to the existing ones. Rail services connecting the airports to Milan's downtown do exist for Malpensa only. Though services run to Milan's city centre, their primary destination is neither the main station (Milano Centrale) where high speed and long-distance trains stop, nor the main station for commuting trains (Milano Porta Garibaldi). Only recently new rail services have been operating from and to these two stations. Rail accessibility is expected to improve over the long-term as the planned investments should provide additional interconnection with the existing regional lines and, consequently, improving rail accessibility to the Malpensa airport from a larger territory.

Area of intervention: Quality of interchange
Assessment against EU work: Low
Comments Quality of interchange mainly suffers from a poor integration of the services provided, namely with regard to integrated ticketing. Indeed, passengers are required to purchase several types of tickets for each of the distinct sections of their journey from the airports to the city centre either of Milan or Bergamo. Due to its role of quasi international hub, this is of particular concern when the current practices at the Malpensa airport are investigated. Though performing slightly better than integrated ticketing, also integrated information is not fully satisfactory. Although the airports' websites provide rather comprehensive information for pre-planning a trip, surveys conducted within the INTERCONNECT project demonstrate that still an important number of passengers have a need to collect additional information at their arrival at the airports. Finally, air / rail integration (ticketing, information, facilities like luggage handing or check-in at rail stations) is totally absent.

Area of intervention: Integration of transport operators
Assessment against EU work: None
Comments Integration of transport operators is an element of weakness within Milan's airport system. In fact, no joint partnerships or agreements exist between the operators, namely those that provide shuttle bus services. Moreover, the latter offer the same service at similar fares, but without any integration of the ticketing system. Therefore, some kind of integration would be recommended for improving quality and reliability of services.

Area of intervention: Planning process
Assessment against EU work: Low
Comments Malpensa airport was kicked-off in 1998 when only two-thirds of the infrastructure was built and no railway link existed. In fact, the investment to guarantee surface accessibility to the airport, which was fundamental for the project 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. As a consequence of this approach, for over 10 years most of the efforts in terms of planning and funding infrastructures were devoted to the completion of Malpensa land accessibility. Accessibility for Linate and Orio al Serio never seemed an issue, at least until the award of the EXPO2015. A comprehensive planning approach is still to be achieved, and a low degree of cohesiveness seems to emerge as far as the development of the Milan's airport system is concerned, since the current planning, also the one related to EXPO 2015, does not properly focus on the growing role of Orio al Serio within the system.

Area of intervention: Promotion of intermodality
Assessment against EU work: None
Comments Product marketing of integrated transport services is a key element in strengthening their attractiveness to the travellers, essentially by communicating the convenience they may provide to the users with. With respect to the Milanese airport system case, and whereas integrated services would be put in place, it would be clear that promotion of intermodality would secure a positive effect on improving travel behaviour and business performance.

4.5 SCOTTISH AIRPORT SYSTEM INTERCONNECTIONS: EDINBURGH, GLASGOW AND PRESTWICK

4.5.1 Background

With just over 5 million inhabitants and a land area of nearly 80,000 km^2, Scotland is a sparsely populated region. Its capital Edinburgh has around 480,000 inhabitants, but Scotland‘s largest city Glasgow is just over 584,000 inhabitants. Most of the Scotland‘s main towns and cities are located in the so-called Central Belt with Glasgow in the west, and Edinburgh and Dundee on the east coast. Around 70% of Scotland‘s population live in the Central Belt, including major towns such as Paisley, Stirling, Falkirk, Perth and Dundee.

The concentration of population in the Central Belt explains why Scotland’s three main airports, Edinburgh Turnhouse, Glasgow International and Glasgow Prestwick are all within a 45 km radius. Edinburgh and Glasgow airports are only 67 km apart from each other. Prestwick, the third major airport, is just 41 km to the south-west of Glasgow.

Edinburgh airport had just over 9 million passengers in 2009. Passenger number had increased steadily from 5.1 million in 1999 to 9 million in 2007 and remained stable around this mark during the recession in 2008 and 2009.

Glasgow had much slower growth with an increase from 6.8 million passengers in 1999 to 8.8 million at its peak in 2006; until then Glasgow’s passenger number still surpassed Edinburgh’s. But since then passenger numbers have declined steadily, although with 7.2 million passengers in 2009 Glasgow is still by far Scotland’s second busiest airport and is still the main Scottish airport for long-haul flights.

Prestwick, which caters only for low-cost airlines and charter flights, was Scotland's fastest-growing airport over previous years, with an increase from 900,000 passengers in 2000 to 2.4 million passengers in 2005 and projected figures of 5.7 million for 2018 and 12 million for 2033. However, passenger numbers stabilised around 2.4 million between 2005 and 2008 (holding up even in the first year of the recession), but among all UK airports with at least 1 million passengers, it was by far the worst hit by the recession in 2009 with a drop in passenger numbers from 2008 to 2009 by 25%.

4.5.2 Assessment against EU Objectives in the Field of Interconnectivity

Accessibility by road is good to excellent for all three airports: Glasgow airport is located directly on the M8, which is the main east-west artery of the Central Belt. Edinburgh airport is just over 1 km from the A8, which links after 2 km into the M9 and from there within another kilometre into the M8, thereby readily serving the east, north and west of Scotland. Prestwick is served by the A77, which is a dual carriageway for 20 km and then becomes the M77, which then links into the M8.

Accessibility by rail is only given for Prestwick, which has its own railway station just across the road from the terminal, connected by a covered footbridge. The railway links the airport to Ayr, Stranraer and Glasgow Central. However, there are only 11 trains per day that link Glasgow Central directly to Edinburgh and they take between 3 and 19 minutes longer than a connection that would use a bus or involve a 500m walk on foot from Glasgow Central to Glasgow Queen Street and then an onward train from there. To access most of the rest of the Scottish rail network a bus is needed to transfer between the two Glasgow rail stations, or travel times increase radically: for instance a connection from Prestwick to Inverness that involves the bus transfer in Glasgow takes around 4 ¾ hours, while the only alternative using a train throughout is to change trains in Edinburgh and the total journey time is then 6 ¼ hours.

For Glasgow and Edinburgh airports there is a room for improvement, since both of them have mainline rail lines passing in their vicinity. Specifically, the nearest train line to Glasgow International is 2 km away and to Edinburgh Turnhouse 5 km away from the airport. This opens the option of extending the rail system by just a few extra kilometres of track running next to or underneath the airport and opening new rail stations within the airports.

Plans to do just that for both Edinburgh and Glasgow had been at an advanced stage, when the Scottish government cancelled both of these projects, Edinburgh Airport Rail Link (EARL) in 2007 and Glasgow Airport Rail Link (GARL) in 2009 for cost reasons.

Following the rejection of EARL by the new Scottish government, a new plan for a stop on the existing rail line received the backing of Edinburgh City Council in May 2010, and the new rail station at Gogar will be directly linked to the airport by the new tram system with one intermediate tram stop. It will reduce congestion in particular on the main route between the city and the airport, because it will travel in parallel to this route and help reduce the number of buses, taxis and private cars on that route.

But even given that, the cancellation of both the EARL and the GARL projects is a huge opportunity lost, since even the tram link will not guarantee a greater complementary between air and rail transport, and therefore the large scale benefits mentioned in the *Action Plan on airport capacity* (EC, 2007b) will be not achieved.

Nevertheless these services provide connection between the airports and their city centres (i.e. Edinburgh and Glasgow), but the three airports are not directly connected with each other by any form of public transport.

Two projects that are under discussion, but for which no concrete planning exists and which are both highly unlikely to be realised in the foreseeable future, would be a Crossrail project that would link the two stations in Glasgow underground and the upgrade of one of the connections between Edinburgh and Glasgow to a high-speed line. If this high-speed line would run from Edinburgh Waverley via Edinburgh airport to Glasgow Queen Street, and would continue from there to Glasgow Central and Glasgow airport, then this would provide the ideal solution for a link between the two airports and to and between the two cities.

As it has been shown in milestone M4.5, a high-speed connection between the two airports would make it possible to save around a dozen flights per day, where currently the same airline serves one destination from both airports within the same hour and both flights are heavily underused.

The best existing **local transport connections** to the Glasgow and Edinburgh are high-quality shuttle bus services, equipped by comfortable vehicles with large dedicated luggage space and free wifi access, between the airports and a small number of strategically chosen stops in the city centre, including stops at the Glasgow Central and Glasgow Queen Street rail stations respectively the two main Edinburgh stations Waverley and Haymarket.

Prestwick also has one general express bus service to a central Glasgow bus terminal, and in addition another bus service to Glasgow and Edinburgh for very early and very late flights when trains do not yet / no longer operate. In spite of the existence of the rail station right next to the bus stop, there are still some travellers who do take the bus.

Furthermore, four regular local bus services stop at Edinburgh airport and three at Glasgow.

With regard to **ticketing integration** practices, there are two relevant applications between bus and rail connecting Glasgow airport. The first one is the rail ticket for the section Paisley Gilmour Street – Glasgow Central, which also allows the subsequent use of bus line 66 for the last mile from Paisley Gilmour Street station to the airport. With € 3.15 (£ 2.75), the integrated train and bus day ticket is cheaper than the airport express bus, which costs € 5.20 (£4.50) for a single fare. Nevertheless, in terms of travel times, this travel combination is less attractive than the direct express bus.

Integrated ticketing for local public transport and rail is for instance also available for a journey from Edinburgh or Inverness to Glasgow airport: the www.buytickets.scotrail.co.uk and the major UK wide www.thetrainline.co.uk website sells a ticket that covers the train journey to Glasgow Queen Street, the bus to Glasgow Central, the train to Paisley Gilmour Street and, as shown above, the bus from there to the airport. In contrast, and although the Edinburgh airport website says that "Combined train and bus tickets are available to or from any rail station in Scotland", the request for a ticket to Edinburgh airport on either the Scotrail website or thetrainline.com only yields the reply "invalid station entered".

Integrated air/rail or air/bus ticketing exists at none of the three airports, although in Prestwick, reduced rail fares between the airport to and from anywhere in Scotland are available. The airport operator could press for such an arrangement with Scotrail, since they own the actual train station. A 50% discount on rail travel (it cannot be booked on-line) requires showing the official flight confirmation and photo ID at a ticket office or, if departing from Prestwick and because there is no ticket office at Prestwick, to the train conductor. Moreover, for the first 6 months of any new air route all passengers are entitled to entirely free rail travel to and from Prestwick airport. In this case the train is not any faster than the bus shuttle from Glasgow to the airport. But with the discounts rail travel is much cheaper, and this is one obvious reason why in 2005 21% of travellers arrived in Prestwick by train, which was already then the highest percentage of all UK airports outside London. This percentage has grown further since then, and the airport aims at raising this number to 30%.

The provision of **integrated information** to users, in order to allow for door-to-door journey planning, is crucial for fostering modal interchange at major hubs and transfer points. All three airport websites provide good information on the various ways in which to access the airport. They all list the bus or train services that are available together with the service frequency or schedule and for the key services also give information on ticket prices.

Furthermore, they all have hyperlinks to a range of travel planners, in the case of Edinburgh and Glasgow to Traveline Scotland, which provides timetables and a journey planner for all bus, rail, coach, air and ferry services in Scotland on-line and by phone and to the transportdirect website of the UK Department of Transport, which provides information for all forms of travel - car and multimodal public transport, in the case of the latter including the walking time to the nearest bus stop or train station from the home and to the final destination. These two sites only plan journeys, but do not sell any tickets. Prestwick has links to five different journey planners and map sites, all of which focus on car travel.

All the airports are equipped with conveniently located stops for all buses, car parks and taxi ranks.

One example of very poor information is Paisley Gilmour Street rail station, where to find the bus connecting to Glasgow airport is less than straightforward, since the bus stop is not conveniently identified in the maps available within the ticket hall and the display boards at the bus stops do not list all the connection opportunities in an appropriate way.

Facilities like luggage handing or check-in at rail stations are not available.

As already mentioned, one purpose of the Commission's action is to complement its regulatory efforts, namely by encouraging different stakeholders to set up **voluntary agreements** in order to make journeys easier and more comfortable for users and to achieve an integrated approach in the design and development of transport policies. The Airport Transport Fora established in Edinburgh and Glasgow airports are the basis for such voluntary agreements.

BAA, the management company of Edinburgh and Glasgow airports, has developed an Airport Surface Access Strategy (ASAS) both for Edinburgh and for Glasgow (BAA 2007, BAA 2009). For the development of theirs, Edinburgh airport worked in partnership with a range of local stakeholders, brought together in the Edinburgh Airport Transport Forum (ATF). To create such fora was a requirement for all major English airports following the 1998 English White Paper — A New Deal for TransportII, but BAA decided that this was good practice and established such a forum in Edinburgh already in 1999 and now also in Glasgow.

The ATFs comprise actors both from the airport and from outside: public administrations, public transport operators (rail, bus, taxi etc.), and sustainers of green mobility; they are tasked with overseeing the strategy to increase the mode share of public transport, agreeing and setting targets for increasing public transport use and monitoring progress towards these targets.

4.5.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Medium
Comments Accessibility by road is very good for all the three airports. The big weakness for the two larger airports of Glasgow and Edinburgh is the lack of a rail connection, and even although Prestwick has a direct rail link, most connections from Edinburgh or the north necessitate a 500 m walk or a bus trip between the two railway terminals in Glasgow.. Well advanced plans for connecting Glasgow and Edinburgh directly to the rail system were cancelled by the last incoming Scottish government for cost reasons The alternative solution planned for Edinburgh airport is the construction of a tram link that will connect the airport to a new rail station at Gogar. Even though this will improve the connectivity to the airport, it will not provide the large scale benefits achievable through a direct rail connection.

Area of intervention: Quality of interchange
Assessment against EU work: Low
Comments All three airports have conveniently located bus stops, car parks and taxi ranks, but other forms of facilities like luggage handling or check-in at rail stations are not available. Glasgow advertises the rail connection via Paisley Gilmour Street as one possible access mode on their website, but the interchange at Gilmour Street is of extremely poor quality, primarily because of poor signposting for the bus stop, poor route information and an unsafe underpass between station and bus stop. As far as ticketing is concerned, the only integration that is easily accessible is between Scotrail and the buses between the two Glasgow rail stations and the bus from Gilmour Street to the airport. But while the Edinburgh airport website says that “Combined train and bus tickets are available to or from any rail station in Scotland”, the main travel website www.thetrainline.com does not recognise Edinburgh airport as a station at all. For Prestwick a real integrated ticketing air/rail does not exist, but reduced rail fares for Prestwick to and from anywhere in Scotland are available for air ticket holders. However, the ticket can then not be booked on-line, but the traveller has to show the official flight confirmation and photo ID at a ticket office or to the train conductor when purchasing the ticket.

Area of intervention: Quality of interchange

The provision of information to users is good on the airport websites, where information on all access modes is available and direct links also exist to journey planners, although in the case of Prestwick only planners for car travel, while the Glasgow and Edinburgh sites connect to the multimodal door-to-door planner at www.transportdirect.info. Information at the airports exists in the form of pictograms signposting bus stops and taxi ranks and info kiosks in the arrivals hall, but there is nowhere any information on onward travel already in the baggage hall.

Area of intervention: Integration of transport operators

Assessment against EU work: Low

Comments

Even though the case study did not highlight a real integration of transport operators in providing integrated services, the Airport Transport Fora established in Edinburgh and Glasgow airports can be considered as a form of voluntary agreements among different actors of the transport sector to achieve a common strategy to increase the mode share of public transport, agreeing and setting targets for increasing public transport use and monitoring progress towards these targets.

Area of intervention: Planning process

Assessment against EU work: Low

Comments

All three airports have Masterplans that include plans and targets for airport access, but they have no authority over what happens outside their boundaries, and there is also no other single authority outside that would guarantee a coordinated approach. Train operators, multiple bus operators and regional and local authorities for the road network all operate at their own behest.

Area of intervention: Promotion of intermodality

Assessment against EU work: Low

Comments

Product marketing of integrated transport services is a key element in strengthening their attractiveness to the travellers, essentially by communicating the convenience they may provide to the users with.

Prestwick actively promotes train usage through the agreement with Scotrail on rail ticket prices and advertises this agreement on their website and within the airport.

Glasgow tries to encourage bus use by having left only the bus stops directly at the airport exit doors, while the zone for drop-off and pick-up by car has been moved to the side of the terminal.

Edinburgh has switched the locations for taxi ranks and bus stops so that now the bus stops are directly in front of the exit doors, while the taxi rank has now to be accesses via a short covered footpath. Furthermore - and quite controversially - they have moved the drop-off zone into the ground-floor of the on-site car park and drivers are now charged £1 for using this drop-off zone. A free drop-off zone is only available at the long-stay car park that can be reached from the terminal by shuttle bus.

However, while the initiatives in Glasgow and Edinburgh go some way towards discouraging car

Area of intervention: Promotion of intermodality
usage, they do not amount to an active promotion or advertising of bus use. The websites show information on the different access modes on an equal footing. Moreover, the main page of the Edinburgh website does not mention the drop-off charge at all, and only a special pdf drop-off leaflet that can be downloaded from the site then highlights "Our £1 drop off facility" in contrast to "Our free drop off facility". If truly integrated services were to be put in place and these were to be properly promoted, then this would certainly have positive effects on a modal shift away from the car and improve travel conditions and business performance.

4.6 INTERCONNECTIVITY OF RAIL AT LEEDS RAILWAY STATION

4.6.1 Background

When it is the aim to increase rail use, investments should actually be directed towards areas where the level of service (in terms of the rail service and the access to it) is already relatively high and to the most populated areas or urban centres (which led to the choice of Leeds as a case study to investigate). Leeds is connected to the rest of Britain by an extensive network of rail routes and services, including the flagship East Coast Main Line (ECML) route. ECML is electrified and runs from London to Scotland via York, with a spur to Leeds. Journey times from Leeds to London are between 120-150 minutes, and Leeds to London is the biggest long-distance rail market in the UK - passenger numbers having risen by 30% over the past decade. In common with virtually all passenger rail services in Britain, all services operating through Leeds are franchised. The services of five franchisees serve Leeds. There is an extensive set of stakeholders involved, comprising the rail infrastructure manager, the various train operating companies, planning and funding agencies (including government and regulatory agencies) and passenger groups.

Leeds City Station has undergone some substantial changes over the past decade aimed at enhancing its capacity and accessibility.

The dominating focus of attention from the Leeds-based stakeholders is upon Leeds as a local and regional centre for commuting and shopping, and so most of the proposals currently on the table seek to enhance connections in this context. In contrast, there is very little attention given to Leeds as an origin or destination of long-distance trips, particularly surprising given that Leeds to London is the largest long-distance travel market in the UK. Whilst there have been improvements, access and egress problems continue to exist, with many bus services not properly linking up with the station and pedestrian facilities in the immediate vicinity of the station continuing to be particular issues.

4.6.2 Assessment against EU Objectives in the Field of Interconnectivity

The principal infrastructure enhancements were packaged together as the Leeds First project, completed in 2001. This significantly improved track capacity on the approaches to the station and allowed for increased connectivity, in particular southward to London (and beyond) and westward to Manchester and Liverpool. However, ten years on the infrastructure is again reaching capacity, rendering further service enhancements increasingly problematic.

At a more micro level, an adjoining bus interchange was established, but only a relatively small proportion of local bus services currently use this interchange, meaning that most people wishing to access the station via bus are faced with not insignificant walk distances, with a number of busy and complex road crossings to traverse.

A major project to open up a new southern entrance to the station is at an advanced stage of planning with its funding bid submitted. This would represent a major enhancement to pedestrian access to the station, and would allow for further improved bus access. However, in the UK's current funding climate it must be very doubtful that this project will advance further in the short to medium term.

In addition, there is a second major project to develop a new generation transport (trolley bus) system, which would provide a high-quality link with three sets of suburbs and provide a new public transport interchange point adjacent to the station. This is also at an advanced stage of planning with its funding bid submitted, but again grave doubts must be expressed about the likelihood of this proceeding further in the current funding climate.

In addition to this, recognition of the expansion of the city centre and the growing distances being traversed between the station, the main bus and coach station, the hospitals and the universities, led to the introduction of the Leeds FreeCityBus to connect these various key city nodes. Whilst this is well-used, congestion in the city centre can mean that the FreeCityBus journey times are often unattractive to people with a train to catch.

Despite the fact that the principal bus operator in Leeds is also one of the principal train operators at Leeds Station, there is a low-level of provision of integrated bus and rail ticketing. There are, nevertheless, plans for the roll-out of a Yorkshire-wide smart card ticketing initiative that could provide a step-change improvement here. There is a relatively high degree of integrated trip-planning information available, via the local Passenger Transport Executive (Metro), which has an on-line journey planner, and the nationwide system of Transport Direct. The real-time passenger information system for bus services throughout Leeds is also an important feature of information provision.

