Final Report for Publication

DELIVERABLE 8

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Project Co-ordinator: Nexus

Project Partners:
Transport & Travel Research Ltd (TTR)
Verkehrsverbund Oberelbe (VVO)
City of Rotterdam
City of Dordrecht
Azienda Servizi per la Mobilita (ASM)
Azienda Consorzio Transporti Veneziano (ACTV)
SAVE Engineering SPA (SAVE)
University of Venice / Cities on Water (IUAV)
City of Pilsen
University of Pardubice
Center for Clean Air Policy (CCAP)

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EXECUTIVE SUMMARY

SWITCH (Sustainable Workable Intermodal Transport Choices) set out to demonstrate the delivery of the seamless journey concept in passenger transport. It brought together researchers and transport authorities in five European countries who worked together to design, implement and evaluate a number of demonstration projects with the aim of overcoming some of the barriers to intermodality.

The ultimate aim of SWITCH was 'to demonstrate good practice in the provision of intermodal passenger transport and to assess the impacts on transport operation, traveller behaviour, environment and economics'.

A three-phase evaluation process, incorporating user needs assessment, design validation and verification and post-implementation assessment, was adopted to ensure that the measures which were implemented reflected expressed needs and the overall impacts were as anticipated early in the project.

A wide range of measures was implemented aimed at reducing and ultimately removing barriers to intermodality. These included

- Measures to improve information to reassure travellers before and during their journey
  - *dynamic trip planning*
  - *real time information*
  - *enhanced static signage*
  - *dynamic Park and Ride signage*

- Measures to improve the travel experience within interchanges and at interchange points
  - *redesign of infrastructure*
  - *park and ride developments*
  - *improved pedestrian and cycle access*
  - *improved vehicles*
  - *integration of taxis*

- Integrated ticketing solutions to remove the need to purchase multiple tickets

Evaluation within SWITCH focussed on short-term impacts, as the majority of the measures had not been implemented for enough time for their longer-term impacts to be assessed.

All partners experienced barriers to implementation during the project, indicating the difficulties of delivering intermodal systems, including:
  - *Land ownership / legal issues*
  - *National regulations*
  - *Inter-agency co-operation*
  - *Political delays*
  - *Institutional factors*

Within SWITCH a wide range of high quality technical measures has been implemented in four cities across Europe, each of which has made a positive contribution to the elimination of barriers to intermodality. In addition, a great deal of knowledge and experience has been

gathered during SWITCH, much of which is directly transferable to EU cities and beyond. In conclusion, the project has made a significant contribution to the intermodal transport debate by furthering existing knowledge and understanding of this complex policy area. The key recommendations from the project and areas for further research are summarised below.

Key Recommendations

- *Intermodal interchanges should be designed with the needs of users in mind*
- *Intermodality should be approached from a network rather than site-specific perspective*
- *Intermodality should be promoted as a new concept to encourage public transport use*
- *Pre-trip information should be provided in a range of formats*
- *High quality, standardised signage should be developed throughout interchanges / networks*
- *Real-time information should be installed in order to reassure passengers*
- *Access issues must be foremost when designing and implementing intermodal measures*
- *High quality P&R car parks should be provided to encourage interchange from car to public transport*
- *Car drivers should receive benefits for interchanging*
- *Kiss and Ride spaces should be provided at intermodal interchanges*
- *Cycles should be fully integrated with public transport*
- *Consider the role of waterborne solutions in an intermodal transport network*
- *Taxis should be fully integrated into intermodal interchanges*
- *Intermodal ticketing should be offered to travellers to facilitate transfer between modes*
- *The needs of users and potential users should be identified in the design process*
- *Co-operation between organisations is vital for the delivery of intermodal measures*
- *Project planning is vital to ensure technical applications are delivered on time and within budget*
- *A dedicated project manager should be employed to deliver the technical measures*
- *Intermodal measures should be evaluated to ensure that they have the desired impact(s)*

Key Areas for Further Work

- *Investigation into the acceptability of European access standards for new intermodal measures*
- *Investigation into the acceptability of European intermodal signage standards*
- *A European review of the role of taxis within intermodal interchanges*
- The establishment of a set of minimum standards for cycle provision
- *Consideration of the relative importance of minimum connection times or comfortable waiting environments at intermodal interchanges*
- *Further work to ensure that multimodal transport incorporates all available modes*

1 INTRODUCTION

Optimal integration of different modes is a key element in the provision of a cost-effective, attractive passenger transport system able to take people from door to door. An efficient intermodal transport system will help to increase the use of public transport and may have wider social benefits by increasing labour movement and social inclusion.