In terms of partnership working, the Leeds Station Travel Plan is an interesting recent development. The plan has been piloted and is now being rolled out, incorporating a variety of sub-solutions, including:

- Legible Leeds project - free Walkit maps now available at the station with accompanying publicity campaign;
- Potential to expand the project to bus stops being explored;
- Travel Information point - installed by National Express in the station;
- Agreement by Network Rail to improve signage on the station;
- Installation by Network Rail of additional cycle racks on platform;
- Cycle Point - due to open in 2010 (see below);
- Approval being sought by Network Rail for an electric car recharging bay;
- Agreement by Network Rail to car share parking bays in the new car park/deck scheme.

In terms of planning processes, there seems to be a clear disconnect between those stakeholders at the local level and those at the national level, with no defined mechanisms for integrating their different perspectives. Local stakeholders are predominantly interested in inward travel to Leeds and travel around the Leeds area. In so far as Leeds Station figures in local strategy, it is generally as a key arrival point for commuters and shoppers, with the focus consequently being on egress, rather than access. Similarly, the national stakeholders appear to be more interested in the long-distance, 'trunk' parts of the national transport system, and much less on how these parts of the system connect at the local level. This would appear to be a key challenge for the period ahead.

4.6.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Medium
Comments On a macro-level there is a high level of connectivity from Leeds to most other points in Britain, in particular London and the other major cities in northern England. However, on a micro-level users still face important difficulties in getting an easy and convenient access to the station.

Area of intervention: Quality of interchange
Assessment against EU work: Medium
Comments Travel information, both pre-trip and en-route, is well integrated, and there is inter-availability of rail tickets. However, integrated bus/rail ticketing is poorly developed, even where the same operator is responsible for bus and rail services.

Area of intervention: Integration of transport operators
Assessment against EU work: Medium
Comments Coordination amongst the various train operating companies operating out of Leeds Station is, up to a point, facilitated via the rail franchising process and other central-government-led initiatives. Further coordination has recently also developed via the Station Travel Plan process, bringing many of the key stakeholders together to improve access/egress. However, as mentioned above, this has not developed into joint arrangements amongst bus and rail operators regarding ticketing or timetabling, for example.

Area of intervention: Planning process
Assessment against EU work: Low
Comments The local and the long-distance elements of travel appear to be quite separate within the planning process. Local stakeholders are very focused on egress, whilst long-distance stakeholders (I.E. at the national level) are very focused on the 'trunk' routes, with the specific interaction of short-long distance travel apparently "falling between the cracks".

Area of intervention: Promotion of intermodality
Assessment against EU work: None
Comments No efforts to promote intermodality are detected.

4.7 THE MILAN RAILWAYS NODE

4.7.1 Background

As presented in D4.1, the Milan railway node plays a key role within the overall rail network system in Northern Italy. The node is relevant at different levels, as it secures the interlinking between the long-distance routes (international and national, conventional and high speed connections) with the regional and suburban lines. In principle, such interlinking also entails the connections to the Milan airports.

Therefore, the entire network is currently characterised by a high degree of complexity, which is expected to be further increased by the opening of new stations for the new high speed lines. Moreover, this complexity is further exacerbated by the increasing number of commuters and tourists that reach the Milan stations every day.

As highlighted in D4.1, considerable effort has been made for addressing such complexity, by primarily improving the interconnections with the local public transport network (including the underground network).

A number of key issues still remain open, however. In particular, integration (tickets, fares, information) is still lacking, and there is also a lack of adequate information and facilities to users, or of intermodality facilities at the interchange points. Additionally, weaknesses emerge with respect to the strategic planning process, although these should be viewed more in terms of different scheduling and timing between the responses from the public authorities and the investment choices made by private actors, rather than in terms of incoherence or inconsistency of the planning process, either with the legislation in place or the major policy objectives for a more sustainable mobility and land-use planning.

4.7.2 Assessment against EU Objectives in the Field of Interconnectivity

When cross-checked against the EU policy actions and objectives, the overall quality of interconnectivity for the Milan railway node appears to be inadequate, particularly when the interlinking between short- and long-distance journeys is investigated.

Over the last years several important investments have been planned and are under implementation, namely for increasing the efficiency of the rail infrastructure. Priority has been given to the extension of the high speed lines and improvement of the service, and a major objective has been the opening of the new rail link between Centrale and Garibaldi stations, which has made it possible for Trenitalia to start a connection link to Malpensa airport (which was considered as TEN-T priority project when it was built in the 90s). In the years to come, this new connection could also foster a potential integration between air and rail services.

Nevertheless, it is also worth mentioning that the majority of regional trains operated by Trenitalia arriving in Milano stop at Garibaldi railway station and not at Milano Centrale, where, on the contrary, most of high speed trains stop and, as previously mentioned, where Trenitalia has recently started operating a High Speed Rail service to Malpensa airport. Milano Centrale station, in fact, is not included into the suburban rail network and there are no plans to include it in the future.

Passengers are then forced to change transport mode (mainly underground) to reach Milano Central station, with a subsequent increase in transfer time. Inconvenience for them may be even greater when the interchange is not supported with adequate information about timetables, maps of the stations, etc.

The impact is, then, negative on the interconnection between short- and long-distance journeys at various level, as it affects the connection between the suburban rail system (*micro* level) with both the national long-distance passengers rail network (*meso* level), and in principle the TEN-T network (*macro* level) too, as Milan is a crucial node being crossed by priority project 6 and permitting access towards priority projects number 1 and 24.

Another project planned to improve the rail system is the so-called “Circle Rail Line”, which should connect all peripheral areas of Milan with a rail line interchanging with the underground lines in several stations. The main purpose of this new line is overcoming the major problem of forcing travellers to cross the city centre to reach their destination, even when they do not have such need. Nevertheless, the simulations carried out during the test-bed phase have not shown appreciable impacts for long-distance trips since the new rail line will not interchange with the main railway stations, thus no substantial impacts on interconnectivity between short- and long-distance networks have been found.

Overall, it may be concluded that specific attention has been paid to the infrastructural development, which, however, has not been complemented by a similar attention to interventions for making the transport system more user-friendly. It appears that similar interventions are missing or poorly implemented, and therefore a certain distance between the existing practice and the EU policy work in this field may be highlighted.

For example, it is acknowledged that **integrating ticketing** and fares is a priority area for the Commission (EC 2009d; EC, 2008a; EC, 2001). Indeed, the Commission views the possibility to

integrate tickets and fares from transport service providers of either the same mode or of different transport modes as a pre-condition for a seamless journey and for combining short- and long-distance trips.

On this, the Milan node is poorly performing, as:

- The current integrated ticketing system called SITAM is available only within the Milan metropolitan area.
- For a rail journey starting outside Milan's metropolitan area and ending within the urban transport network, ticketing integration between rail services and the urban public transport network is available only in the case the modal shift occurs in a metro station or at bus / tram stop that is located within the urban network of the city. In contrast, when the interchange between rail and the PT network occurs in the suburban areas of Milan, integration does not apply and travellers are requested to hold two different tickets: one for the rail journey until the first interchange, and a second ticket for making use of the public transport network until their destination in the city centre.

Furthermore, as far as the current system SITAM is concerned, some problems arise from the unclear procedure ATM (the main public transport operator, publicly owned by the Municipality of Milan) follows in relation to the clearing system on which the revenue sharing with the other private operators participating in the system is based. Thus many private operators have expressed the intention to withdraw from the system, and therefore its future development seems to go more in the direction of a further division rather than of consolidation. As a result, this would have serious consequences for the travellers as they would be forced to buy and hold different tickets instead of integrated ones: one for travelling on ATM's means, and one for travelling with the other local transport operator supplying inter-urban services.

The provision of suitable, **integrated information** to passengers, especially as far as (i) journeys requiring multiple public transport modes to reach the desired destination, and (ii) interconnection between long- and short-distance trains are concerned, is a common problem of the railway stations of Milan. Notably, this occurs in the stations where high speed or national trains stop, as they are not or not adequately equipped with maps containing the plan of the stations and the indications of the interchange points and times with local public transport. However, no integrated timetabling is available even in those rail stations (e.g. Rogoredo, Porta Garibaldi) which host both suburban and high speed trains. As a consequence, interchanges are not simplified with a subsequent impact on transfer times. Moreover, scarce information is also available on-line, which makes pre-planning the journey in an optimal manner difficult.

The lack of integrated services (ticketing, information, check-in, luggage handling) also emerges when the **link between air and rail transport services** is investigated. Again, this is nowhere near the linkage the Commission is aiming for when fostering a greater air/rail complementarity (see the Action Plan on airport capacity in this respect (EC, 2007b)). Though a high speed train from Milano Centrale railways station to Malpensa airport is operated on a daily basis since recently, travellers still do not have the possibility to:

- Get information about their air connections at either the station or on board of the trains;
- Purchase an integrated (air/rail) ticket;
- Check-in at the railway station (including the luggage handling).

A final component of integration refers to the **integration between transport operators in terms of partnerships** for combining resources and organisational structure, promoting a common strategy and offering joint-branded services. This type of integration is also viewed favourably by the Commission (2009d), although responsibility is left to the individual operators to structure their cooperation in the most suitable fashion according to their organisation and services provided.

The Milan rail case study shows a recent example of integration, which is the new company Trenitalia-LeNORD (TLN) that has been established in August 2009 after the agreement between the Italian Government and the Lombardy Region with the purpose to unify the regional rail service providers (Trenitalia and Ferrovie Nord Milano, respectively). The new company is equally-shared by Trenitalia

and Ferrovie Nord Milano and positions itself as the single rail operator for the regional service in Lombardy. This new integration allows the optimisation of the regional rail service by overcoming the previously existing fragmentation (in terms of fares, ticketing, service) and therefore securing a more efficient service in meeting passengers' needs. Nevertheless a full integration of services is still to be achieved.

Deficiencies may also be noted with respect to the **strategic planning processes**. On this issue the Commission (EC, 2009d) recommends to make use of planning tools (for instance the SUTPs) that allow, on the one hand, an integration of land use and the transport network, and, on the other hand, the integration of planning of the different transport modes. Here, deficiencies should be viewed not in terms of coherence and consistency either with the legislation in place or the major policy objectives for a more sustainable mobility and land-use planning, but essentially in terms of different scheduling and timing between the responses from the public authorities and the investment choices made by private actors. This has led to an uncoordinated relationship between urban policy-setting and real investments, which resulted, for instance, in the redevelopment of urban areas without providing them with adequate transport infrastructures and connections.

From a more general perspective, these unbalances in the development of urban areas, where real-estate investments and the subsequent increase in urban settlements are not accompanied by a parallel growth of the transport infrastructures and interconnections, not only negatively affect transport interconnectivity at all levels, but may also lead in the long-term to a disruption of a more general vision of a sustainable integration between land use and transport network planning.

Finally, the **promotion of integrated transport services**, and thus of transport interconnectivity facilities, appears to be less structured compared to other existing best practices across Europe. It is acknowledged that an effective marketing campaign may have a twofold valuable impact: on the one side, in terms of awareness (and therefore attractiveness) about the services provided for the customers, and, on the other side, in terms of business and new market development for the operators. Where integrated services were put in place, it would be clear that promotion of intermodality would secure a positive effect on improving travel behaviour and business performance.

4.7.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Medium
Comments The major objective has been to increase the efficiency of the rail infrastructure. Priority has been given to the extension of the high speed lines and improvement of the service, including the possibility to operate a connection link to Malpensa airport, thus providing a major opportunity for fostering a potential integration between air and rail services. Nevertheless, an optimal interconnection between long-distance rail journeys (both high speed and conventional) with the regional/suburban networks is still to be achieved as trains stop in different stations. This requires passengers to include an intermediate stage for reaching the desired station resulting in increased transfer time and reduced convenience of the interconnection.

Area of intervention: Quality of interchange
Assessment against EU work: Low
Comments Interventions for making the transport system more user-friendly and improving the quality of interchanges for the Milan railway node appears to be missing or are poorly implemented. Specifically, the Milan rail case study is characterised by the following aspects: ➢ Poor development of integrated ticketing systems; ➢ Inadequate integration of information system, and subsequently poor quality information in the stages of trip pre-planning and when the journey is ongoing; ➢ Absent integration of air/rail ticketing and information systems; ➢ Absent facilities for luggage handling at the railway station; ➢ Poor quality in the case of flight check-in at the railway station.

Area of intervention: Integration of transport operators
Assessment against EU work: Medium
Comments The organisational integration between Trenitalia and Ferrovie Nord Milano has recently led to a new jointly shared company (Trenitalia-LENORD) for operating the regional rail service in Milan's urban and suburban areas. This enables overcoming the previous fragmentation (in terms of services, ticketing, fares) and paves the way for optimising the regional rail service and consequently providing passengers with a more efficient transport service. Nevertheless a full integration of services is still to be achieved.

Area of intervention: Planning process
Assessment against EU work: Low
Comments Deficiencies are more related to the different timing and scheduling between the responses from the public authorities and the investment choices made by private actors, rather than potential inconsistency or incoherence of the planning process with the legislation and policy objectives in place. This produces unbalances in the development of urban areas, where real-estate investments and the subsequent increase in urban settlements are not accompanied by a parallel growth of the transport infrastructures and interconnections. Therefore, such urban developments are less sustainable and integrated from a transport perspective.

Area of intervention: Promotion of intermodality
Assessment against EU work: None
Comments Product marketing of integrated transport services is a key element in strengthening their attractiveness to travellers, essentially by communicating the convenience they may provide to the users.

Area of intervention: Promotion of intermodality
With respect to the Milan rail case, if integrated services were put in place, it would clear that promotion of intermodality would secure a positive effect on improving travel behaviour and business performance.

4.8 THE DUAL-MODE RAILWAY SYSTEM: THE KARLSRUHE MODEL

4.8.1 Background

The solutions of interconnectivity established in Karlsruhe concern the urban tram system, which is enriched by bus lines, the inter-regional aspect of the tram system as well as the integration of tram services on the traditional railway tracks and the connection point to the railway station for long-distance transport. In addition to the technical aspects concerning the tracks and the vehicles, the service types offered are of special interest.

The dual-mode railway system of Karlsruhe is widely regarded as the model of a high-quality and well patronised local public transport system. It has earned the city the nickname “The Mecca of local public transport”. The successful track-sharing experience of the various Karlsruhe rail systems has revolutionised urban and regional public transport: Karlsruhe trams are running on the urban light rail system and on the heavy rail tracks of the German Railways (Deutsche Bahn).

4.8.2 Assessment against EU Objectives in the Field of Interconnectivity

The Karlsruhe model of a dual-mode railway system is an outstanding example of best practice for the following reasons:

- Continuous extension of an environment friendly transport system from the urban area to the surrounding region;
- Excellent facilitation of commuter movement between railway and tramway;
- A massive mode shift from individual to public transport;
- Limitation of deficits for public transport;
- Introduction of innovative technology;
- Revitalisation of urban life in the city centre by supporting pedestrian districts;
- Increased mobility for all social groups including disabled persons;
- Higher attractivity of the area through integrated high frequency public transport services;
- Dissemination of expertise.

Concerning the field of interconnectivity the Karlsruhe TramTrains are an innovative approach to overcome the barriers when switching between different modes of transport: instead of the passenger, who has to transfer between classical trains and urban trams, the dual mode TramTrains change from the tracks of conventional heavy rail to those of the urban tram network.

Network and infrastructure

As the key element of the Karlsruhe TramTrain system is the dual mode vehicles which can be run on classical railway lines as well as on urban tram networks, infrastructure in the sense of stationary equipment has more a complimentary, but nevertheless important role in this case study. The importance is in the field of connecting existing infrastructure and networks and in its upgrade to enable efficient services with high frequency, reduced overall travel times and increased operating hours without additional staffing costs. Furthermore the upgrade of existing and the implementation of

additional stops along the TramTrain services help optimising the access to the system by regional bus lines and enlarging the zones where access within walking distance is feasible.

For the European scope concerning infrastructure it has to be mentioned that at Karlsruhe central station two TEN-T corridors (Rotterdam – Genoa and Paris – Bratislava) cross each other. So the improved services of the TramTrain lines which in majority also serve this railway station also improve the access to European core transport infrastructure for the rural areas in the wider vicinity of Karlsruhe.

Due to the effects mentioned which apply when TramTrains were put into service the case study is assessed as high against infrastructure issues in relation to EU aims.

Quality of interchange and promotion of intermodality

The interchange between classical regional rail and local tram does not exist any longer, since the dual mode vehicles abolished the necessity for the customer to change between these modes. Furthermore, implementing face-to-face transfer points between rural bus services and the TramTrains also made these transfers easy.

Interchange between different modes and the services of different operators has also been massively improved by setting up a common tariff regime for the whole area, meaning one ticket (irrespective whether for single trips or as a season-ticket) can be used for the whole public transport in the area, so that the coverage of **through-ticketing** is at 100% of all regional travel. This degree of integration is also given for travel information (via web including door-to-door-information, as well as for printed timetables) and customer care, as with the regional transport association there is one central contact point available for all customers. As there is absolutely no difference for the customer whether travelling uni-modal or using different modes (rail, TramTrain, tramway, bus) for a trip in the area, a better promotion of intermodality is hardly imaginable.

As seamless travelling is totally realised in the whole area, irrespective of modes used by the customer and the origin-destination pairs one travels, the quality of interchange is assessed as high. The same is valid for the field of 'promotion of intermodality'.

Integration of transport operators

Many different transport operators act in the Karlsruhe area: besides Deutsche Bahn with their regional train and bus divisions, there are rail and bus services belonging to the Federal State of Baden-Württemberg and numerous operators of urban transport.

All services offered are ordered, co-ordinated and paid for by the regional transport association which belongs to the municipalities and the counties in the area. This association has also set up the common tariff regime and receives all revenues from the ticket sales of the operators and the complementary deficit funding from its stakeholders.

With this structure all services offered are fully integrated and their schedules are well co-ordinated. Parallel services, especially between bus and rail lines existing in the past, were abolished and regional bus services rerouted in favour of feeding the railway or TramTrain lines instead of cannibalising them.

Due to the organisational principle of a regional transport association which has been installed in the area it has to be stated that all transport operators – although in many cases still independent companies – are fully integrated from the users' point of view. Therefore, the integration of transport operators is assessed as high in this case study.

The implementation of regional transport authorities, with their power concerning ticket revenues and deficit financing, is quite feasible if a legal framework for that exists. Nevertheless it has to be stated, that still many parts of the European Union lack such possibilities. As an example see chapter 4.14 dealing with the situation in the Tri-City region in Poland.

Planning process

With the first experiences made in the Karlsruhe area by interconnecting a worn out railway line which has been upgraded with the tram network of the town resulting in boosting passenger figures, the decision was taken to focus totally on the TramTrain system when upgrading the regional public transport. With the help of the federal financing system for regional transport infrastructure and services following the principle of subsidiarity the fast planning and immediately following realisation of several TramTrain lines was enforced.

The decision of the stakeholders to go for TramTrains was followed by an analysis of the status quo situation out of which the traveller needs were identified. The next step was to define type and amount of services to satisfy the needs identified to achieve this in an environmentally friendly and sustainable way. Nevertheless the optimisation of planned infrastructure with the services to run on it did not only deal with the identification of existing gaps but also made sure that there will be sufficient scope concerning flexibility and possible future amendments for the services to be offered.

After the exploration of the technical needs and necessities (e.g. same gauge of heavy rail lines and the tramway network to be connected, the dual voltage equipment needed for the vehicles, etc.) the organisational structure was set up to connect urban and (inter-) regional transport systems and operations. The fact that the management of the TramTrain operator (Verkehrsbetriebe Karlsruhe) and the planning institution and infrastructure owner (Albtalbahn Verkehrsgesellschaft AVG) is the same for several lines was extremely helpful for streamlining the planning process. Furthermore, in many cases where the infrastructure had been owned by Deutsche Bahn, it was either bought or at least leased by AVG, making planning again very straightforward. This left only a small number of specific cases where the involvement of other stakeholders, mainly Deutsche Bahn, remained an obstacle and the planning process was more complex.

The structure of the planning process as mentioned above could be adapted in principle in other parts of the European Union although specific national legal issues outside the EU's sphere of influence may limit this.

4.8.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: High
Comments Upgrading and modernising existing infrastructure has been a complimentary element to enable TramTrain services. This is in line with the principle of "making better use of existing infrastructure" namely in terms of optimisation of the access to the system by regional bus lines and enlargement of the zones where access within walking-distance is feasible. Importantly, improved access through the TramTrain service is also of benefit for the Karlsruhe central station where two TEN-T corridors cross each other. This also results in improved access to European core transport infrastructure for the rural areas in the wider vicinity of Karlsruhe.

Area of intervention: Quality of interchange
Assessment against EU work: High
Comments Instead of the passenger changing vehicles, the vehicle itself operates on different systems embedded in an organisational structure enhancing public transport use and a harmonised tariff system.

Area of intervention: Integration of transport operators
Assessment against EU work: High
Comments In the Karlsruhe TramTrain case study all operators are fully integrated concerning all aspects relevant for the customer (timetabling, tariffs, information and customer care). This has been possible with implementing a regional transport association by the regional stakeholders for which a legal framework is a prerequisite.

Area of intervention: Planning process
Assessment against EU work: High
Comments The sequence of elements of the planning process (decision, status quo analysis, identification of traveller needs, technical necessities, united planning, operating and ownership of infrastructure) may be taken as a blue print for other projects. Nevertheless power of promoting this by the EU may be limited due to specific legal situations found in its Member States.

Area of intervention: Promotion of intermodality
Assessment against EU work: High
Comments As there is absolute no difference for the customer between travelling in the region un-modal or changing between different transport modes, and as TramTrains in many cases abolished the necessity to change between modes at all, a better promotion of intermodality is hardly imaginable.

4.9 TRAIN-TAXI AND FEEDER BUS SERVICES

4.9.1 Background

This case study is unique in that three separate concepts have been brought together under a single umbrella, the aim of which is to examine how business and leisure travellers can be persuaded to take the train rather than the car for long-distance journeys. In particular, this case study examines one key barrier that prevent this, namely the difficulty in accessing and egressing train stations as part of a journey; particularly the destination station, which tends to be unfamiliar to the traveller especially when making business or leisure trips (e.g. an unfamiliar journey).

This barrier can manifest itself as a number of separate issues which, when taken together, may result in the traveller opting to travel by car rather than train. Amongst these are the following, all of which create uncertainty for the traveller:

- What public transport options are there to travel to the origin train station?
- How much will public transport cost to travel to the origin station?
- What public transport options are there to travel to the final destination from the destination station and back again?
- How much will public transport cost to travel to the destination and back again?

Together these issues can combine to produce a powerful barrier that may prevent travellers from choosing to travel by train rather than by car. Several scenarios can be imagined that would produce

a range of uncertainties for the traveller. Three possible scenarios are presented below for the outward leg of a journey only:

- Scenario 1 – *Stage 1* – Home to familiar train station; Stage 2 – Familiar train station to familiar train station; Stage 3 – Familiar train station to familiar destination.
- Scenario 2 – Stage 1 - Home to a familiar train station; Stage 2 - Familiar train station to unfamiliar train station; Stage 3 – Unfamiliar train station to unfamiliar destination.
- Scenario 3 – Stage 1 – Home to unfamiliar train station; Stage 2 – Unfamiliar station to unfamiliar train station; Stage 3 – Unfamiliar train station to unfamiliar destination.

Clearly scenario 3 provides the most uncertainty for a traveller and is therefore most likely to result in that traveller avoiding travel by train, although this will vary according to the level of uncertainty that a person is happy to accept. There is therefore a certain irony in the fact that whilst a traveller may prefer to travel by train for the main leg of their journey (100+ kilometres) the uncertainty surrounding the first and especially the last legs (both of which may only be a 2 to 3 kilometres) of their journey may be enough to prevent them travelling by train and instead travel by a more familiar mode such as car.

The UK government's 1998 Transport White Paper termed this barrier, 'those final few miles' and they are the focus of this case study with regard to rail travel. Three very different specific solutions that have been identified which help to overcome this barrier.

UK Train-Taxi (T-T)

The Train-Taxi (T-T) concept has attempted to overcome the key 'final few miles' barrier by creating an accessible database of information with regard to the taxi services available at and serving the UK's train stations. Potential passengers can now obtain the following information for all train, metro, tram and underground stations in Great Britain:

- Whether each station has a taxi rank of taxi office;
- Contact details of up to three local taxi firms serving each station;
- Whether these firms offer wheelchair – accessible vehicles.

The key aim therefore of the T-T concept is to provide comprehensive information to potential passengers that remove the uncertainty about where taxis can be caught or booked from. In addition an attempt has been made to ensure that this information is as accessible as possible to travellers. So the information can be accessed by various means including:

- The national rail website – www.nationalrail.co.uk/passenger_services/traintaxi.html;
- Train operating company websites;
- Journey planning systems and websites;
- Transport Direct website – www.transportdirect.info .

The T-T concept was initially launched in February 2002 as a pilot project operating under the Rail Passenger Partnership (RPP) scheme, funded jointly by the Strategic Rail Authority and the National Express Group Plc. It is currently funded by the passenger rail industry and other commercial licensees.

Dutch Train-Taxi (T-T)

The Dutch T-T scheme is very different from the UK T-T concept in that it provides a specific Demand Responsive Transport (DRT) service rather than an information service. The concept was first introduced in 1989 by Nederlandse Spoorwegen (NS) (Dutch Railways) as a pilot scheme, with the general aim of offering train travellers an alternative means of access to the train station or continuing their onward journey from it. Therefore it was also attempting to overcome the barrier of 'those final few miles' as identified in the UK. More specifically the aims were to:

1) To provide DRT for individuals accessing/egressing train stations;

2) To provide frequent taxi services from and to train stations; and
3) To increase the number of passengers using trains by providing better access to train stations. (Mott 2008a)

The current service has not changed significantly since 1989 (although it now operates from fewer train stations) and in essence offers a shared taxi service to and from specific train stations for passengers who are able to pre-book or wait at the train station for a shared ride with other passengers.

For train passengers egressing the train station a T-T ticket can be purchased at the same time as their train tickets or separately (either at counters or vending machines). Upon disembarking from their trains, passengers head to the T-T stand outside the station. Normally, there will be a taxi waiting and the taxi will wait for up to 15 minutes for other passengers to join (a maximum of 4 passengers can be carried at any one time). The driver will then decide on the best route to transport people. If no taxis are at the stand then the passenger can speak to a commercial taxi operator via an intercom who will send a T-T to the stand (the average waiting time is around 10 minutes).

A telephone booking can be made for train passengers accessing the train station from home; however this must be at least one hour before travelling. The scheme currently extends for a distance of 8 kms around train stations and the cost of a ticket is fixed regardless of how far a person is travelling, i.e. in 2008 it stood at € 3.13 per traveller. In terms of hours of operation the T-T service normally operates between the times of the first and last train service that call in at the train station, although some stations provide a 24 hour service.

The original scheme was jointly funded by NS and the Dutch Ministry of Transport, who provided € 5.08 million. Collaboration was also obtained from the Nederlandse Samenwerkin Taxibedrijven BV (NST) who agreed to implement a standard tariff. In 1991 an initial assessment led to the scheme being introduced in 60 cities and 200 municipalities. This saw around 2 million users of the scheme and in 1993 the scheme was expanding further resulting in 111 stations being covered and around 3 million users. A subsidiary of NS took over the management of the scheme following the initial pilot, Transvision, and acted as a co-ordinator between NS, taxi companies and passengers.

Privatisation of NS in 2002 led to them withdrawing funding for the scheme and Transvision approached Dutch provinces to seek financial assistance as well as the Dutch Ministry of Transport for a state subsidy. This led to a rationalisation of the T-T services with the closure of inefficient services where an authority was not willing to provide funding. As a result the scheme covered only 62 of the original 111 stations by 2004, which also saw Transvision withdraw from managing the T-T service. In 2007 only 38 stations operated T-T services organised by private taxi services with funding from local government and marketing support from NS. The dedicated service they provide is increasingly being taken on by other DRT services, such as RegioTaxis (RG), which provide much wider regional services in a number of Dutch Provinces (Mott, 2008b).

The provinces argue that, '*…this arrangement allows them to reduce operating costs through contracting one company to provide shared taxi services across the full range of passenger requirements, rather than just travel to and from rail stations.*' Mott (2008a), whilst for other provinces the train-taxi service (as a commercially run service) does not align itself with their policy of developing community and voluntary run DRT services.

Plusbus

Plusbus (www.Plusbus.com) is a recent UK development that offers an optional add-on when purchasing a train ticket. The add-on is in effect a discounted bus pass (similar to a travel card) which allows a train traveller unlimited travel on the buses serving the urban area around both the traveller's origin & destination train station area, on the day of travel.

The scheme is supported, crucially, by Britain's five largest public transport companies – FirstGroup (www.firstgroup.com), Go-Ahead (www.go-ahead.com), National Express (www.nationalexpress.com), Stagecoach (www.stagecoachbus.com) and Trans-Dev (www.transdevplc.co.uk) – who operate a mix of bus and train services within their public transport portfolios. Their involvement in the Plusbus

scheme should come as no surprise, since they have an interest in promoting both train and bus travel.

Offering a product like Plusbus, that is complementary to both train and bus, makes strong commercial sense. Other tacit support has come from train operating companies and from industry bodies in both the rail and bus sector. The Plusbus concept has been rolled out to 276 towns in Great Britain, with another five towns to join in September 2010, and to 13 towns in Northern Ireland. In addition Plusbus can also be used to travel by tram in Birmingham, Nottingham, Sheffield and Wolverhampton.

The main urban area not covered by Plusbus is Greater London. The ticket add-on can be purchased either over the counter at all train stations, via the internet and via the phone.

In addition to offering single and day return Plusbus tickets, the promoters of the scheme also offer a Plusbus season ticket for 7 days, monthly, 3 monthly and yearly time periods which are aimed at the commuting market. Plusbus claims that in nearly all cases a Plusbus ticket will be cheaper than the equivalent bus ticket bought on the day. A further discount of a third is available for travellers who hold the following rail cards:

- 16-25 Railcard;
- Disabled Persons Railcard;
- Family & Friends Railcard (on-line purchase not available);
- HM Forces Railcard;
- Network Railcard (or Gold Card);
- Senior Railcard.

The scheme has proven to be highly successful since its launch with substantial growth, as illustrated by the sales figures for the last two years with 280,357 Plusbus tickets being sold in 2008/09 and expected sales in 2009/10 of 475,500 tickets. Of these around 70% are day tickets (principally business and leisure) and 30% are season tickets (commuters) with a heavy bias towards weekly and monthly tickets. The reasons for such strong sales growth are credited to:

- The national availability of Plusbus tickets;
- Greater availability of season tickets for commuters (85% of schemes now offer these);
- Better promotion of Plusbus by themselves and also by train companies (through more advertising posters at train stations, more information on websites, in customer newsletters and onboard magazines etc);
- On-line retailing of Plusbus day tickets (which started august 2009 and now accounts for 20% of all day ticket sales);
- Advertising in newspapers e.g. 'metro';
- Word of mouth - existing customers telling their friends, family and work colleagues about Plusbus.

4.9.2 Assessment against EU Objectives in the Field of Interconnectivity

The assessment against EU objectives for this case study will differ to other case studies because of the nature of the concepts under consideration. For example the UK T-T concept is purely informational in its content; it is therefore problematic to include any meaningful discussion with regards to ‘network and infrastructure’ or ‘quality of interchange’ for example. This needs to be borne in mind when reading the assessments.

Network and infrastructure

This assessment is only relevant at the micro level (regional/local network) and as such does not appear to be of relevance for either the UK or Dutch T-T concept, since the former provides an information only service and the latter has direct links to railways stations via the local road network.

The issue does remain a concern for the Plusbus scheme and bus feeder services to mainline train stations.

Clearly, the Plusbus scheme is successful in reducing users' uncertainty about how much the bus fare will be when travelling, however the scheme does not reduce users' uncertainty about whether there will be a service that they wish to catch at the train station or close by to the train station. There is therefore an integration issue in terms of ensuring that the urban bus network in cities and towns is linked to the rail station physically (e.g. the railway station is served by bus services). Where this is not the case (perhaps the result of historic development) a further barrier to travel is erected.

Some of the best examples of bus services providing both a physical link to train stations and a high quality network of bus services are to be found in Switzerland, where the addition of integrated timetabling ensures an even higher quality service for travellers.

Quality of the interchange

This touches upon some of the physical infrastructure aspects mentioned above in that one of the key reasons for poor integration between rail and bus services is the lack of rail/bus interchange facilities at rail stations. In a large part this relates to historical development in terms of (1) no consideration given to bus services when rail stations were constructed; and (2) development since has bypassed the train station, positioning them on the periphery of urban cities meaning that bus interchanges are sited away from the rail stations.

One important barrier that Plusbus overcomes is, in effect, facilitating the integration of train and bus operators by offering an add-on bus travel card, in effect an integrated ticket bought via an integrated booking and payment system. This ensures that rail travellers have confidence that they can continue their journey by any bus operator. The Dutch T-T scheme offers a similar feature by allowing rail travellers to purchase a taxi journey at the same time as purchasing a rail ticket.

At the same time as ensuring physical integration it is also important that the bus feeder services linking a train station are of sufficient quality and relevance to attract the users. For example, operating a service twice a day to the rail station is unlikely to engender confidence in that service. Similarly, operating a service from the rail station to obscure destinations or that are not direct will again have adverse impacts on users who want direct services to major destinations. If a rail station is not located at the hub of the city centre, then these issues are likely to be accentuated since bus operators may not have a sufficiently strong business case to run specific services that serve the train stations. If the reverse is true, then the financial case for re-routing existing services via the train station becomes much stronger.

A further important aspect of service quality is door-to-door travel information (pre-trip and on-trip). Here the UK T-T concept provides assistance to rail travellers by providing details of taxi services and ranks at train stations or numbers of taxi companies who serve particular train stations; particularly as the information it provides can be accessed via the national rail website, train operating company websites and journey planning websites. For bus feeder services this area of information provision at the rail station is still likely to be an issue. The lack of information (be it real-time or schedules) will add to users' uncertainty and may dissuade them from possibly travelling by train or travelling by bus when arriving at the train stations. It would appear that there is still an issue about who should provide (and therefore bear the costs of) such information at the rail station, especially when train and bus operators are not owned by the same company.

Finally, there is the issue of co-ordinating timetables between rail and bus services. In Switzerland this tends to be the norm and is very attractive to travellers since it reduces time spent interchanging. This is easier to achieve if bus services are integrated, but not impossible if this is not the case, and indeed it should make commercial sense.

Integration of transport operators

The Dutch T-T and Plusbus concepts perform strongly with regard to these criteria. With regard to the latter, voluntary agreements have been entered into by bus and rail operators, which cover joint ticketing and revenue sharing agreements between both modes.

The Plusbus add-on is purchased at the same time as a train ticket. The revenue for both parts of the journey is therefore collected by the train operator before the bus portion is redistributed to the specific bus operator(s) that it relates to. In addition both sets of operators have established joint partnerships with regard to the marketing of the Plusbus brand. Both sides recognise the benefits that result from working together to ensure the promotion and operation of Plusbus, (e.g. increased patronage) and both appear committed to rolling the scheme out to all areas of the UK.

Crucially, the scheme is supported by Britain's five largest public transport companies who operate a mix of bus and train companies within their public transport portfolios. The scheme also has the tacit support from other train operating companies and from industry bodies in both the rail and bus sectors.

The Dutch T-T scheme has a formal partnership agreement in place between local authorities, taxi companies and the national rail operator (NS). Local authorities are the 'driving forces' and sole funders of the scheme, although marketing support is provided by the national rail operator (NS). NS also operate the joint ticketing scheme that allows taxi journeys to be purchased at the same time as a rail ticket. Taxi companies appear to be passive partners / subcontractors in the scheme.

Promotion of intermodality

This has already been touched upon in the previous subsection, however all three concepts discussed here engage in this to various degrees, particularly Plusbus.

Interestingly the UK T-T scheme is funded largely by the passenger rail industry and yet promotes another mode (taxi) in order to attract customers to rail. The scheme itself is promoted heavily on a number of websites where current or potential rail users may browse, as well as being available to telephone callers using the National Rail Enquiries call centre.

Similar promotion is accorded to Plusbus except that in this case the operators across both modes are involved, resulting in multimodal marketing. The concept is heavily promoted on all train operating company websites; with the option to purchase a Plusbus add-on ticket when buying rail tickets. The scheme is also advertised on buses, at rail stations advertising boards, in customer newsletters, on board magazines and in newspapers.

Promotion has focused upon several aspects of the ticket including:

- Time savings – buy tickets for your complete journey before you travel, no rush hour driving, no hunting for car park spaces;
- Great value – exclusive, discount price bus travel;
- Save money – railcard holders save one-third off the cost, no car parking costs;
- Go anywhere – unlimited bus travel around town;
- More flexible – travel on all participating buses;
- Reduce hassle – no need to keep change for fares.

There are significant cost economies from marketing Plusbus as a single brand covering many operators. In addition the promotional message is not diluted, as would be the case if different train operators and bus companies had their own ticket brands. The majority of the current marketing is targeted at existing public transport users, however, this does not mean that the message is failing to get across to car users since occasional leisure users and business travellers will be well represented by this cohort.

4.9.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Low
Comments This assessment is only relevant at the micro level (regional/local network) and as such does not appear to be of relevance for either the UK or Dutch T-T concept, while it remains a concern for the Plusbus scheme. More broadly, the physical connection of bus services to railway stations is variable throughout Europe. This may be due to historical development in terms of no consideration of bus services when stations were originally constructed resulting in poor infrastructural links. Similarly, the quality of the bus service network that may serve a train station is variable with excellent examples to be found in Switzerland and poorer ones in the UK.

Area of intervention: Quality of interchange
Assessment against EU work: Medium
Comments There is rarely a bus station located beside railway stations (e.g. Hull transport interchange) and frequently not even bus stops, (e.g. Edinburgh Waverley). In a large part this is due to historical development in terms of: (1) when train stations were originally sited there was no consideration of bus services; (2) development since the train stations were built has led to expansion away from the stations and so the siting of bus stations away from rail stations. In terms of quality of service, initiatives like Plusbus have provided travellers with an integrated ticketing and payment system that has facilitated greater ease and confidence in onward travel. The same can be said for Dutch T-T concept. The UK T-T concept provides a good example of helping to provide door-to-door travel information, something that Plusbus and rail station operators still fail to provide. There are still issues with the co-ordination of timetabling between rail and bus providers and moves to achieve this would provide great benefits for travellers.

Area of intervention: Integration of transport operators
Assessment against EU work: Medium
Comments Dutch T-T and particularly Plusbus are both examples of how separate transport operators across different transport modes can come together and integrate their ticketing and marketing operations. Theyboth differ however in that Plusbus is based upon voluntary partnerships between commercial organisations that have worked together for mutual financial benefit. This can be contrasted with the Dutch T-T scheme, which is heavily subsidised by local authorities and has a passive partner in the shape of the taxi companies who are contracted out to operate the service. One scheme appears to be flourishing (Plusbus) whilst the other is in decline (Dutch T-T).

Area of intervention: Planning process
Assessment against EU work: Not Relevant
Comments Not relevant.

Area of intervention: Promotion of intermodality
Assessment against EU work: High
Comments The Plusbus scheme provides a good example of the promotion and marketing of intermodality by partners from different modes of transport. By promoting the concept across modes and by focusing on a single brand the transport operators involved have magnified the effectiveness of their branding and promotion and benefited from cost economies at the same time. The UK T-T concept demonstrates that promotion of intermodality need not involve all the modes, however by involving them in the manner that Plusbus has achieved, the message will be stronger.

4.10 AMSTERDAM FERRY SERVICES

4.10.1 Background

Amsterdam has a population of 743,000 and is the biggest city in the Netherlands. The greater Amsterdam region relevant for this case study has a population of about 1.5 million inhabitants.

The Netherlands and, within this context, Amsterdam are quite often seen as a model regarding public transport and public transport policies. Amsterdam currently runs a campaign with the aim to be a sustainable city. The public transport system in Amsterdam includes tram, metro, bus, ferries, water taxis and railway (regional, national and international).

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 international ferries from the port of Ijmuiden.

The first type of ferry service 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 outside the Amsterdam Centraal Railway station. This location allows for quick interchange to other public transport modes (tram, bus, taxi) and individual active travel modes (bicycle and walking), but also to regional and long-distance rail services, which leave from the railway station platforms. Finally the 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.

The second type of ferry is operated by Connexxion, a company that is the largest regional bus operator in the Amsterdam region, and provides a high speed (65km/h) service to Ijmuiden. The FFF is a regional service and with its use of the terminal at Amsterdam Centraal is well integrated as described above for the GVB ferry services. At the same time the interconnection at Ijmuiden reveals potential for improvement. Furthermore, 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.

All paper tickets in the Amsterdam city region have been eliminated since June 2010 and been replaced by a personalised and anonymous smart card. This is part of the —Regionaal Verkeer-en-Vervoerplanll (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 more variable tariff design, but also to improve service management e.g. with line operation (via GPS) data, vehicle occupation, and passenger flow data. The introduction of the smart card is 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 beyond the Amsterdam region.

4.10.2 Assessment against EU Objectives in the Field of Interconnectivity

Current integration in public transport exists by means of joint ticketing and the expansion of the OVChip card across the Netherlands including the Amsterdam region. Moreover, integration is also present at the main terminals and, where possible, offers multimodal travel options. Integration is driven by the national and regional authorities and their strategic transport development plan. A main driver for interconnection and integration is the goal to move towards a sustainable society.

The development of ticketing from a modal or operator led approach towards a 'mobility' approach is contributing significantly to an improvement of interconnectivity and integration, particularly as the development in the Netherlands is driven from a national perspective.

The sustainability of interconnection beyond integrated ticketing in terms of timetables and multimodal trip information was identified as an emerging topic, which is not yet considered in the EU objectives in the field of interconnectivity. This topic emerged as the sustainability of a system with a co-existence of interconnection and competition might be questioned in the medium and long-term. These two market conditions are somewhat contradictory and the development of sound tendering procedures should be analysed further in this respect.

While the interconnection between the PT and regional and long-distance rail services is well developed, the interconnection between the Amsterdam regional transport system and intercontinental ferries is rather limited and today only interconnection by bus is an effective possibility.