Although public transport networks cannot operate without the need for passengers to interchange, it must be recognised that interchange is not of itself a desirable activity. In general, people interchange when there is no direct, convenient through service or route for their journey or when interchanging offers a faster or more comfortable journey overall. Interchange is considered to be unpleasant as it often increases travel time. It also increases the traveller's uncertainty about their journey, which in turn leads to feelings of insecurity. In many interchange environments, the information provided is not sufficient to reduce uncertainty, and the fact that transport operations are often not fully co-ordinated simply adds to the levels of anxiety experienced by travellers. Infrequent public transport users, people with impaired mobility, and those making a particular journey for the first time, are likely to have an especially strong aversion to interchange.

If transfers between services can be made easier, quicker, and more convenient, the overall integration and flexibility of transport networks is improved. Any improvements to make interchange more seamless could in turn encourage people to travel more by public transport. In addition, if the levels of inconvenience, complexity and uncertainty experienced by travellers transferring between different modes can be reduced, the overall journey experience for existing passengers will also be improved.

The SWITCH project brought together transport authorities and researchers in five European countries, who worked together to design, implement and evaluate a number of demonstration projects with the aim of overcoming some of the barriers to intermodality. SWITCH included urban and inter-urban demonstration projects covering three key areas:

- Information
- Development of integrated networks
- Ticketing

Demonstration projects were implemented in Dresden (Germany), Newcastle and Gateshead (Tyne and Wear, UK), Rotterdam and Dordrecht (Netherlands), and Venice (Italy). Partners in Pilsen and Pardubice (Czech Republic) undertook research studies to investigate means to improve intermodality in their country.

SWITCH was supported by the European Commission through its Transport RTD Programme. The project began in January 1999 and was completed in December 2000. The total costs of the project were 3.2 million euros, of which 59% was contributed by the project partners and 41% by the European Commission.

This report provides an overview of the procedures developed, activities undertaken and evaluation conducted within the SWITCH project in order to demonstrate the delivery of the seamless journey concept in practice. Section 2 introduces the objectives of SWITCH and the methodologies adopted. Section 3 introduces the SWITCH partners, their respective

cities and the local problems to be addressed. The evaluation process is outlined in Section 4. The technical measures implemented by each of the project partners are presented in Section 5. Section 6 reports on the evaluation of the technical measures and emphasises the key results from this process. Section 7 concludes the report by providing a series of recommendations for the future development of intermodal transport solutions and suggesting key areas for further work.

2 OBJECTIVES AND METHODOLOGY

2.1 Overall Aims of the Project

The ultimate aim of SWITCH is expressed in its Mission Statement:

"To demonstrate good practice in the provision of intermodal passenger transport and to assess the impacts on transport operation, traveller behaviour, environment and economics."

Underlying the Mission Statement were four key project objectives

1. To set up a range of inter-urban and urban intermodal demonstration projects, building upon existing infrastructure and experience;
2. To develop and implement a comprehensive evaluation and assessment process incorporating user needs assessment, validation and evaluation phases;
3. To make recommendations for the future implementation of intermodal passenger transport systems and services throughout the European Union;
4. To develop and implement a pro-active dissemination process aimed at encouraging the widespread adoption of good practice.

2.2 Means Used To Achieve The Objectives

2.2.1 Demonstration Planning and Implementation

The first SWITCH objective was to set up a range of inter-urban and urban transport demonstration projects, building upon existing infrastructure and experience. In order to achieve this objective, each partner created a list of the technical measures which they intended to develop during the course of the project. The measures proposed spanned the three key categories of measure to facilitate intermodal journeys – Information; Integrated Networks; and Ticketing.

In designing their technical measures, the partners considered how existing infrastructure could be improved to better enable passengers to interchange between modes, and which specific schemes were feasible within the lifetime of SWITCH. An Inception Report (Deliverable 1) was produced, which set out the detailed project plan. A Position Statement (Deliverable 5) described changes to the original plan due to circumstances unforeseen at the start of the project. This first objective was achieved by designing and implementing a wide range of measures, the details of which were reported in Deliverable 4 (Technical Report on the Design Phases) and Deliverable 6 (Technical Report on Implementation and Demonstration).

2.2.2 Evaluation and Assessment

The second objective was to assess user needs, validate the scheme designs, and evaluate the impacts of the project. The demonstration projects were assessed in three ways: at the level of individual implementations, as local packages of complementary measures, and at the cross-site (European) level.

In order to meet this objective, an evaluation plan was developed (Deliverable 2), whose aim was to provide a coherent framework and detailed description for the evaluation and assessment process. The Plan established the format in which individual pieces of data were to be collected and the detailed evaluation processes to be undertaken. The Plan included a centralised definition of evaluation categories, indicators and methodologies to enable a fully consistent evaluation procedure to be conducted at test-site level within each of the partner cities.

The SWITCH partners utilised the methods detailed within the Plan to undertake market research and collect the relevant data. Partners reported their results back to the Evaluation Co-ordinator to enable a thorough evaluation to be carried out at both the local and the cross-site level. The final evaluation results were reported in Deliverable 7 (the Evaluation Report).