Ferry operators actually discourage other possibilities through their description and the FFF option, even though possible, is not even mentioned on the port's website. The promotion of the existing DFDS shuttle service between Ijmuiden and Amsterdam is primarily driven by image and profit interest of the international ferry service provider DFDS. This finding is quite relevant as interconnection is recognised by the private sector as an important part of the travel experience, which is especially true when it comes to tourist travel as in this case study.

Further, multimodal travel information systems do not even include the ferry port as an option. Therefore, the potential of interconnection is not being fully exploited. Consequently, the development potential is relevant but, given the operating structure, will have to be driven by the private sector.

4.10.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: High
Comments The transport network and infrastructure is well developed and offers multimodal options for travel. High relevance is given to continuous improvement of the network and infrastructure. This is also reflected in the tender processes for PT services and the constant evolution of these processes.

Area of intervention: Quality of interchange
Assessment against EU work: Medium
Comments The quality of interchanges in relation to ferry services discussed in the case study differs significantly. While the central interchange at the Centraal Station offers a multimodal and smooth transfer between local, regional and long-distance services, the potential of the interchange in Ijmuiden has not been exploited. While there seems to be potential for improvement of the latter interchange between long-distancel ferry services and the PT transport network, it should be acknowledged that the private ferry operator is offering an interconnecting bus service to the Centraal Station. Therefore, the awareness of private operators to provide interconnecting services is given and they should be encouraged to further integrate them in the PT transport system.

Area of intervention: Integration of transport operators
Assessment against EU work: Medium
Comments Transport operators are integrated as far as nationwide information on routes, timetables, tickets and fares is concerned. The introduction of the OV-Chip card has brought significant progress in the integration of transport operators from a modal or operator led approach to a “mobility approach. Furthermore the data from using the OV-Chip card also allows for exact division of traffic revenues between operators etc., which contributes to a more equal distribution of revenue among operators. The recent integration of the FFF into the OV-Chip card system can be seen as a substantial step towards the integration of ferry services. However the provision of integrated information on regional buses and urban public transport has suffered a lack of completeness and co-ordination of timetables after the introduction of concessions obtained by competitive tendering (WP/Law on Passenger Transport 2000). These procedures and developments limit the transport providers‘ co-ordination activities in respect to joint information provision and marketing efforts. The complementarity of competition for and in markets with simultaneous integration of services and information sharing is an emerging topic and it should be analysed thoroughly what steps can be undertaken to develop tender procedures in compliance with EU regulation, so that they on the one hand maintain competition, but on the other hand facilitate further integration of transport systems.

Area of intervention: Planning process
Assessment against EU work: High
Comments The planning process is well developed and coordinated at national and regional level through regional mobility and transport policy plans. Furthermore the organisation and implementation of the new ticket system has been driven under a multi stakeholder approach including public and private sector bodies. Overall nine public transport carriers and their 19 contracting parties (regional public transport authorities) were involved to determine the issues related to the introduction of the system for more than 60 regions (concession areas) across the Netherlands. This included tariffs, travel products, communication campaigns and recharging locations. While a nationwide agreement was reached, a national organisation could have been more effective in developing the system. Furthermore, the principal discussions among the involved parties were of technical rather than organisational and strategic nature.

Area of intervention: Promotion of intermodality
Assessment against EU work: Medium
Comments The OV-chip card being functional in the whole country can be seen as a significant promotion of intermodality as it includes all public transport modes in the Netherlands, including the regional and national railways. Promotion of intermodality on the other hand could be further improved by the complete integration of timetables and information sharing. Also private sector initiatives like the DFDS bus services that connect long-distance ferry services to main interchanges could be more integrated and further developed.

4.11 LISBON FERRY SERVICES

4.11.1 Background

The city of Lisbon is occupied by about 600,000 people. The Metropolitan Area of Lisbon (AML – Área Metropolitana de Lisboa) has approximately 2.7 million inhabitants spread over 2,963 km^2 and a total of 18 municipalities. Population density is just above 6,600 people/km^2 and a fast growth in population over the past decades has been experienced. The average population increase hides strong differences between the municipality of Lisbon itself with a declining population and the suburban regions which grew at rates above 10%.

Lisbon is located on the River Tagus and, despite the construction of the Ponte 25 de Abril bridge which links the two sides and carries both rail and road traffic, the ferry network has continued to play a vital part in Lisbon‘s public transport network. With the opening of the Fertagus railway line and the new Vasco da Gama road bridge, services have been reduced, but nevertheless remain frequent to Cacilhas, Barreiro, Seixal and Montijo.

Consequently, it is interesting to note how the ferry services have coped with their changed role after long-distance rail travel was joined by these bridges and the ferry interface was not needed any more. Additionally the ferry services continue to play an important role in the network and research in the organisation of integrated ticketing and terminal development is expected to deliver insights on the reasons for well-functioning interconnections.

Figures for 2008 estimate 3.8 million daily journeys using motorised transport of which 1.37 million daily journeys are made on the public transport system throughout the AML.

In comparison to other cities, Lisbon has a densely developed public transport infrastructure and bus network in relation to the size of its population. Lisbon has three types of rail-based public transport (tram, light and heavy rail), which is relatively uncommon for cities of comparable size. Lisbon‘s public transport system is planned to be 100% wheelchair accessible, except for buses for which just above 90% are accessible (TTR, 2006). Interestingly, the study does completely exclude ferry services from its analysis.

The creation of Sistema de Transportes de Lisboa (STL) was a first attempt to counteract a falling and today stagnating public transport share, and aimed to improve the provision of increased and integrated public transport services. This first effort included the three main public operators Carris, Metropolitano de Lisboa and CP (national railways). STL, which was promoted jointly by the Portuguese government, the Municipality of Lisbon and the Metropolitan Transport Authority, started to include other public and private operators. The initiative included extensions of the metro system and building of tramway lines, increased and more reliable bus services, fare integration between various transport companies, and institutional evolution. This included the extension of the four lines of the Lisbon underground. In relation to interconnection the extension of the blue line to Santa Apolonia railway station and the red line connecting the Estacion Oriente have been major developments. The

extension of trams and their interconnection with railway lines have also contributed to a better interconnection between these two public transport options (e.g. Santa Apolonia and the south bank of the River Tagus - Metro Sul de Tejo). The parallel development of light rail, tram and heavy rail also aimed to convert the traditionally radial network into a more circular one, thus creating more direct and faster connections.

The underlying idea of the current network is a three-tier network with each tier fulfilling different functions within the network. The highest level is served by high speed services complementing the heavy rail services (rail and metro) network and light rail and bus services. The core routes are fed by intermediate level (speed) services. The final local level assures connections to the metro and rail network within a maximum of 10 minutes. This idea has been led by Carris, but has left out ferry services in the consideration of this approach.

Institutional evolution is a key topic in the integration and interconnection in this case of Lisbon. A further focus is the integration of the fare system in public transport. It is important to note that this case study focuses on the interconnection of ferry services in the AML and thus the development of the other transport modes, while relevant, is only considered in relation to the development and functioning of ferry services.

The intermodal connections in the case of Lisbon have various dimensions: a) ferry services form a vital part of the local public transport network (short-to-short distance interconnection) and this can either be uni-modal within the ferry network or intermodal between the ferry, bus and metro network.; b) ferry services traditionally bridged a gap between long-distance rail services; and c) ferry services today interconnect with long-distance rail travel at the train stations.

In contrast to other case studies ferry services in Lisbon have changed their role within the transport system significantly in history. The ferry services historically fulfilled the role of connecting long-distance rail (northern and southern Portuguese rail networks). This ‘obligatory‘ role changed with the construction of the rail bridge across the River Tagus. The connection of the rail network thus created competition for the ferry services and also changed their role within the network to ‘optional‘ rather than ‘obligatory‘.

The physical geography of the AML 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 alongside rail or road transport on one of the two bridges. They continue to play an important part within the Lisbon transport network and, despite overall continued passenger losses, the focus on improved terminals seems to partly counteract this negative development. Interconnection of the ferry services to regional and long-distance rail is thus in the focus of the case study.

4.11.2 Assessment against EU Objectives in the Field of Interconnectivity

The integration of waterborne transport with other modes and operators (physical integration of services, integration of fares and of information, etc.) is a fundamental requirement to offer travellers a seamless trip. Transport authorities at various levels play a major role in the effectiveness of interconnection. The following aspects have been identified as critical in the assessment of the Lisbon ferry services:

- Improved interchanges. Terminal location and development will be discussed along with the potential impact on interconnection of modes.
- Improved links (technical evolution). The impact of the conversion of the ferry fleet from conventional to fast catamaran ferries and the impact on the role of ferry services within the transport network have been a main influence on the development of the ferry services. This reflects the importance of technological innovation to maintain or improve a sustainable market share within an interconnected network.
- Improved links. Bridges are the main arteries to sustain traffic and have defined capacity limitations. How far do ferry services and their level of interconnectivity play a role in alleviating traffic demand pressure on the bridges?
- Effective integration. Lisbon‘s trains, buses, trams and ferries all accept compatible contactless paper tickets (paper tickets with RFID chip). While there is a clear development towards

integrated ticketing to improve the accessibility of the transport system at Lisbon Metropolitan Region level and beyond, integration does not bring equal benefits to all operators and might even influence revenue levels. Therefore, cooperation is a publicised strategy, but the actual underlying competition might counter some of these efforts.

- Information and marketing. Mobility portals exist that allow for multimodal trip planning. Nevertheless each transport operator directly markets their own service and this can be in competition with other operators and/or modes on certain routes. Furthermore, the available mobility portals do not always give the full number or the best of options the question is what might be the underlying constraints for achieving this.

The interconnection of long- and short-distance travel in the Lisbon Metropolitan Area (AML) has progressed over the last years. The case study focuses on the interconnection of ferry services, rather than the level and quality of interconnection of the whole transport system in Lisbon. A number of important solutions and efforts have been developed to improve the integration of the ferry network with the other modes. While the cooperation 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.

The current cohesiveness of the network is enhanced with the generation of LTMA (transport authority of the metropolitan area of Lisbon). Nevertheless, success and evolution of cohesiveness will depend on the willingness of individual operators to integrate. At the same time the continued work and expansion of integrated ticketing within metropolitan regions and beyond is strengthening the provision of integrated networks and services. The implementation of the technology to be able to better track the movement of passengers has and will play a major role as this also improves fair revenue splitting and transparency in the fare system. Despite all these efforts the reaction of transport operators to growing competition cannot be estimated.

The implementation of integrated ticketing options including the ferry services exists since 2005. Today various combined and multimodal ticket options are available and are further developed under the co-ordinating efforts of OTLIS (Transport Operators of the Lisbon Region). There is high acceptability of combined and multimodal tickets as these make up the biggest share of tickets used for ferry services.

The expansion of this effort is particularly interesting as competing transport operators have agreed to use the OTLIS framework.

New initiatives are aiming at stronger integration. Key success factors are the adoption of a smart card that fits the highly complex existing fare system and all networks. This includes the development of a common interoperable specification and applications embedded in the smart card and in all equipment, thus building in full interoperability from the start. A further key success factor was the existence of a supra-operator organisation to co-ordinate issues in each market for the successful implementation of an intermodal system. The success of non-formalised frameworks of negotiation stands out between the state government and the private sector and between the central government and regional or local interests (often also represented by the private sector, or by the municipal authorities, in the absence of regional administrations).

While the integrated ticketing in theory provides seamless transport, the working of the system presents failures in day-to-day use and today only reaches out to the regional level. A ticketing option that allows integration with the national railway network is currently under development. The fares system of the public transport system, despite efforts to simplify, remains complex and using concentric crown zones includes over 300 ticket types that differ in geographical, temporal and usage validity. Examples include: multimodal, combined, exclusive, single, daily, weekly, monthly, etc.

The advantages of good interconnections might get lost, if there is no information about them. However, integration of information in terms of routes and timetables and interconnections remains at a very general level at the different transport operator portals. The operator Carris does not even show the ferry routes in its networks map. Multimodal trip information can only be retrieved from the specifically developed portals: transporlis and transpor. The available multimodal travel information

systems and portals do not function satisfactorily and have been found to return varying information for similar routes.

The main opportunities for interconnection arise from improvement of information systems, integration of the national railway within the ticketing options and integrated timetabling, particularly for off-peak travel.

4.11.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Medium
Comments The provision of integrated networks has been improving continuously, particularly as the metropolitan regions take responsibility to develop terminals and do this under a multimodal mobility strategy. Integration in terms of interchanges in terminals has been one of the main focuses in the transport network development and was established quite successfully and is still expanding. Technological change has contributed to the competitiveness of the ferry services within the ALM. In order to stay competitive with the competing travel modes the ferry transport operators embarked 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. This technological strategy improved services and travel time substantially.

Area of intervention: Quality of interchange
Assessment against EU work: Medium
Comments The multimodal options in the case of Lisbon that focus on the integration of ferry services depend primarily on the location and interconnection of the terminals. While a general accessibility to other transport modes at the ferry terminals is given, the dimensions and quality of this accessibility varies, but is undergoing a redesign process. The redesign of ferry terminals with particular focus on improving the interconnection between the ferry services and other transport options is a strategy still under development. Particular emphasis is given to improving the interconnection with public transport systems and active travel modes, but also to improve the potential of ferry terminals as an entry point to the public transport system by creating park and ride facilities. The renovation and redesign is already showing effects in increasing passenger numbers on certain routes where the process has been concluded.

Area of intervention: Integration of transport operators
Assessment against EU work: Medium
Comments The cohesiveness of the network is currently being enhanced with the generation of the transport authority of the metropolitan area of Lisbon. Nevertheless, success and evolution of cohesiveness will depend on the willingness of individual operators to integrate. Today various combined and multimodal ticket options, including the ferry services, are available and are being further developed under the co-ordinating efforts of OTLIS (Transport Operators of the Lisbon Region).

Area of intervention: Integration of transport operators
New initiatives are aiming to achieve a stronger integration (e.g. the adoption of a smart card that fits the highly complex existing fare system and all networks).

Area of intervention: Planning process
Assessment against EU work: Medium
Comments Significant effort has been put into the planning and expansion of the PT system in Lisbon to counteract the rise in motorised traffic. Improving interchanges through network restructuring (lines, routes, timetable and frequencies) is one possibility. The transport operator Carris is developing the so called Rede7 (Network 7) plan. This plan includes the underground extension (on the blue line) to Terreiro do Paço and Santa Apolónia. The changes made are improving the interconnections in public transport supply with the other operators in the area, specifically the Lisbon Underground and the ferry operators Transtejo and Soflusa.

Area of intervention: Promotion of intermodality
Assessment against EU work: Low
Comments Integration of information in terms of routes and timetables and interconnections remains at a very general level at the different transport operator portals. The available multimodal travel information systems and portals do not function satisfactorily and have been found to return varying information for similar routes. The main opportunities for interconnection arise from improvement of information systems, integration of the national railway within the ticketing options and integrated timetabling particularly for off-peak travel.

4.12 HELSINGBORG FERRY TERMINAL

4.12.1 Background

Helsingborg is part of the Øresund Region, a transnational region consisting of the Swedish region of Skäne (Skåne) and the Danish island Zealand (Sjælland). The region has around 3.7 million inhabitants (2010) and it includes cities such as Copenhagen, Helsingborg, Helsingør, Lund, Malmø and Roskilde.

The Port of Helsingborg is one of the world's busiest ferry ports. There are only 4 km between Helsingborg and the neighbouring town of Helsingør in Denmark. The crossing has experienced a decline of about 2 million passengers annually since the opening of the Øresund Bridge (year 2000) about 40 km to the south connecting Copenhagen (the capital of Denmark) and its airport with Sweden and the major city of Malmø. However, at present day still more than 11 million passengers travel with the ferries between Helsingborg and Helsingør every year.

In the 1980s a decision was made to create a central terminal for all modes of public transportation in Helsingborg. Since the 1990s the original plan for the terminal has been developed and expanded. Furthermore, the facilities are being improved gradually to maintain the terminal as an excellent example of a major interconnection node.

The terminal is located right at the port facilitating direct and rapid interchanges between the ferries and all possible modes of public transport.

4.12.2 Assessment against EU Objectives in the Field of Interconnectivity

Compared to the major EU policies and actions in the field of Interconnectivity, this terminal appears to be a very good example of what can be achieved, although the main drivers for the development have probably been

- the strong Swedish planning tradition (rather than European influence),
- the priorities given to public transport and
- the commercial necessities fuelled by the building of the Øresund Bridge.

Especially the ferry companies came under severe economic pressure, and became highly motivated to improve facilities and intermodality to remain competitive. In addition there has been a strong local political and commercial interest in maintaining the "twin cities" (the Swedish Helsingborg and the Danish Helsingør) as centres for commerce and cross-national day-to-day trade generating travels to and from Denmark/Sweden.

Geographically, Helsingborg and the Danish city on the other side of Øresund Helsingør, has always been a natural interconnection between different modes of transport and cross-national traffic between Sweden and Denmark, thereby also connecting Sweden indirectly to the European continent.

The present terminal has therefore been able to take advantage of the possibilities created from the historical development and the geographical positioning. The long-, medium- and short-distance network and transport modes represented in Helsingborg have consequently, with minimum land use for the terminal facilities (by e.g. using a building design in horizontal layers), been able to create an almost perfect example of coordination between network, infrastructure and terminal facilities.

The facilities for the operators and their passengers benefit and interact with each other, thereby creating a better commercial viability for all parties involved. The integration between regional transport networks and the international networks and connections is reinforced by facilities available to both passengers and operators.

This passenger and operator orientated complementarity is further reinforced by the use of passenger information systems and integrated ticket systems. The design of the terminal, and the presence of so many different transport modes and operators achieving advantages of the collaboration and co-presence, gives raise to further use of ITS on a commercially viable basis.

The intermodality is actively promoted by collaborative arrangements and combined tickets between different modes and operators.

At this terminal it is possible also in practical terms to shift between a planned mode of transport and/or operator, and use another mode/operator, if there are delays, or if a passenger is late for a connection. The integration of networks, information and ticketing systems involves all combinations of local-, medium- and long-distance transport options.

The collaboration between operators and public stakeholders present at this terminal is therefore an example to be followed at an EU scale, and one of the good practical examples of what can be achieved, if the EU intentions are adhered to by national stakeholders of the present European interconnection nodes.

4.12.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: High
Comments The terminal gives access and interchange possibilities to all transport modes and to every public transport network available in this area. Thus access to local, medium- and long-distance networks are established.

Area of intervention: Quality of interchange
Assessment against EU work: High
Comments Generally, the quality of the interchange and its passenger related facilities is high. The present plans for improvement will bring the terminal's general standard up among the best examples in Europe. It could be argued that a direct interchange/check-in facility to Copenhagen International Airport and/or the national/regional airport of Sturup is missing. However, given the very easy and direct access by frequent trains to Copenhagen Airport, and the also easy access to similar bus connections to Sturup, the absence of check-in facilities to the two airports seem to be of lesser importance.

Area of intervention: Integration of transport operators
Assessment against EU work: High
Comments The involvement of transport operators in the planning and execution process, and in the operation of the terminal are an example to be followed.

Area of intervention: Planning process
Assessment against EU work: High
Comments The planning of the terminal has probably been made easier by the strong public planning tradition of Sweden, and the high percentage of public ownership of the involved area. Furthermore, the competition from the opening of the Øresund Bridge to the South of the Helsingborg/Helsingør crossing, have probably positively influenced the interest of participation in the planning process by all operators and specifically the ferry operators, who had a clear self-interest in making it as easy as possible to use the ferries.

Area of intervention: Promotion of intermodality
Assessment against EU work: High
Comments The high integration and easy access to information and ticket systems combined with other elements of passenger orientated intermodality as e.g. possibilities to change between car, bus, local and long-distance carriers etc., practically under the same roof, are unique for this terminal and an example of the general EU vision of intermodality in a node/terminal of EU importance.

4.13 ROSTOCK FERRY TERMINAL

4.13.1 Background

The Port of Rostock has a reasonably large potential as passenger transport terminal between Scandinavia, Russia, The Baltic Countries and Germany. Nevertheless, with the exception of the ferry to Gedser in Denmark the frequency of the ferries are relatively low.

The Port of Rostock is owned by The Federal State of Mecklenburg-Western Pomerania and the Hanseatic City of Rostock. Being the largest port in the state of Mecklenburg-Western Pomerania, the state cooperates with the city of Rostock to continue to develop the Port of Rostock, e.g. in foresight studies, infrastructure development and maintenance.

The focus of the development in the recent decades has been on the most economically viable transport forms of the car (passenger) and the lorry (with regard to freight transport).

With more than two million passengers annually it is one of the busiest ferry ports in the Baltic Sea. However, as a Southern Baltic Sea crossing for foot passengers by ferry, it lost its importance during the last two decades. Presently, passengers with private cars are the major source of revenue in passenger traffic, for the ferry operators and the port. The infrastructure and services are adjusted mainly to these target groups. The share of passengers travelling by foot is only about 10% of the total amount of passengers, thus no investments are made in creating attractive conditions for the non-motorised passenger segment, leading to a vicious circle of decline.

The Rostock ferry port is well connected to the European highway network; the E55 links directly to the pier, and as all ferries accommodate buses and cars, there are no interconnection issues related to these modes. The closest airport (Rostock-Laage) is situated about 40km from the Port of Rostock, offering a limited number of destinations, mainly European. Three daily buses connect the airport to Rostock Hauptbahnhof (the central station of Rostock).

Long-distance train connections to and from Rostock are via Rostock Haubtpahnhof, located about 12 kilometres from the ferry terminal. There is no direct and convenient connection between the ferry terminal and Rostock Hauptbahnhof. From the point of view of a non-motorised passenger, the quality of the interchanges between the ferries and other modes of transport in Rostock cannot be considered optimal. The S-Bahn station (Seehafen Nord) closest to ferry terminal is located about 1.5 km from the ferry terminal. Alternatively, you can get to the city by local busses departing directly from the passenger terminal on the port, but none of those goes directly to Rostock Hauptbahnhof, making at least one extra interchange unavoidable.

4.13.2 Assessment against EU Objectives in the Field of Interconnectivity

The Port of Rostock example demonstrates how the lack of focus on the interconnections for certain groups of travellers has led to a situation with unsatisfactory interchange options, making Rostock an unattractive destination for non-motorised travellers.

In historical terms the development of the present design of the Rostock Ferry Terminal can be seen as a manifestation of the political system of the GDR, which had a strong focus on political and economical planning. However, the free movement of people and capital were not part of the GDR objectives, contrary to the European Union were this is one of the main pillars. It is therefore quite logical, that there is no planned integration between local, medium- and long-distance transport in the geographical setting of the Port of Rostock, which in its present main setting was planned during the GDR period.

The development in recent years with a fairly reasonable integration between ferry operators and transport by lorry, ferry and private car, can be seen as the development that is possible to achieve on a free market basis.

The present function and design of the Rostock Ferry Terminal can therefore be understood as a manifestation of a substantially different political and economical agenda to the development of interconnectivity between local, medium- and long-distance transportation.

Compared to the intentions on intermodality of the EU, the Rostock Ferry Terminal is moving from a close to zero point, into a future with a stronger influence from the EU strategic issues of intermodality.

The planned test during 2011 of an integrated and frequent shuttle bus service is an example of one of the possibilities open to improve this terminal in order to match the visions of a better interconnectivity in the EU.

The present separated local, medium- and long-distance networks are linked together by the planned shuttle bus. This is in accordance with the intentions of the present EU strategies. Although the quality as such of the interchange is hardly affected, the functional quality as an interchange node is improved. The planned collaboration of the operators through marketing and combined ticketing could, if proved successful, lead to an increased integration on a step-by-step basis.

The attempt to involve as many stakeholders as possible in the planning process of the shuttle bus system, the promotion of intermodality and the connection between different operators and modes of transport, falls clearly within the lines of present EU strategies.

In conclusion, the Rostock Ferry Terminal is on the move from its past into its present EU reality.

4.13.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Low
Comments The infrequent and inconveniently placed possibilities for foot passengers to interconnect with any mode going to and from the ferry terminal leads to this evaluation. It would be justifiable to argue for an evaluation of “Network and infrastructure” categorised as “none”. However, due to the recent effort of the planned shuttle bus, the overall evaluation is instead “low”.

Area of intervention: Quality of interchange
Assessment against EU work: Low
Comments The interchange to and from ferries using the transport mode of a cars is very good. Interconnections with other modes are practically absent or insufficient. The planned shuttle bus will be a substantial improvement.

Area of intervention: Integration of transport operators
Assessment against EU work: Low
Comments At present the integration of operators is low. The example of the planned “shuttle-bus service due to be in operation from spring 2011, is however an example of an increasing integration of operators.

Area of intervention: Planning process
Assessment against EU work: Low
Comments It could be argued that the need for integration has been almost fully developed in relation to the present dominating traffic relation between cars and ferries. If this terminal is to stand up to the best standards in Europe, the future planning process related to the development of the terminal and its connections, would need to be improved. A way forward has been shown by the planning process and involvement of actors leading to the shuttle bus system due in operation from the spring 2011. An improved planning process involving all aspects of passenger interconnectivity would add greatly to the probability of the terminal to unfold its potential as a major passenger node of the Baltic Sea.

Area of intervention: Promotion of intermodality
Assessment against EU work: None
Comments None of the actors have promoted the possibility of intermodality except the cars/tourist bus – ferry option. This is hardly surprising, as there in practice has not been any other viable option to choose. The geographical position of Rostock could be an indication of the potential for this terminal to play a larger role as a major intermodal node in the emerging passenger networks of the Baltic Sea area. A major test of this - and an indication of the potential of Rostock in the future - will be the success or failure of the planned shuttle-bus service to start spring 2011. The related promotion, planning and stakeholder involvement process gives rise to some optimism on behalf of the future possibilities for the Rostock Ferry Terminal.

4.14 TRI-CITY GDANSK / SOPOT / GDYNIA

4.14.1 Background

The Gdansk Metropolitan Area located in the Pomerania region is inhabited by 2.2 million people representing 5.7% of Poland's total population. This area is more frequently addressed as Tri-City, referring to Gdansk, Gdynia and Sopot, while the region is often described under the name of Pomorskie voivodship (voivodship is NUTS II administrative level in Poland). The term Tri-City metropolitan area or Tri-City agglomeration is often used for the three above mentioned cities plus the urbanised area (smaller towns and villages) in the vicinity.

The key issues addressed by the Tri-City case study are the interconnections between long-distance transport from outside the Tri-City metropolitan area with transport within the Tri-City network. The specific situation of the area is that Gdansk and Gdynia, at opposite ends of the Tri-City could both be considered as the core of the network. As a result it is very difficult to address any particular gravity centre within the Tri-City area, which provides some obstacles towards integration, which is more easily achieved under one organisational structure. Due to the geographic location of the Tri-City there are also a number of modes which play (or could potentially play) a key role in the transport network.

Additionally, due to historical factors, organisational structures and infrastructure still represent some post-socialist heritage influencing the present situation and further development. Therefore, a majority of conducted and planned actions in the Tri-City area aim at better interconnectivity through new

investments, because currently the transport system lacks basic infrastructure for good interconnections. In the Tri-City case study the problem of insufficiency of consistent and efficient legal and organisational arrangements is considered. That is a result of the geographical location (the area lacking a single gravity centre), but also the problem of transformation of the legal arrangements towards market economy relations (mainly in the case of state-owned companies). These unresolved problems influence the implementation process of solutions like a metropolitan transport network or integrated ticketing.

Tourism is an important sector of the regional economy due to the area's natural features and rich cultural heritage. But the access to some tourist destinations is poor. The Euro 2012 football championship, which will be hosted by Poland and Ukraine, and for which a new stadium is being built in Gdansk, will provide a particular challenge to the transport network and its interconnectivity. Both for tourists and also for local passengers the integration of the transport system and / or integrated ticket seems to be a natural offer, but the implementation process described in the case study has been very difficult.

The Tri-City case study shows a number of barriers to integration from which the most important one is financial. The support of the European Union through the Cohesion Fund and Structural Funds can be successfully used for the development of the projects aiming at improving interconnectivity. Within several existing and envisaged solutions, the EU funds are the primary source of the investment.

4.14.2 Assessment against EU Objectives in the Field of Interconnectivity

Looking at the assessment's results, it may be pointed out that the performance of this case study against the priorities at EU level in the domain of interconnectivity is not very satisfactory, in particular when the integration issue is investigated. Due to Poland's economy being transitional, transport integration has not progressed as far as in many countries where this process has been conducted step by step over decades. The current situation resulting from this condition is not very satisfactory with only some integrated services, mainly in short-distance (city) routes. However, this lack of established integrated networks could also be an asset, if only experiences of more advanced systems could be utilised and many mistakes in the process of their development could be avoided in the Tri-City.

The majority of conducted and planned actions in Tri-City area aim at better interconnectivity through new infrastructure investments, because currently the transport system lacks basic infrastructure for their provision. Therefore, infrastructure development is given priority in Tri-City. New links and interchanges concern almost all transport modes, but the most important investments take place (or will take place) in rail, air and sea / inland waterways modes. This action is in line with EU policy, especially since two TEN corridors are located in this area: Ia Via Baltica and corridor VI.

Integration of metropolitan and regional networks is therefore very desirable in terms of increased ease of travel, better information, directness of routes and time savings. From the authorities' point of view integration should increase economic efficiency of the system.

In the context of TEN corridors one of the most important elements is the airport. The Tri-City region is currently served by Gdansk L.Walesa Airport (Rebiechowo). The airport is served by both regular and low-cost carriers. Access to the airport is provided by public city transport acting as intermediary. Current access from/to airport is rather poor with a single road which connects to the Tri-City bypass. This road crosses the bypass and then goes to the Gdansk city centre – it is heavily congested in peak hours, but often also in off-peak hours. The bus uses this congested route. Moreover, the frequency of bus departures is rather low and one of the two lines servicing Gdansk takes a detour through a suburb built near the airport. Creation of a direct rail line connecting the airport with the main rail line across and beyond the region could facilitate interconnectivity between air and both long-distance and short-distance rail. Furthermore, the rail line would reduce travel times between the airport and the various parts of the Tri-City as well as the wider region significantly, since they currently have no direct public transport links to the airport at all and air passengers have to travel into Gdansk first to connect to the airport. Furthermore, the new rail line is supposed to connect to second airport in the Tri-City area (planned but recently suspended) in Gdynia with an expected capacity of 1 million passengers yearly.

Even though the huge effort of public bodies is observed with regard to the new infrastructure programme, several weaknesses related to passenger interconnectivity can be detected in the current Tri-City system. Integration of tariffs is one of the most important activities of public transport integration. It should aim to establish common and internally integrated tariffs for transport services and a common ticketing system. In the Tri-City tariff integration begun with integration of urban transport in the Gdansk Metropolitan Area. An increasingly popular tool for implementation of common tariff / ticket is a ticket in the form of a smart card – also a solution being introduced in the Tri-City. In addition to the electronic ticket other applications can be added gradually, allowing the use of other services within an integrated urban transport system. At the same time an electronic ticket can serve as student card or allow access to cultural facilities or services.

It is therefore necessary to take actions aimed at further integration of the transport system in the region on both regional and metropolitan levels, including the promotion of a sustainable transport system and the implementation of transport for social needs. The lack of integrated ticketing is of particular concern, since integration does exist neither between air and bus shuttle services, nor between shuttle buses and the local public transport services.

Integration of transport operators within Tri-City is rather poor**.** Many different transport operators act in the area and almost all modes of transport are involved. In rail transport there are three operators: Intercity, Regional Railways and SKM (Tri-City Rapid Train). In regard to road transport there exist a number of municipal public transport companies complemented by private operators, including a number of long-distance coach companies, and there are also ferry operators.

Given this variety any thorough integration is tedious task. There are always local interests and the sheer number of participants makes any integration attempt difficult. Moreover, not all modes are really interested in full integration. When different services are successfully interconnected, it is usually under the direction of single company. A good example is the interconnection between city public bus transport and the ferry from Gdansk to the Hel Peninsula, where both legs are operated by the same municipal transport provider. The same applies to Gdynia and its ferry line to the Hel Peninsula – again compatible with Gdynia public bus transport services but competitive against the solution offered by Gdansk for air or rail travellers or travellers from the hinterland who could equally arrive at either port.

In the provision of rail services some integration exists due to the fact that all different operators are descendants of one Polish State Railways Company which has been divided into different companies. This division did not sever all links between newly created companies and they still remain one capital group. Nevertheless there is a fierce competition between companies within the group and instead of timetable coordination timetables often serve as a weapon in the struggle for attracting clients. Integration of timetables with other modes (especially with the city transport bus based network) is only recently becoming a consideration in business decisions of rail operators and municipal public transport companies. The latter are geographically divided and operate mainly within the borders of different cities which constitute the Tri-City. In rare areas where more than one municipal company provides transport services (e.g. Sopot) interconnectivity is not observed. Rather to the contrary services are offered by one public transport provider in such a manner as to make them most competitive against the other public transport company.

The platform which promises more cooperation and better interconnectivity for the future is certainly the Metropolitan Transport Network of the Bay of Gdansk, which integrates various public transport providers within area. Under its auspices a common ticket for services offered by four city bus/tram operators, rail operator and ferry services has been introduced. The ticket in its current form is far from perfect (price, availability, operational difficulties), but it is a solid base from which further integrating action could be launched. There are also interesting new investments in planning and/or construction stages where integration is an important consideration (e.g. new metropolitan rail). There is a positive change occurring, but while assessing current conditions the degree of consistency with EU wide standards has to be valued as low with prospect of change in the near to medium future.

Planning process assessment in the Tri-City case study cannot be reduced to technical process steps necessary to create particular interconnectivity solutions. This case study is different from others in the way that it deals with systemic solutions rather than any single action like improving a particular mode or selected link. Therefore, the planning process has to be reviewed on three levels: high-level

of government/country, mid-level of Tri-city metropolitan area and low-level of particular cities. The problem with the Tri-City is that planning is conducted on all three levels with sometimes contradictory results. Moreover there are different entities responsible for every level.

On the top most level governmental policy documents have to be looked upon as source of plans for improving interconnectivity. In 2010 the Polish government decided to put all approaches included in hitherto existing country's development strategies in order. Actions undertaken in this respect aim at reduction of the number of existing and developed strategic documents, including the development strategy adopted by the Council of Ministers. For transport interconnectivity issues a document of special importance is the Transport Development which sets main goals of better interconnectivity, enumerates modes involved and proposes actions (although on general level only). The interconnectivity actions could also be derived from: maritime development strategy, railways development masterplan and national plan for construction of roads and motorways.

On the mid-level the interconnectivity transport problems are formulated very generally in the Strategy for the Development of Pomorskie Voivodships from 18 July 2005. In the "Regional transport development strategy in the Pomeranian region for the years 2007 to 2020" from the 29 September 2008, the features of urban public transport in the Pomeranian region include: improvements in transport accessibility of different modes, improvements in transport infrastructure to meet new interconnectivity demands, improvement of the coherence of the network, creation of an integrated transport system.

The important planning body on this level is also The Metropolitan Transport Network of the Bay of Gdansk (MZKZG) - an alliance of 13 communities bordering the Bay of Gdansk and its vicinity, established on the 16 March 2006 by the representatives of local authorities. This created a platform for formulation of actions for integration of separate urban transport networks in the Tri-City area into one entity.

Basis for planning on local level is the legal act dated 8 March 1990 about local governments, which stipulates that the organisation of urban transport and interconnection of urban and rural transport within cities belongs to the duties of municipalities. Local planning is also a matter of numerous specific investment projects like: metropolitan rail, extension of ferry and airport passenger terminals, construction of new tram lines and others currently under construction in the Tri-City.

Consistency with EU expectations in the planning process regarding interconnectivity is varied. Government level documents usually follow general rules of interconnectivity pursuance similarly as in other EU Member States. Local investment plans – in particular projects co-financed from EU funds – by default have to follow EU regulations. Some problems could be probably encountered in local plans/ regional development strategies where local peculiarities often surface. In general, this mid-level should be perceived as least in line with EU established standards.

Finally, interconnectivity is not well promoted and marketed in the Tri-City area. Marketing of integrated services is rather fragmented and actions are separate for separate service providers. As a result transport users are not given opportunities to make a rational choice of routes and means of transport. Currently there is almost no integrated service although some preliminary work on electronic info boards are conducted within the Tri-City as well as some internet travel guides and mobile phone timetables.

4.14.3 Overview of the Overall Assessment

An overview of the assessed consistency with the EU work in the field of interconnectivity is provided in the factsheets below.

Area of intervention: Network and infrastructure
Assessment against EU work: Medium
Comments Overall, the transport system in the Tri-City area lacks basic infrastructure for good interconnections. However, the majority of conducted and planned actions in Tri-City area aim at better

Area of intervention: Network and infrastructure
interconnectivity through new infrastructure investments to tackle this situation. New links and interchanges concern almost all transport modes, but the most important investments take place (or will take place) in rail, air and sea / inland waterways modes. Accessibility to the airport, seaport or railway stations is a major priority issue and emphasis has been placed to planning and implementing interventions for improving infrastructure links.

Area of intervention: Quality of interchange
Assessment against EU work: Low
Comments The most tangible result of the integration for the citizens of the Tri-City should be a reduction of travel time through the coordination of schedules, creation of the conditions for faster movement or ensuring better public transport to facilitate modal shift. However, also other important elements of creating an integrated range of transportation, such as frequency, punctuality, availability, security, straightforwardness, reliability should be taken into consideration. Particular attention, especially in the initial period of integration, should be given to tariffs and appropriate information about public transport services In the area of the Tri-City and its surroundings, the integrated ticket seems to be a natural alternative for passengers both local and tourists. However due to organisational and legal problems the implementation of a common ticket has been very difficult. The ticket existing at present can be treated as only a test and first step for future development and extension. Problems in allocation of revenues resulting in a high price of a ticket are addressed in the case study.

Area of intervention: Integration of transport operators
Assessment against EU work: Low
Comments: Competitive service providers exist in the Tri-City area which reduces chances for better coordination and integration of services. There is a need to remove political barriers (in form of different cities rivalries) in order to achieve full institutional integration. In addition operators may have contradicting objectives. Long-distance providers' decisions (especially in rail mode) could be dictated from outside the region (on government level) disregarding local integration needs. Functional integration is currently introduced on a limited scale, but involves many different modes (bus, tram, rail, ferry). Integration currently is limited to areas like: common ticketing for selected services, common marketing for selected routes, integrated electronic timetables.

Area of intervention: Planning process
Assessment against EU work: Medium
Comments: On the top level, where governmental plans are created, the planning process is similar to that of other EU countries with plans describing actions and interconnectivity goals in line with EU objectives. On mid-level in regional planning there are various local impacts which often make planning

Area of intervention: Planning process
homogenous. Actions are addressing specific local conditions and needs. Although sometimes still compatible with the EU general framework they often propose region specific practical solutions that are not always transferable into wider EU scope. On local level specific projects development plans are in majority consistent with EU directions. The majority of new interconnectivity solutions in the Tri-City area are accompanied by substantial infrastructure investments. Those in turn are almost always co-financed by EU funds and thus EU policy guidance has to be followed.

Area of intervention: Promotion of intermodality
Assessment against EU work: Low
Comments The level of promotion of intermodality is low. Since still there are some organisational problems, marketing is currently not even treated as priority. Mainly local authorities and operators aim at integration of services.

4.15 Overall Conclusions Concerning the Cross-Checking with EU Policies

Chapter 4 was devoted to reviewing the INTERCONNECT case studies with the major purpose of undertaking a qualitative assessment about their degree of consistency with the EU interventions in the field of transport interconnectivity, while eventually identifying the most significant deficiencies, gaps and areas requiring future further intervention on transport interconnectivity.

As described in Section 3, where the methodological and conceptual framework for such assessment was presented (see Figure 3-1), case studies were discussed along the following five main themes:

- Network and infrastructure;
- Quality of the interchange;
- Integration of transport operators;
- Planning process;
- Promotion of intermodality.

This was intended to provide a broad and comprehensive understanding of how and to what extent the EU policy work in the field of transport interconnectivity was met by the different case studies. The main findings of the cross-comparison between themes are summarised in Table 4-2 .

Before going into depth of the conclusions, it should be stated that case studies differ very much from each other, in terms of geographical coverage, transport modes involved, catchment areas etc.

This heterogeneity inevitably implies a certain complexity in defining common cross-cutting criteria for comparing different themes across different cases. Nevertheless, the proposed criteria allowed a comprehensive common path of analysis through all cases.

Thus, the results achieved through the cross-comparison enabled to address major criticalities, to identify best practises and to outline domains where future actions are advisable.

Table 4-2 Overview of the evaluation per theme and case study

Case study	Network and infrastructure	Quality of interchange	Integration of PT operators	Planning process	Promotion of intermodality
Frankfurt Airport Interconnections	High	High	Medium	High	High
Catalan airport system interconnections	Medium	Medium	Low	Medium	Medium
Milanese airport system interconnections	Medium	Low	None	Low	None
Scottish airport system interconnections	Medium	Low	Low	Low	Low
Interconnectivity of rail at Leeds railway station	Medium	Medium	Medium	Low	None
The Milan railways node	Medium	Low	Medium	Low	None
The dual-mode railway system: the Karlsruhe model	High	High	High	High	High
Train-Taxi and feeder bus services	Low	Medium	Medium	Not relevant	High
Amsterdam ferry services	High	Medium	Medium	High	Medium
Lisbon ferry services	Medium	Medium	Medium	Medium	Low
Helsingborg ferry terminal	High	High	High	High	High
Rostock ferry terminal	Low	Low	Low	Low	None
Tri-City Gdansk / Sopot / Gdynia	Medium	Low	Low	Medium	Low

Table 4-2 allows to observe that "**Network and infrastructure**" shows the overall best performance thanks to the number of high (four, though similarly to "Planning Process") and medium (seven, more than all other themes) values it gets when compared to the other themes.

In this respect, it is important to say that creating a converged infrastructure backbone enables interchanges to be strongly interlinked and accessible not only at a micro-level (regional/local network) but also at a macro-level (TEN-T network). Given that many of the case studies concern airport infrastructure, the issue of their interconnection with the short- and long-distance networks is key because of the need of not just making the airports accessible, but more crucially to make them a core and functional part of the network as a whole. Besides encouraging travellers to shift from car to rail for reaching the airports, direct and better rail access to airports would also provide a greater degree of integration between air and rail, where the former might benefit from the availability of long-distance and high speed operated rail services. As in the case of the Frankfurt and the Catalan airport systems, and to a certain extent of the Milan airport system which is making important headway in relation to the connections to the Malpensa airport, this would result in an opportunity for rail and air operators to offer combined intermodal services in an economically viable and sustainable way.

Improving the network and its infrastructure, and consequently the integration between distinct transport modes for both short- and long-distance journeys, is equally a key issue for other case studies as well, such as for instance in the cases of the Amsterdam and Lisbon ferry services, and the TramTrain system in Karlsruhe. Here high relevance is given to the integration of terminals' interchanges, which is viewed as a major path for offering multimodal travel options. The two case studies of Amsterdam and Lisbon also added two important elements in this respect:

- On the one hand, in the case of the Amsterdam ferry services, the inclusion of infrastructure developments into the tender process for public transport services, and
- On the other hand, in the case of the Lisbon ferry services, the design and implementation of a technological strategy, which contributed to the increase in competitiveness of the ferry services compared to other travel modes, by changing the structure of service supply and considerably improving quality of services and travel time.

For each case study, an overall overview of their performance with respect to this theme is illustrated in Figure 4-1.

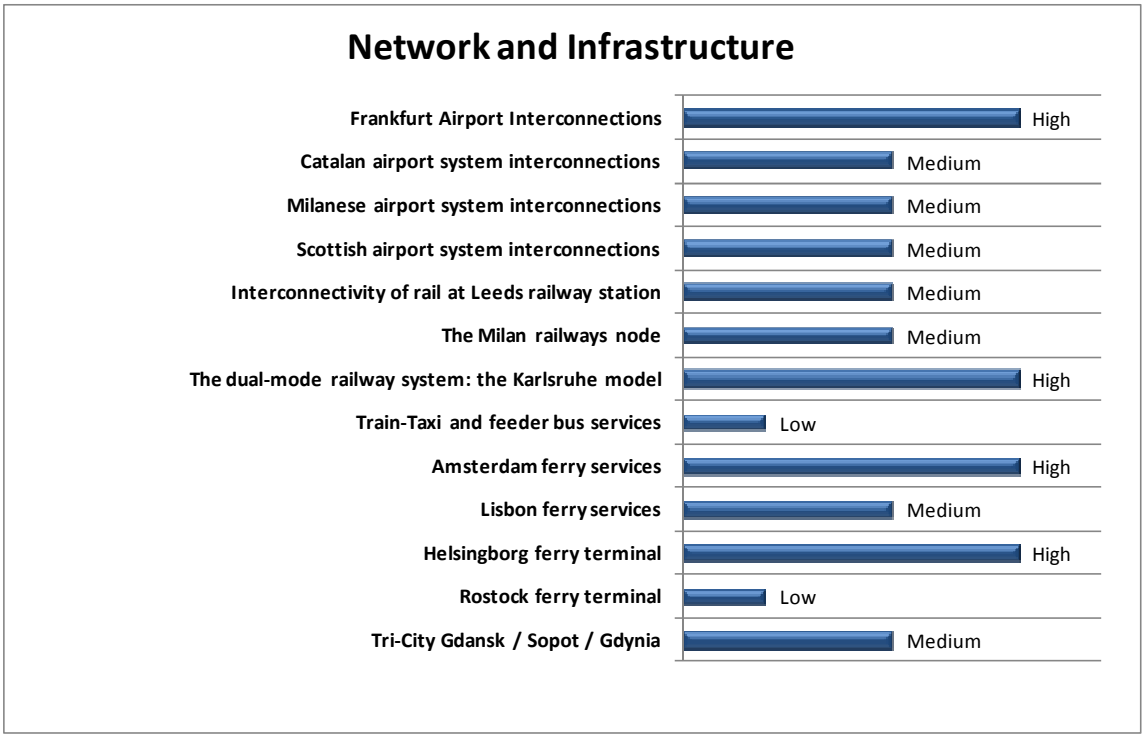

Figure 4-1 Overview of the theme "Network and infrastructure"

Like "Network and infrastructure", "**Quality of interchange**" might be positively evaluated across several of the case studies. It is acknowledged that interchanges are a crucial "break" in the trip chain as they produce important effects on how travellers perceive the overall quality and smoothness of their journey. Good quality of design of the interchanges is therefore essential for making the transfer from one mode to another easily and conveniently accessible. Additionally, this contributes reducing travellers' perceptions that their time spent at interchanges is "lost" or "wasted". Good design of interchanges is also essential to increase the attractiveness of interconnected transport services as valuable alternatives to car usage. This calls for the implementation of more integrated timetables, availability of door-to-door information (pre-trip and on-trip), integrated ticketing and fares, integrated booking and payment systems, handling of luggage.

These requirements are best embedded in: the *Interconnections at Frankfurt airport*, the *Helsingborg ferry terminal*, and the *Karlsruhe model of dual-mode railway system* case studies, which might be viewed as the best case studies for this theme. Indeed, they all guarantee an ideal interlinking between the "hard-side" and the "soft-side" of the infrastructure, since they do not only provide easy and conveniently-designed access to a range of interlinking modes, but have also implemented a vast array of through-services that enable travellers to experience a seamless journey thanks to the possibility to get harmonised and integrated ticketing and information, as well as further facilities such as check-in and baggage drop-off / collect at rail station in the case of Frankfurt. As shown by the Helsingborg case study, appropriate design of terminals and high-quality facilities available to both passengers and operators (for instance by making use of horizontal layers making interconnection to different transport modes) is a remarkable way to encourage integration. In turn, this allows to achieve

advantages due to the collaboration, coordination and co-presence between networks and modes and, consequently, creating room for further use of ITS on a commercially viable basis.

When compared to the EU policy work aiming at improving quality of interchanges, and consequently interconnectivity between short- and long-distance journeys, shortcomings are to be noted in the existing practice related to five other case studies: the *Catalan airports*, the *Interconnectivity at Leeds railway station*, the *Train-Taxi and feeder bus services*, and the *Amsterdam and Lisbon ferry services,* which, indeed, feature a medium performance. For these case studies the quality of both design of interchanges and services might be generally rated as good, but significant improvements are advisable, however. This specially apply to: the development of integrated ticketing/information systems (as in the case of the Leeds railway station), the introduction of adequate signposting (as in the case of the Train-taxi feeder bus services), a greater awareness among private operators to increase the degree of interconnectivity of their services with the local public transport system (as in the case of the Amsterdam ferry services), a greater co-ordination of timetabling between rail and bus providers (as in the case of the Train-taxi feeder bus services) and the need to improve the potential as a entry point of the terminal to the public transport system (as in the case of the Lisbon ferry services).

Finally, for five other case studies (the *Milan airport system*, the *Scottish airports*, the *Milan railway node*, the *Rostock ferry terminal* and the *Tri-City*) the scoring is low. The main weakness is the integration with other modes, which either only barely supports interconnectivity in these case studies or is even non-existing.

For each case study, an overall overview of their performance with respect to this theme is illustrated in Figure 4-2.

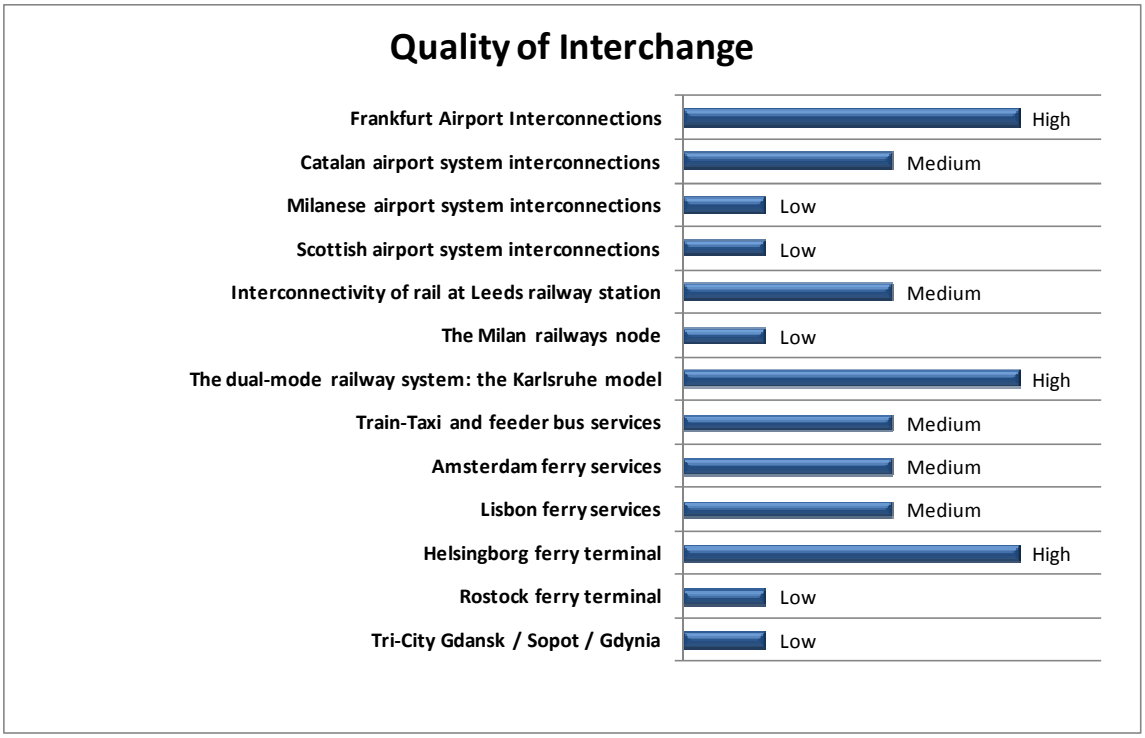

Figure 4-2 Overview of the theme "Quality of interchange"

Also "**Integration of transport operators**" presents an average performance across the case studies. In fact, apart from a couple of outstanding examples of best practice, in general the case studies highlighted a growing attention to this theme. Even though an effective integration of all transport operators is still not completely achieved, the cases generally revealed the existence of different forms and degree of integration; only five of them perform poorly in this respect. Complementary to the integration at the level of services (ticketing, luggage handling, information etc.), the organisational integration among transport operators is a further key element for making interconnectivity successful

and for achieving a shift from a modal/operator-oriented approach to a broader and more comprehensive "*mobility approach*". Though not easy to achieve, solid and fair joint partnerships and voluntary agreements enable transport operators to increase patronage and quality of transport services by optimising their provision. Further advantage is with the possibility to exactly frame the division of traffic revenues between operators, which might result in increased transparency in the fare system. Moreover, integration offers transport operators the opportunity to plan and market their transport services as a unified whole under a common brand image, thus increasing their attractiveness to the general public and presenting a coordinated transport strategy and vision as well. Finally, where integration works at the level of networks, information and ticketing systems and involves all combinations of local/medium/long-distance transport options, there is also the important advantage to always provide travellers with alternative transport solutions and the possibility to use another mode/operator if there are delays, or if the passenger is late for a connection.

As witnessed by the best cases of the *Karlsruhe TramTrain* and the *Helsingborg ferry terminal* an element of strength was the creation of joint forms of partnership and association which both:

- Made it possible to overcome fragmentation by entirely integrating transport operators in relation to all aspects relevant for the customers (services, ticketing, fares) and consequently optimising the provision of the interconnected transport service; and
- Directly involved transport operators since the beginning of the planning and execution process.

The latter is a key step, nonetheless, because (as in the case of the Catalan airport system) organisational issues might become very complex and not easy to manage, especially when negotiation shall involve multiple stakeholders. Additionally, operators shall share and agree on a common vision of mobility, whilst their objectives might be conflicting. These issues were often reported for the case studies that scored lower. An interesting approach is, finally, illustrated by the Leeds case study, where the existence of a rail franchising process and other central-government-led initiatives might encourage a further coordination amongst the various transport operators.

For each case study, an overall overview of their performance with respect to this theme is illustrated in Figure 4-3.

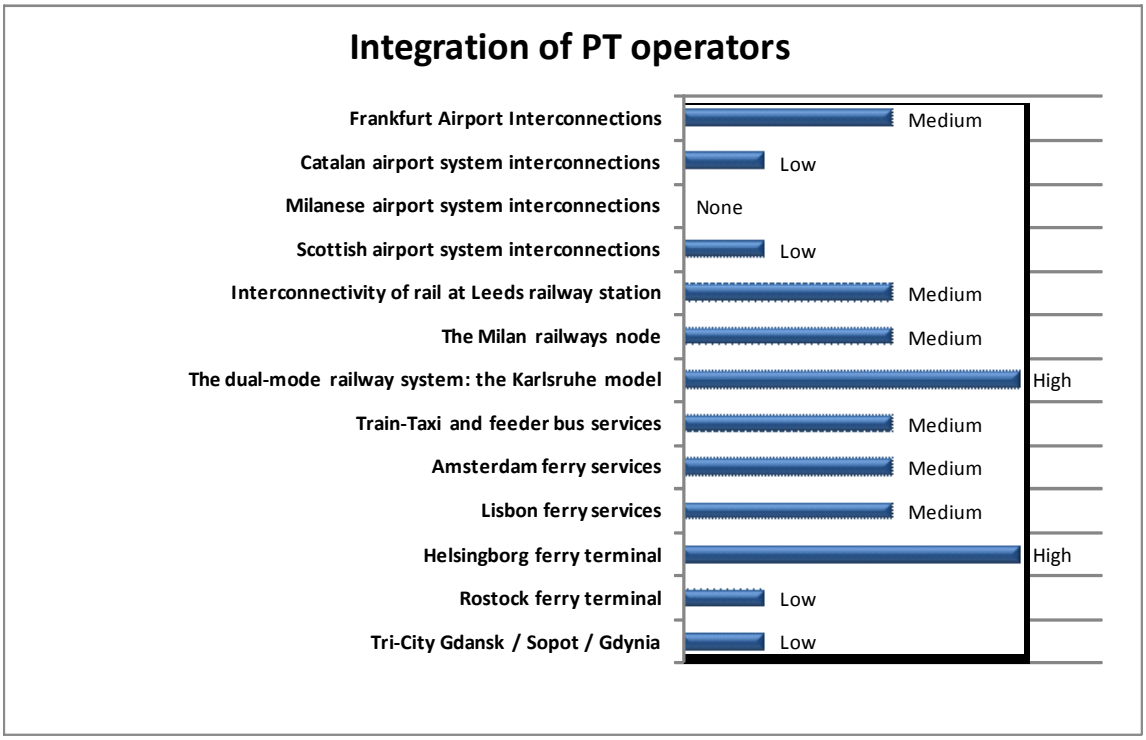

Figure 4-3 Overview of the theme "Integration of PT operators"

"**Promotion of Intermodality**" offers a fairly patchy situation and highlights the need for additional efforts. Intermodality needs to be properly advertised and promoted in order to enable users to improve their knowledge about not only the existence of intermodal and interconnected transport services, but also the opportunities they may offer (reduced travel time, reduced waiting time at interchanges, more comfort, etc.).

Broadly, it might be pointed out that the extent to which "Promotion of intermodality" is achieved is dependent on two main factors:

- The existing degree of integration among transport operators, and
- The availability of a vast range of services travellers are provided with.

Therefore, it is not a surprise that those case studies that perform best in PT operator integration are also the case studies scoring "high" values as far as the promotion of intermodality is concerned. In fact, this applies to those cases where having the possibility to cooperate as a unique and integrated system, the single transport operators might market and communicate under a common brand and image their strategies accordingly to the specific users groups they intend to target, in order to build/consolidate their loyalty as well as to satisfy their travelling needs.

Important advances in this area are achieved by two other case studies: the *Train-Taxi feeder bus services* and the *Catalan airport system*. The former provides a good example of promotion and marketing of intermodality by partners from different modes of transport, where emphasising a single brand has enabled the transport operators involved to make their branding and promotion stronger, whilst benefiting from cost economies at the same time. The latter has similarly put in place some efforts for establishing a common corporate image for all transport operators within the regional framework, even though further interventions are needed for improving users' awareness of public transport and information services.

Conversely, in the remaining case studies promotion of intermodality does not emerge as a priority. This is confirmed by the fact that for four of them (the *Interconnectivity of rail at Leeds railway station*, the *Milan airport system*, the *Milan railways node* and *the Rostock ferry terminal*) no promotion of intermodality exists, while for the remaining ones (the *Scottish airport system*, the *Lisbon ferry services* and *Tri-City*) advertising is limited if existing at all.

For each case study, an overall overview of their performance with respect to this theme is illustrated in Figure 4-4.

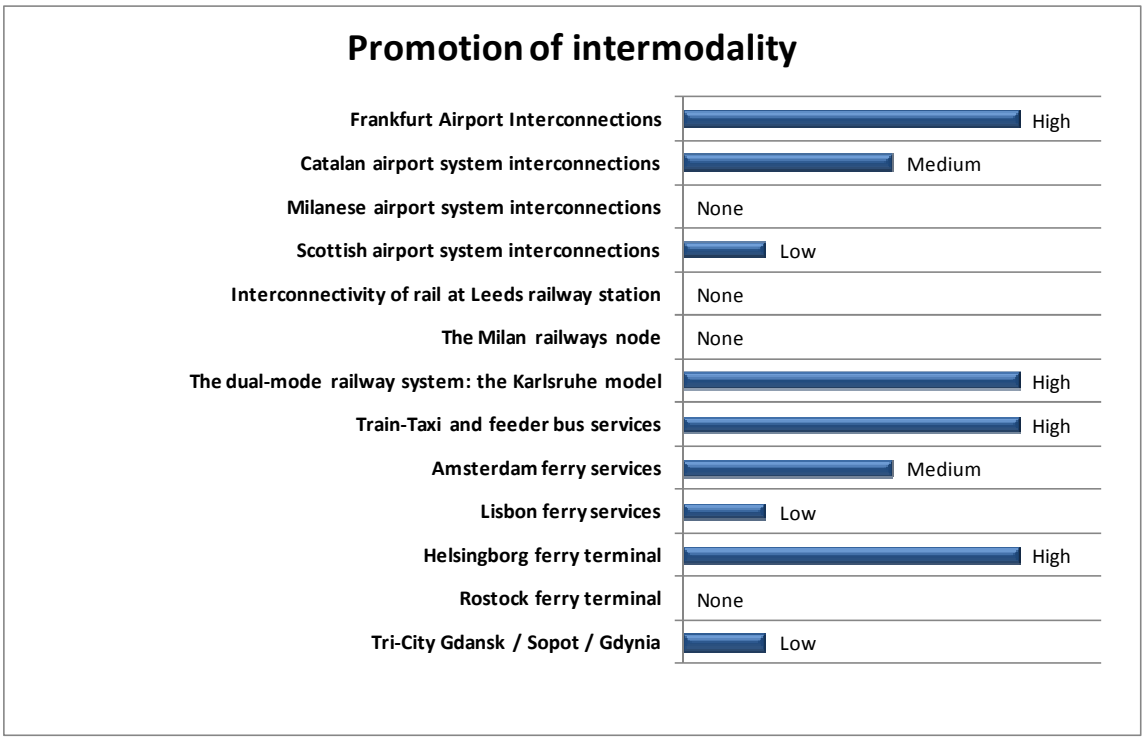

Figure 4-4 Overview of the theme "Promotion of intermodality"

Reasoning about the "**Planning process**" refers to the need to set up organisational structures that should ensure an integrated planning approach, so to make the interplay between networks easier. This calls for a large involvement of all relevant stakeholders, not only including authorities and transport companies traditionally responsible for the development and ownership of the interchanges, but also of other operators that could contribute to the further development of the interchanges.

In this regard, four case studies (the *Frankfurt airport system*, the *Karlsruhe TramTrain,* the *Helsingborg ferry terminal* and the *Amsterdam ferry services*) score a "high" value and, thus, might be taken as reference for best practices for implementing a sound planning approach which is able to deliver a balanced development of transport infrastructures and interconnections. The Amsterdam case study is also of particular interest in this respect, as here integrating ticketing was one of the main levers for promoting a multi-stakeholder approach, gathering both public and private actors.

In these case studies major efforts were done for incorporating interconnections between short- and long-travelling distances and their related land-use developments at the heart of the planning approach from the very beginning.

Conversely, with the exception of the Train-taxi feeder bus services for which the theme was judged as not relevant, the other case studies show much room for improvement. Deficiencies are primarily due to:

- A lack of a comprehensive planning approach and the subsequent low degree of cohesiveness,
- A lack of coordinating authorities even when plans, objectives and targets are set out,
- A different timing and scheduling between the responses from the public authorities and the investment choices made by private actors,
- Differences in interests between local and national stakeholders, reflecting their different and sometimes conflicting priorities in terms of prioritisation between accessibility (referring to short-distance travels) and interconnection (referring to long-distance travels).

For each case study, an overall overview of their performance with respect to this theme is illustrated in Figure 4-5.

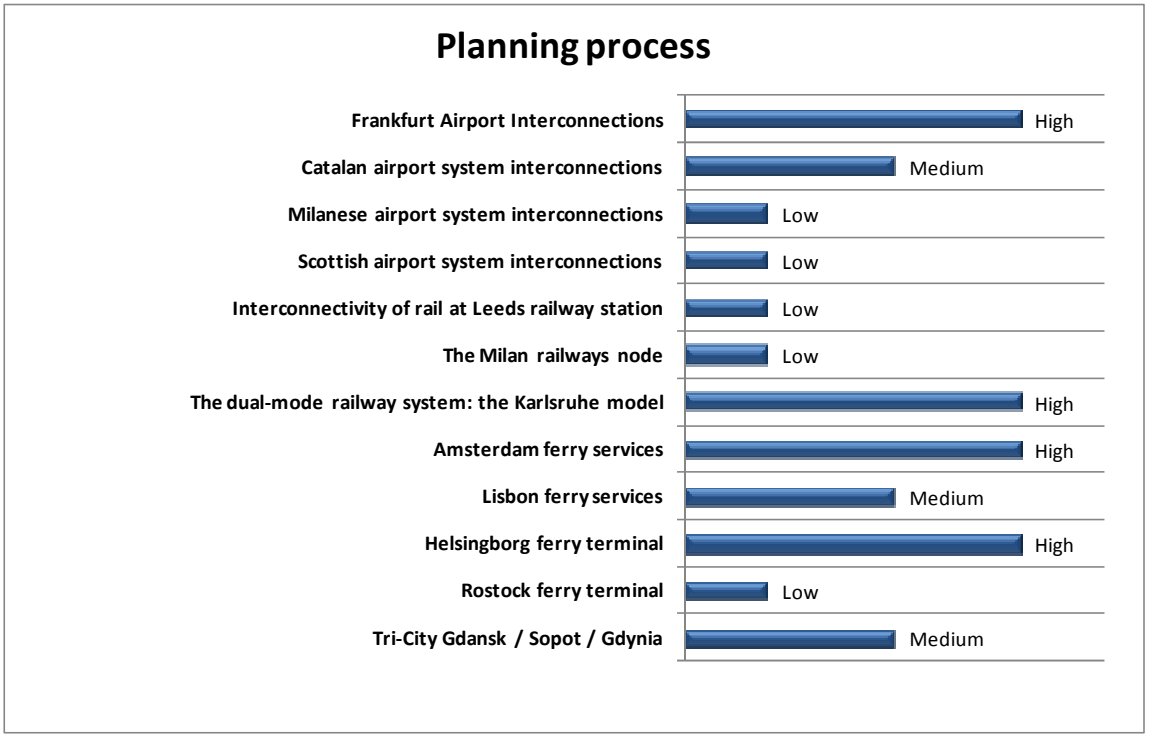

Figure 4-5 Overview of the theme "Planning process"

To conclude, a number of recommendations can be drawn from the analysis of the case studies.

- The need to further optimise the interfaces between transport networks and modes, addressing aspects related to design of interchanges, planning and services.
- The need for interchanges to be a core and functional part of the network as a whole. Accessibility itself is not enough.
- Voluntary agreements and/or cooperation schemes where operators see win-win situations might be intermediate formulae that allow different transport actors to achieve a common strategy while maintaining the possibility to act independently.
- The need for incorporating interconnections between short- and long-travelling distances and their related land-use developments at the heart of the planning approach from the very beginning.
- The need for securing consistency of timing and scheduling between the responses from the public authorities and the investment choices made by private actors.

5 MODELLING INTERCONNECTIVITY AT EUROPEAN SCALE

5.1 INTRODUCTION

In the context of the INTERCONNECT Project, the Task 2.2 *"Forecasting and modelling tools"* focused on investigating how "interconnected" trips are modelled in forecasting transport models.

As documented in Milestone 2.4 *"Availability and utility of analytical techniques"*, the activities performed within the task allowed for:

- An overview of the main theoretical requirements for the modelling of interconnectivity by outlining the main features in modelling multimodal trips on interconnected networks, providing an overview of the main modelling approaches found in literature, and describing the type and amount of data needed for the modelling purposes;
- A review of some modelling applications, both at a European and regional level, with the purpose to investigate how and to what extent the theoretical requirements are dealt in current modelling practice;
- A comparison of theoretical requirements and current modelling practice.

The review of the theoretical requirements showed that traditional transportation modelling approaches are in general not designed to deal with interconnectivity and multimodality. Often the definition of "multimodal model" is adopted if the model covers more than one transport mode, regardless of its capability of dealing with trips composed of different transport modes on multimodal paths, and the possibility to distinguish between the access/egress and the main mode of a trip.

It is for example the case in TRANS-TOOLS model, where only uni-modal passenger trips are covered. In this case uni-modal matrices are assigned to separate uni-modal networks (***separate uni-modal approach***). The interconnection between different transport networks is not covered and there is no modelling of interchanges.

Even though in recent years growing attention was given to the modelling of multimodal trips, this aspect still remains not fully developed in most of current modelling applications.

Transport models are developed according to the specific purpose of the analysis targets. The development starts after clarifying the analysis purposes, the scope of the issues or problems being considered and the nature of the objectives being addressed. Therefore, modelling applications can differ to a great extent.

Strategic models, characterised by large geographical coverage, have the general purpose to provide long-term forecasts of main mobility trends and to assess the impacts of transport policies at an aggregate level; thus their focus does not require necessarily the modelling of interconnectivity.

This evidence was recently confirmed during a workshop with major European transport modellers organised in the context of the project "European Transport Policy Information System – Development and implementation of data collection methodology for EU transport modelling"[3].

Held in Brussels on March 2011, the workshop had the participation of a selected representative group of transport modellers in order to discuss the ETISplus database contents and its applicability to the most relevant applications at European level. It emerged clearly that passenger multimodality is currently not considered at European scale modelling; the examples documented in M2.4 (STREAMS and VIA models) can be considered as an exception to the usual practice mostly oriented to develop separate uni-modal models, like TRANS-TOOLS.

[3] TREN/FP7TR/"ETISplus". The ETISplus project has the main objective to update and further develop a common database to be used by modellers and policy makers, as first implemented through the framework project ETIS in 2005.

Also in lower scale models, that in principle should be more interested in the analysis of multimodal trips, interconnectivity is not always modelled in detail as shown in the examples provided in M2.4: only in few cases transfers are modelled with great care through the detailed representation of the main activities performed at interchanges, such as the access and egress phases, the waiting time, the boarding and alighting phases etc.

The reasons for this lack of attention to multimodal trip modelling, both at European and local scale, could be explained by different elements.

First of all, modelling multimodal trips is a complex task. In fact, multimodal passenger travel modelling needs to deal with a wide range of mode combinations: various vehicular modes might be used in the access and egress parts of a multimodal trip, such as car, bus, tram, and metro. If these possible access/egress travel modes are combined with the possible main modes, such as train or plane, this results in a huge number of multimodal alternatives.

This variety in multimodal trip composition is further enlarged by the various possibilities of transfer points for boarding, alighting and switching main modes.

Given the low share of multimodal trips in the total of trips (due to the many short trips rarely being multimodal), the implementation of such a complex model is generally limited to specific kinds of analysis where this kind of mobility cannot be neglected.

Furthermore, data availability to implement and calibrate such kind of applications was revealed to be very poor. The availability of data for modelling purposes is an important issue, since the quality and amount of available data directly determine the performance of the model.

Since the cost of collecting data is considerable both in budgetary terms and in terms of effort, the exploitation of existing data sources is the usual practice of transport modelling.

Unfortunately official statistics and demand surveys almost never contain information about passenger transport chains, which is crucial for multimodal trips modelling. In fact, the analysis performed in INTERCONNECT deliverable D2.1 on the available statistical evidence on long-distance travel indicates that very few surveys have recorded detailed information about multimodal journeys.

This lack of information poses very strong restrictions on the development of multimodal trip modelling.

5.2 How to Improve the Modelling of Interconnectivity at European Scale

5.2.1 Introduction

As shown in INTERCONNECT D2.1, passenger intermodality is present in a large proportion of long-distance journeys, especially for journeys above 400 km where the car is a less viable alternative.

This evidence confirms the need for European scale models to deal with this peculiarity of passenger transport. Nevertheless, given the strategic nature of this kind of modelling, a certain distinction about the kind of multimodality that can be modelled has to be made.

Given the wide geographical coverage, European scale models are generally characterised by a relatively reduced number of large zones and by a less detailed representation of local networks and public transport services.

In this kind of models, the access/egress to/from the long-distance networks is generally managed through dedicated virtual links (connectors) that connect the zones to the networks. It is obvious that this approach poses strong limitations on the modelling of multimodality in the access/egress part of the long distance trips.

A different reasoning can be reserved to the modelling of multimodality during the long-distance trips, for example a long-distance trip that encompasses a first link made by high speed train and a second

one by plane. This kind of multimodality that involves connections through high-level modal networks and interchanges at major terminals is of particular relevance at European level and therefore it should be considered by European scale models, also in view of the growing role of air-rail intermodality in Europe.

The approach to model multimodal trips has to ensure that the principal features of multimodal schemes and policies are captured by the model. Therefore, there is a need to adopt a modelling approach, which is capable of representing the characteristics of multimodal schemes and policies that influence the way travel decisions and choices are made.

At a general level, the recommended framework to enable the proper modelling of multimodal trips on interconnected network encompasses:

- The use of a network-based representation of alternative routes and modes within the transport model, where the network model should employ appropriate multi-pathing algorithms to construct alternative routes through the network between origin-destination pairs;
- The transport model should employ some form of choice model which estimates the demand on each mode combination/route based on the generalised costs of the different alternatives;
- The generalised cost formulation used in the transport model should include an explicit representation of costs of modal transfer.

Below the main requirements in modelling interconnectivity are addressed in more detail. These requirements apply equally to models designed to assess the impacts both at European and local scale, but it is implicitly recognised that for highly strategic applications, where the geographical coverage and the possible alternatives heavily increase the complexity of the model, a certain kind of simplification of the problems to be investigated is needed.

5.2.2 Network Representation

In modelling transport systems, and especially when modelling multimodal trips, particular attention should be devoted to the network representation for several reasons. First of all, a good network representation should facilitate the travel demand analysis since the travel costs are predominantly determined by the network. Secondly, an appropriate network representation allows for a proper route choice modelling.

Transfers representation plays an important role in multimodal trip modelling, since transfer links are used to model the cost and/or restrictions of choosing or transferring between the alternatives. Transfers are fundamental for the route and the mode choice processes: their existence allows the modelling of multimodal routes and their disutility is to be taken into account when computing total travel costs used in the mode choice.

Therefore, the physical features associated with interchange need to be represented in a relatively straightforward manner by means of time, distance or cost penalties included within network representations of transport supply.

Apart from their physical features, interchanges are also characterised by other organisational and institutional aspects in a generalised form that can be hardly represented by modelling parameters.

In assessing how a multimodal network should be specified, particular attention needs to be given to the extent to which the network is capable of representing the key features of each specific multimodal scheme. The level of spatial disaggregation and the level of detail at which modes and routes should be defined will depend on individual circumstances.

For highly strategic studies, such as major Trans- or Pan-European connections, the network is likely to be based on very large zones and only broadly defined transport links. For more detailed applications, such as peri-urban studies, greater spatial and network detail will be essential. In addition, in urban environments representation of highway congestion is likely to be essential.

5.2.3 Demand Segmentation

Demand data is crucial to any transport modelling application. This general consideration and requirements regarding sources of data, data segmentation and the forecasting of overall demand levels are equally as applicable to multimodal modelling as to transport modelling in general. However, multimodal modelling does feature a number of specific requirements.

The way in which passenger demand is segmented is a key consideration for successful multimodal modelling. In fact the choice of the used transport mode can be influenced by the age of user classes (younger traveller may choose public transport, because of the unavailability of private vehicle) or by their personal income (low income users will probably prefer public transport modes), or by the trip purpose (when travelling for work the lowest travel time is sought, whereas in travelling for leisure it could be a minor issue) etc.

Given the importance of transfers, in modelling multimodal trips also the route choice can be highly influenced by population characteristics: elder people may prefer uni-modal trips just to avoid the discomfort of transferring between modes; business men may not consider the possibility to choose public transport at an airport interchange, etc.

Therefore, population characteristics and trip purposes should be used to induce demand segmentation in user classes in order to define *choice sets* for each class, where choice sets are defined as the collection of travel options perceived available by individual travellers in satisfying their travel demand.

Therefore, it is recommended that careful consideration is given to demand segmentation in the specification of multimodal modelling approaches. This is likely to have important implications for the way in which data collation and surveys are undertaken.

5.2.4 Travel Choice Model

Modelling mechanisms are required by which total travel demand is allocated to specific corridors, modes and routes taking account of transport supply and levels of service. Such mechanisms are standard features of most transport modelling applications, and specifically of the conventional and well-established four-stage modelling approach.

Choice models can be specified on different levels of complexity. The level of complexity applied to the modelling of the respective travel choices will depend upon the specific characteristics of the multimodal scheme being assessed. In any event, there will be a need to ensure that intermodal options are sufficiently specified to avoid biasing demand towards single mode routes whilst adequately representing perceived deterrence of interchange.

The modelling approach should employ some form of choice model which estimates the proportion of total demand on each mode/route based on the generalised costs of the different alternatives.

5.2.5 Multimodal Routes

It is critical that the choice model employed is formally linked to the network model(s) and operates using consistent levels of detail. Thus, in order to model multimodal trips, it is fundamental to have an assignment algorithm that is able to compute *realistic* multimodal routes that do not comprise a high number of transfers and an improbable combination between transport modes. The various alternatives (as combinations of route/mode/intermodal interchange points etc.) generated by the network models for individual origin-destination movements need to be used in the choice model.

5.2.6 Generalised Cost Modifications

Changes in transport supply (and the demand/supply relationship where this is relevant) arising from multimodal schemes need to be represented as modifications to generalised costs.

Generalised cost can comprise a range of out-of-pocket costs, journey times, and less directly quantifiable attributes relating for instance to the traveller's perception of comfort, quality, interchange and reliability.

This has important implications for multimodal modelling, given that multimodal travel choices will be made on the basis of a range of trip attributes which extend well beyond travel time and distance. The concept of interchange is central in this context, and, accordingly, there is a particular requirement to represent interchange in an appropriate manner as part of the definition of generalised cost for multimodal trips.

5.2.7 Computational Issues

Another important issue related to modelling transport systems is the capability of the model to be executed by current computational instruments. In fact, even if the development of the computational power of common personal computers has led to an improved capability of executing transport models, limitations about the size of the model (i.e. number of zones, links and nodes handled by the model, etc.) still remain. An increase in the complexity of the model can lead in the best case to long run-times and, in the worst case, to the impossibility of computation.

Multimodal passenger travel modelling needs to deal with a wide range of mode combinations: various vehicular modes might be used in the access and egress parts of a multimodal trip, such as car, bus, tram, and metro. If these possible access/egress travel modes are combined with the possible main modes, such as train or plane, this results in a huge number of multimodal alternatives.

This variety in multimodal trip composition is further enlarged by the various possibilities of transfer points for boarding, alighting, and switching main modes.

Therefore, in order to have a tool that is able to process such complex combinations of travel modes and interchanges it is necessary to limit the complexity of the model. This limitation in general leads to a compromise between the geographical scope of the model and the level of detail of the modelling framework (i.e. demand segmentation, networks representation, transfers modelling etc.): the wider the coverage of the model, the lower the level of detail.

It should be noted that the network representation could have a deep impact on computational issues: a complex network will require a complex research of the possible routes and a substantial computational power.

5.3 DATA NEEDS

5.3.1 Introduction

The main purpose of a model is to depict reality. Model development normally starts with observations or the collection of data regarding the behaviour of the system in reality. The aim is to describe the process in a mathematical model, which can ultimately be used to simulate system performance. However, the mathematical model will be based on a theory on how the system works. Once the hypotheses that support the theory are proved right, the model is calibrated by means of available empirical data. This means that the model parameters are estimated so that they correctly reflect the observed data. Subsequently, the model should be validated to check if the outcomes correctly predict the system performance in all other situations. The quality and amount of available data, therefore, directly determines the performance of the model.

To understand the potential of intermodal passenger transport and how it can best be promoted, there is the need of data on its present performance and potential market. Since intermodal passenger transport deals with door-to-door journeys, what is needed is door-to-door data.

However, this kind of data is generally sparse. The modal structure of the passenger transport industry is reflected in the nature of collected data: most of transport data is modal.

Data needed to show how the form(s) of transport people use for journeys vary with different factors such as the length of the journey, the reason it is being made, car ownership etc. It is also important to understand how these variables are likely to develop over time.

This section describes type, amount and level of detail of data needed to model multimodal travelling. In general the following types of data are to be collected:

- Demand data;
- Individual and behavioural data;
- Supply data.

In the following an "ideal" and not exhaustive list of data that could be collected with the purpose of implementing a European multimodal passenger model is given. More insights on data availability at European level are provided in the next section 5.3.5.

It should be noted that data collection has to be fit for the model specific needs and therefore in some cases not all the information is needed to implement the model whereas in other cases more specific data is to be collected.

5.3.2 Demand Data

- Numbers of multimodal trips;
- Trips origin and destination;
- Trip purpose;
- Frequency;
- Data to describe trip composition in time and space:
  - Departure and arrival times;
  - Access/Egress modes used (including, costs, waiting and in-vehicle times);
  - Main mode used (including costs, waiting and in-vehicle times);
  - Transfer points locations.

5.3.3 Individual and Behavioural Data

Data on traveller's characteristics:

- Age;
- Gender;
- Personal income;
- Preferences on mode;
- Luggage and travel companionship;
- Availability of cars;
- Knowledge of the network and of possible alternatives (awareness of alternative modes, services and boarding/alighting stations, timetables, costs etc.).

It should be noted that demand information has to be associated to individual and behavioural data in order to identify each trip and the correspondent traveller characteristic.

5.3.4 Supply Data

Network data:

- Road network: link lengths, lanes, capacity, costs, speed;
- Rail network: link lengths, scheduling/frequencies, speed, delays, stops;
- Air network: link lengths, scheduling or departures per day, speed.

Transfer points data:

- Available transport modes and correspondent scheduling/frequencies;
- Average waiting time for each available transport mode;

- Effort to find an available parking lot (average time);
- Boarding and alighting times;
- Walking legs length/times (e.g. distance from parking, distance from different rail/metro platforms, distance from PT stops, etc.);
- Delays due to other activities: to purchase a ticket, to check-in (at airport), to pass security controls (at airport), etc.

External conditions:

- Public transport delays;
- Congestion.

5.3.5 Data Availability at European Level

As stated before, the availability of data for modelling purposes is an important issue. While local planning studies can finance their own data collection in many examples, European models must inevitably rely upon existing statistics.

National and international passenger transport statistics, relevant to passenger transport modelling, are generally available; typically these are collected at a national level, according to agreed European standards, and then harmonised and published by Eurostat.

However, these statistics almost never contain information about passenger transport chains that is crucial for multimodal trips modelling.

This evidence is confirmed as well by the analysis performed in Interconnect D2.1: the review of available statistics on long distance travel indicates that very few surveys have recorded detailed information about multimodal journeys. Furthermore, when available, this data differs to a large extent from county to country as to quantity and level of detail and hardly contains information on travellers' characteristics.

This lack of data, reflected in the absence of Eurostat statistics on long-distance multimodal trips, poses strong limitations in the development of passenger multimodal transport modelling at European level.

Even though it is recognised that in budgetary terms and terms of effort the cost of collecting data is considerable, it appears anyhow essential to alert national institutions to the importance of this task.

In this respect the European Commission could play an important role both in harmonising the existing available information and publishing European level basic data, as well as in encouraging future data collection at national level and drawing up guidelines for harmonised surveys on long-distance multimodal trips.

5.3.6 How to Collect Data

If no data is available, then it should be collected; below some general indications on data collection are provided.

Demand data

In order to model multimodal trips, appropriate demand surveys should be designed to capture the entire passenger trip chain and to collect all information not included in statistics. The data can be used for calibration and validation purposes, and to examine and construct travel patterns. The most common format for demand surveys is that respondents are asked to report their long-distance journeys on a given day, with the reporting period for long-distance travel being longer than for short-distance journeys.

Finally, OD data from existing models is an important source in developing new transport models. Even though these data only rarely meet the new requirements, they could be a good starting point for estimating new OD matrices.

Behavioural data

Multimodal trip making involves many different choices, such as choice of type and order of transport modes used during a trip, and type and location of nodes to transfer between these modes. Consequently, in order to study this phenomenon adequately, numerous trip attributes and travellers characteristics should be collected.

In general there are different approaches for data collection to be used to collect empirical data:

- Observing actual travel behaviour (revealed preference);
- Ranking or rating of hypothetical alternatives (stated preference) or choosing between hypothetical trip alternatives (stated choice).

In order to achieve information on actual multimodal trips and known trip alternatives, it is considered preferable to use the revealed preference approach. Stated preference and stated choice techniques are suitable to collect behavioural data and additional data, for example if the necessary variation in trip attributes, which are important in the choice process, is lacking in practical choice situations.

Another important question to answer when collecting data is how to select the respondent selection. In general, two main possible alternatives are available:

- Random sampling, which means for example random draw of addresses or telephone numbers
- Selective sampling, with in-vehicle or on-platform screening.

Random selection of travellers should mostly be preferred to prevent bias. However, only a low share of total trips are multimodal trips, and therefore the random sampling of respondents seems often not to be an option, since the hit rate of multimodal travellers using random selection is too low. Therefore, on-site screening (e.g. in-vehicles or at transfer nodes) of potential respondents could be the best way to quickly find a reasonable group of multimodal travellers. The main disadvantage of this approach is that one cannot determine the knowledge about multimodal trips available to travellers who do not make multimodal trips and about their preferences of trip attributes, such as in-vehicle times and costs.

Supply data

Networks form the basis of every transport modelling assignment. When building road networks, modellers should make use of existing sources, such as national road databases in GIS. Road maps of existing models may be used and combined to cover the area of interest depending on the required level of detail.

Modelling bus and rail service networks is a more complex affair than constructing road networks, because they consist of stops, lines and timetables, as well as links. The increase in computational power today has made it possible to apply more realistic timetable-based network modelling to large-scale models. Detailed information about frequencies and timetables can be collected from services providers. Information about passenger airline services is available from the Internet, but because of the large number of suppliers and the continuous changes in routes it is difficult to implement all airline services for larger modelling areas.

For multimodal trips modelling detailed information about transfer points is to be collected. Because of the heterogeneity of information needed, the optimal way to collect data is by on-site investigation; otherwise information can be collected by services providers and/or interviews with passengers.

5.4 THE MODELLING OF THE TOOLKIT'S POTENTIAL SOLUTIONS

5.4.1 Overview

Modelling tools are used for several purposes; one of these is to simulate and compare the impact of alternative policies. Therefore, after having provided an overview about the main requirements of modelling multimodal trips at European level, both in terms of general modelling approach (section 5.2) and data needs (section 5.3) this section will explore the possibility to model the INTERCONNECT Toolkit's potential solutions, identified in the context of WP 3 activities, and documented in the INTERCONNECT Project Deliverable 3.1.

The toolkit refers to 95 solutions to the problems of poor interconnectivity experienced by long distance travellers whose journeys require them to use short distance "local" mode(s) to commence and/or complete their journeys.

These solutions have been categorised under seven headings, although there is inevitably some overlap between the seven categories:

- Local link infrastructure;
- Local transport services;
- Improvements at the interchange point;
- Check-in and luggage transfer;
- Ticketing and pricing;
- Marketing, information and sales;
- Enabling solutions.

In the following pages it will be explored if and to what extent these groups of policies can be modelled by European transport models, but before going into depth with this analysis, a general premise about the modelling of policies has to be made.

The input required to simulate a generic policy is the changes that the policy would bring about to a set of leverages (e.g. a charging policy would change the cost of travelling on given routes).

Such changes can be **direct** or **indirect**: if, for instance, a policy measure consists of increasing the fuel price and fuel price is a variable of the model, the policy change can be directly modelled. However, if a policy measure affects elements that are not part of the model, the changes can be modelled only indirectly: for instance, rail market liberalisation is expected to modify rail fares, but this is a second order impact, while the measure in itself changes market regulation, entry barriers and so on.

Usually such variables lie outside the transport model domain and so the calculation of the scenario input consists in the second order impact quantification. Modelling input should be then defined carefully: this can be quite straightforward for direct changes, but the quantification of second order impacts is generally much more challenging.

5.4.2 Local Link Infrastructure

The **Local link infrastructure** category includes those solutions which seek to address the problem of inadequate infrastructure for the link between an interchange (such as an airport) and the centre of the city which it serves.

The following solutions have been categorised as belonging to this group:

- Ferry link;
- Maglev link;
- Link into general HSR system;

- Dedicated HSR link;
- Link into heavy rail system;
- Metro / S-Bahn link;
- Tram link;
- Monorail / People Mover;
- Motorway link;
- Park and Ride;
- TramTrain or TrainTram;
- Guided bus link;
- Segregated bus lanes;
- Inroad bus lanes;
- HOV lane;
- Cycle path link;
- Improved maintenance and earlier replacement of infrastructure;
- Vehicle upgrade for increased comfort.

Generally infrastructure interventions can be easily assessed by means of network transport models. In fact, their modelling requires the implementation of an evolution scenario (to be compared with the reference one) whose network encompasses the existence of the new link(s) and services.

In the case of a road link dedicated to private transport, it is sufficient to implement the new link(s) in the model graph, by characterising its functional attributes (length, capacity, travel speed, flow curve, tolls, cost, etc.) and to run the assignment in order to evaluate the impact of the new infrastructure.

In the case of links dedicated to public transport (i.e. bus, rail, metro, ferry connections etc.) apart from the introduction of the “physical” link in the graph, there is the need to specify also the characteristics of the transport service operated on it (i.e. scheduling or frequency, travel time, intermediate stops, capacity of the line/vehicles, cost etc).

In particular, for multimodal trips, there is the specific need to model the interchanges between different networks or different level of the same modal network that can be achieved with the new connection. Therefore, all the interchanges should be modelled with some care by introducing access and egress links capable of representing additional transfer times and costs.

Of course, as previously mentioned, the modelling approach requires that the choice model employed is formally linked to the network model(s) and operates consistently, thus meaning that the various alternatives (as combinations of route/mode/intermodal interchange points etc.) generated by the new network for individual origin-destination movements need to be captured by the generalised cost modifications and used in the choice model.

Apart from the general considerations mentioned above, the modelling of these solutions at European scale deserves some additional thoughts. It was already mentioned that, given their strategic nature, this kind of models generally requires a compromise between the geographical scope of the model and the level of detail of the modelling framework (i.e. demand segmentation, networks representation, transfers modelling etc.). This compromise generally leads to a coarser representation of local level (urban) network in European scale models.

Therefore, it can be expected that some of the above mentioned solutions, which have a local nature, could be not properly analysed by these applications: the impact of a new local connection generally leads to very local impacts that are hardly captured by European scale models.

The impact of other solutions like *Improved maintenance and earlier replacement of infrastructure* and *Vehicle upgrade for increased comfort* cannot be analysed by these kind of models at all.

5.4.3 Local Transport Services

The **Local transport services** solutions concern improvements to the organisation of local transport services which could be achieved without major investment in new infrastructure. The solutions belonging to this group are:

- Robust schedules;
- Integrated timetabling;
- Regular interval timetabling;
- Adding short 'spokes' to a hub;
- Higher service frequency;
- Service re-routing;
- Direct shuttle or express services;
- Addition of intermediate stops;
- Demand-responsive bus service;
- Dedicated shared-ride taxi service;
- Link into general bus lines;
- Shuttle bus between interchanges;
- Provision of short feeder flights.

Some of these solutions are related to the optimisation of scheduled services (buses, trains, airplanes, etc.), which can be used only between terminals (bus stops, stations, airports, etc.) and are available only at certain instants (scheduled departure times).

There are two characteristics that make modelling public transport more difficult than private transport modes, namely the time dimension (i.e. frequencies and schedules) and the concept of lines and thus the need for transfers.

In order to represent public transport networks, two different modelling approaches can be used (see e.g. Cascetta (2001)): the first *line-based supply model* refers to services represented in terms of lines, whereas the second *run-based supply model* considers services represented as single runs.

The main difference between the two approaches concerns the representation of the time component: while in the first case the frequencies of the public transport lines are taken into account, in the second case the timetable is the basis. The first approach is suitable for scheduled services that have high frequencies; the second one is best suited for scheduled services that have low frequencies.

For the optimal assessment of solutions that imply the optimisation of timetabling, a transport model that is capable to deal with a *run-based supply model* and a dynamic (thus meaning varying by time) assignment of demand is needed.

Nevertheless, *line-based supply models* with a static (fixed in time) demand assignment could be used for the assessment of the impact of solutions that imply the increase of frequencies. With this kind of models the solutions that imply the optimisation of timetabling could be roughly evaluated by introducing an estimated variation of frequencies achievable with the new scheduling.

Other solutions that determine the provision of new services or the reorganisation of existing ones may be modelled, as already mentioned in the previous section, by introducing the variations related to the network (i.e. new links, new stops etc.) and by also specifying the characteristics of the related transport service. The same considerations about the necessary care in modelling interchanges apply here.

Also in this case some additional reflections are needed as far the modelling of these solutions at European scale is concerned.

To have a European scale model capable to deal with a *run-based supply model* and a dynamic assignment of demand can be considered a challenge; therefore, it can be concluded that optimal timetabling related solutions can be hardly analysed by European scale models.

Furthermore all these solutions, except for the *Provision of short feeder flights,* are by definition local solutions, and therefore they cannot be properly analysed by large scale tools, since their small impacts could be not captured and reflected by the large-scale modelling results.

5.4.4 Improvements at Interchange

This group of solutions addresses problems experienced at the modal interchange point (e.g. within airports or at major rail stations or ports). It includes improvements to infrastructure which will facilitate movement within the interchange facility, design details which should make movement easier and quicker, and other interventions designed to make the time spent within the interchange more pleasant or productive.

The following solutions have been classified within this group:

- Additional, conveniently located, car parks;
- Conveniently positioned local transport services;
- Convenient position of taxi ranks;
- Cycle facilities at rail stations;
- Provision of moving walkways;
- Provision of elevators / escalators;
- Level access to trains and buses;
- Visibility axes between modes;
- Direct logical paths;
- Assistance for disabled travellers;
- (Tactile) Guidance systems for disabled;
- Improved lighting;
- Increased space and comfort in waiting areas;
- Provision of services for travellers;
- Train information / tickets in baggage claim area;
- Multilingual or pictogram information;
- Improved availability of staff;
- Provision of surveillance cameras;
- Demand management on access modes;
- Multimodal information & ticketing booths.

This group takes into account either solutions aiming at reducing transfer times, or at increasing travellers' comfort (i.e. *increased space and comfort in waiting areas*, *improved lighting*, *provision of surveillance cameras*, etc.). Out of these, only the former can be analysed by modelling tools and, in principle, their effective implementation and analysis would require the usage of dedicated tools that allow for the micro-simulation of the single interchange and its paths, by taking into account both vehicle and pedestrian flows.

In conventional transport models most of these solutions can be indirectly modelled by introducing a reduction of transfer times; in fact it can be expected that a convenient position of *car parks*, *taxi ranks* and *public transport stops* would reduce the time of access/egress to/from the terminals.

The same applies for those solutions that make the movements within the terminals faster, i.e. *moving walkways*, *elevators and escalators*, etc., but in general it is expected that the travel time reduction achievable by these facilities is very slight and therefore their impacts are hardly captured by transport models.

Other solutions like *visibility axes between modes*, *direct logical paths*, *multilingual or pictogram information* etc are not expected to produce appreciable travel time reduction.

Demand management on access modes solution considers the existence of charges and levies to reduce congestion on the access links to the modal interchange and therefore it can be easily implemented by increasing the link cost by setting additional tolls. If the revenue is used to improve or subsidise alternative access modes, it can be easily implemented by increasing the services (i.e. increase the frequency) or reducing the travel costs of the alternative public transport modes.

Also in this case it is worth mentioning that, given the very local scale of these solutions, they cannot be properly analysed by large scale tools like European model, since their small impacts could be not captured and reflected by them.

5.4.5 Improved Procedures for Check-in or Luggage Transfer

This group of solutions deal with improvements to the procedures for check-in and luggage transfer. They are:

- At-station passenger check-in for flights;
- In-train passenger check-in for flights;
- Full check-in at airport rail station;
- Door-to-door luggage transport;
- Flight luggage check-in at rail station;
- Early issue of luggage labels;
- Post-flight luggage collection from station;
- RFID tagging for luggage;
- Self service luggage check-in and drop-off.

In principle these solutions could be indirectly implemented in transport models by considering a reduction of transfer times. However, it is difficult to assess what the impact of these solutions on travel time will be. At a practical level the check-in and the luggage management time will remain the same regardless of whether this is done at the railway station or at the airport. Nevertheless, there may be an effect from the added facilities which would allow passengers to build smaller safety margins into their trips.

The considerations already expressed about the modelling of local solutions by European scale tools apply also to this case.

5.4.6 Pricing and Ticketing

This group of solutions concerns the provision of integrated pricing and/or ticketing for the individual components of long distance journeys, the idea being that this will make a multi-leg journey easier to understand, plan and execute. The general justification for providing “seamless” journeys is that it would reduce the effort involved in making such journeys.

The solutions belonging to this group are:

- Pre-paid tickets /cards for unlimited travel;
- Simple tariff structures;
- Integrated ticketing for all local journeys;
- Competitive pricing of integrated tickets;

- Integrated ticketing for Air & Rail;
- Pre-booked parking and public transport;
- Integrated ticketing for local public transport & rail;
- Inclusion of local taxi in rail and air tickets;
- Smart cards;
- Payment via SM
- Virtual tickets on smart phones.

In principle most of these solutions could reduce travel times because they would allow for pre-journey payments (and information); thus transfer times may be speeded up, since no additional time to purchase tickets (and to collect information) is required, if switching between transport modes or services.

These solutions might also lead to a reduction in travel costs, if discounts are applied for integrated or cumulative tickets but, due to increased revenue demanded by participating operators, in some cases integrated ticketing might be more expensive than for a trip using non-integrated modes within same distance.

In general, these solutions can be indirectly modelled by considering a reduction in transfer times and a variation in travel costs (increasing or decreasing of costs depending on the specific situation).

In any case the variations in travel times and costs are not expected to be significant and therefore the impacts of these solutions can be hardly captured and reflected by European model results.

5.4.7 Marketing, Information and Sales

This group of solutions concerns the marketing of the components of long-distance journeys. It includes branding, the provision of information and new sales channels. The solutions belonging to this group are:

- Common design and content guidelines across operators;
- Uniform international branding and marketing;
- Pre-trip marketing of connecting services;
- En-route marketing of connecting services;
- Pre-journey information about interchanges;
- Multimodal journey planner with ticketing - national;
- Multimodal journey planner with ticketing - international;
- Local transport ticket sales via Internet;
- Pricing information & payment systems for international travellers;
- Smart phone applications.

As far as marketing solutions are concerned, their aim is the incorporation of the services provided by distinct yet complementary operators under the umbrella of a single brand, in order to give them more prominence. Since it is not expected that there is any impact on travel time and costs deriving from their application, these solutions cannot be modelled either directly or indirectly.

The information solutions are mainly targeted at providing travellers with more comprehensive pre-journey information in order to allow them to obtain relevant information at that stage or even in becoming aware of the alternatives available. In principle they could contribute to travel time reduction (by saving time in collecting information at interchanges and by informing passengers of an alternative connecting mode or service), but it is hard to estimate the real impacts they might have. Therefore, in order to indirectly implement such solutions within transport models, assumptions on their potential impacts on travel time reduction have to be made.

Furthermore, it is not straightforward to implement different levels of awareness of alternative transport modes; in this case assumptions should be made by taking into account also the demand segmentation. In fact it seems reasonable to think that the collection of pre-journey information is mainly made by travellers that are more familiar with internet, smart-phone and web applications, and therefore the reduction in travel time is mainly to be applied to certain demand segments (i.e. business travellers, young travellers etc.). The same considerations apply for pre-sales of connecting services via internet.

But in any case the variations in travel times are not expected to be significant and therefore the impacts of these solutions can be hardly captured and reflected by European models results.

5.4.8 Enabling Solutions

The interventions belonging to this group do not provide a complete solution to problems affecting end users; rather, they seek to facilitate the implementation of solutions by reforming aspects of the operating environment. The impacts of these solutions on the traveller experience would come about indirectly – because some other development is facilitated.

The measures are mainly regulatory or organisational changes which might facilitate the introduction of more specific solutions, like:

- Single Strategic Authority;
- Voluntary partnerships;
- Intermodal agreements;
- Relaxation of antitrust laws;
- Increase competition where none/little exists;
- Strengthened Independent regulation;
- Tendering/Franchising/Concessioning;
- Serial motorway concessions;
- Joint management of car parks and serial transport services;
- Price regulation for serial rail concessions;
- Coordination between local public transport and long distance rail operators;
- Coordinated policy for management of interchange access modes;
- System for fair distribution of ticket revenues.

These measures cannot be directly implemented in modelling applications and their indirect implementation is strictly linked on the possibility to assess the potential impacts on travel time and cost variations they might have. But if they would lead to non-significant impacts, their effect can be hardly captured and reflected by European models results.

5.5 THE IC MODULE AND THE IC META MODEL FOR THE ANALYSIS OF INTERCONNECTIVITY

Being aware of the complexity of modelling multi-modal trips at European scale, the INTERCONNECT project has chosen a more simplified approach to investigate interconnectivity at European level and has devoted substantial effort to the development of support tools for the analysis of passenger multimodality. The results are:

- The **IC module**, a C++ application developed in order to perform all-or-nothing assignment of exogenous OD matrices[4] to an interconnected multimodal network, and of

[4] The module is currently fed with OD trip matrices created by the TRANS-TOOLS model in the context of the Ten-Connect project.

- The **IC meta model**, a set of VBASIC macros built over Microsoft Access that compute indicators expressly developed to measure multi-modality and interconnectivity from output of the IC Module.

These tools are satellite modules to be used in parallel with existing and more sophisticated transport models like TRANS-TOOLS and are not intended to replace them or to overcome all the above mentioned weaknesses of the state-of-the-art models at European scale.

In fact, even though the IC module is an important step towards the achievement of a proper multi-modal modelling approach, its development only started within the INTERCONNECT project and its current configuration is not able to satisfy all the above mentioned theoretical requirements in terms of e.g. demand segmentation, (the module does not perform demand generation and distribution steps) or choice of alternative multimodal routes (the module currently performs all-or-nothing assignment to the shortest path).

The module will be further developed and improved in other European projects in order to

- Test a stochastic user equilibrium algorithm to allocate trips among reasonable multi-modal chains between ODs;
- Implement a service scheme for the rail mode as in the case of air services or ferry services;
- Simulate airports using different interconnected nodes for each terminal;
- Refine the process of automatic connector creation; and
- Introduce user behaviour not only by trip purpose but also by age population segment.

Detailed information on the IC module and IC meta model are available in D5.2 and D5.3; in particular D5.2 provides an overview on the interesting analysis that can be performed by these tools.

5.6 CONCLUSIONS

In chapter 5 an overview about how to improve the modelling of multimodal trips on interconnected network at European level was given.

At a general level, the recommended framework to enable the proper modelling encompasses:

- The use of a network-based representation of alternative routes and modes within the transport model, where the network model should employ appropriate multi-pathing algorithms to construct alternative routes through the network between origin-destination pairs;
- The transport model should employ some form of choice model which estimates the demand on each mode combination/route based on the generalised costs of the different alternatives;
- The generalised cost formulation used in the transport model should include an explicit representation of costs of modal transfer.

These requirements apply equally to models designed to assess the impacts at European and local scale, but it is implicitly recognised that for highly strategic applications, where the geographical coverage and the possible alternatives heavily increase the complexity of the model, a certain kind of simplification of the problems to be investigated is needed.

As an example, for highly strategic studies, such as major Trans- or Pan-European connections, the network is likely to be based on very large zones and only broadly defined transport links, thus the modelling of interchanges will inevitably involve a certain degree of approximation.

The way in which passenger demand is segmented is a key consideration for successful multimodal modelling. In fact the choice of the used transport mode can be influenced by the age of user classes, by their personal income, by the trip purpose etc. It is recommended therefore that careful consideration is given to demand segmentation in the specification of multimodal modelling approaches. This is likely to have important implications for the way in which data collation and surveys are undertaken.

In fact, to understand the potential of intermodal passenger transport and how it can best be promoted, there is the need of “door-to-door” data on its present performance and potential market. However, this data is sparse and therefore more emphasis should be given to data collection, even though it is recognised that in budgetary terms and in terms of effort the cost of this task is considerable.

In this respect the European Commission could play a relevant role both in harmonising the existing available information and publishing European level basic data as well in encouraging future data collection at national level and drawing guidelines for harmonised surveys on long-distance multimodal trips.

Because of the compromise between the geographical scope and the level of detail of the modelling framework of European scale models and the subsequent need for simplification, it can be expected that policies which have a very local nature could be not properly analysed by these applications and their (small) impacts would be hardly captured and reflected by European models results. In fact, even though a policy implemented in a certain interchange could lead to a substantial reduction of transfer times or costs, its local benefits are likely to not change the European level results substantially.

Nevertheless, it can be expected that multimodal European models could be able to investigate the impacts of policies which are “massively” applied to all main interchanges all over Europe as witnessed by the modelling exercises performed in INTERCONNECT task T5.2 and documented in D5.2.
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