2.2.3 Recommendations

The third SWITCH objective, to make recommendations for the future implementation of intermodal passenger transport systems and services throughout the European Union, was achieved at the very end of the project. Knowledge and experience gathered during the design, implementation and evaluation of the demonstration projects made it possible to achieve this objective. The positive and negative experiences of partners provided valuable input to the production of a series of guidelines and recommendations to provide assistance for organisations which may be considering developing intermodal solutions in the future. The guidelines comprise three key areas to consider – general interchange principles; the actual design of interchanges / intermodal networks; and the process of delivering intermodal systems. The guidelines may be found in section 7 of this report.

2.2.4 Dissemination

The final objective was to develop and implement a pro-active dissemination process aimed not just at spreading information regarding SWITCH, but also at encouraging the adoption of good practice identified within the project in order to achieve a positive modal shift. The dissemination process began with the production of Deliverable 3 – the Dissemination Plan. This document detailed the aims of the dissemination process and the plans of each individual partner in terms of how they intended to disseminate the results of SWITCH locally.

During the project, a total of five newsletters were produced to report on progress, to promote and encourage attendance at dissemination events, and to provide information about the measures implemented. The publication of the newsletter both in paper format and on the SWITCH website helped to ensure as wide an audience as possible.

Two workshops were held during the project to promote the intermodality concept. The first, held in Rotterdam, focused on involving the user in the design validation and verification processes, particularly in relation to interchange development. The second workshop, held in Prague, promoted SWITCH and the concept of intermodality to Central and Eastern European countries, and was intended to provide guidance for organisations in these countries which had no previous experience of taking forward the concept of intermodality. The project was also presented at a workshop organised by the CARISMA intermodality consortium in Budapest.

The final and arguably most important dissemination activity was the local dissemination, involving the local project partners spreading the SWITCH message at the local, national and European level. Each partner created their own dissemination plan to guide their activities. At the national and European level, this simply involved dissemination of the results of the project as a whole. At the more local scale however, partners were involved in the promotion of the new technical measures in order to inform both users and potential users of public transport of the existence of new intermodal services and as a result, to encourage their use.

3 THE SWITCH CITIES

3.1 Introduction

The partner cities were selected to ensure that a wide range of intermodal transport modes were included within the project. The demonstrations involved integration between land, water and air-based travel and included all forms of transport from waterbuses and ferries, to airports, bus, metro, train, bicycle and walking. The four demonstration partners – Dresden, Newcastle / Gateshead, Rotterdam / Dordrecht and Venice were chosen as they already had good examples of intermodal infrastructure in place, together with experience of operating in both regulated and deregulated environments.

As well as the demonstration partners, the Consortium included a further two partners - the City of Pilsen and the University of Pardubice from the Czech Republic. The Czech partners undertook research to examine the barriers to implementation of intermodal measures in their respective cities and in the Czech Republic as a whole. Based on the results of this research, they considered ways to overcome such obstacles in order to facilitate intermodality.

The Czech partners also gained a great deal from the project in terms of learning from the experiences of the SWITCH demonstration partners in designing, implementing and evaluating their technical measures. At the close of the project, they were in a position to use the lessons learnt and experiences gained from the project to more closely explore the possibilities of developing intermodal measures in their cities. The involvement of the Czech partners within SWITCH also helped to ensure that any recommendations resulting from the project were endorsed by countries from both western and eastern Europe.

3.1.1 Dresden

The City of Dresden is the capital of the Saxony region of Germany, situated in the south-eastern part of the Free State which borders on the Czech Republic and Poland. Dresden forms part of the Oberelbe region, which comprises 5 districts. This region covers 4000 km^2 and has a population of 1.2 million, of which 0.5 million live in Dresden. Dresden is a cultural centre and attracts more than 6 million visitors per year.

Public transport in Dresden accounts for 70% of all public transport services within the Oberelbe region. The transport infrastructure comprises of motorways, trunk roads, railways, and an international airport. The majority of the population (44%) travel by car, 26% walk, 21% travel by public transport, and 10% travel by bicycle.

The three SWITCH demonstration sites in Dresden were Königsbrück, Dresden-Klotzsche and Freital-Deuben (see Figure 1).

In Königsbrück, the key problems to be overcome and addressed by the SWITCH applications were the lack of integrated infrastructure for rail and bus services, barriers to pedestrian access to and egress from the station, and associated deficiencies in passenger information for different services and routes. Redevelopment of the site at Königsbrück concentrated on developing a centralised interchange, improving bus operations between Königsbrück and the neighbouring town of Hoyerswerda, and increasing the speed and efficiency of rail services between Königsbrück and Dresden.

The problems to be addressed at Freital-Deuben involved the major barriers to integration of rail transit and bus services regarding infrastructure design and the lack of a co-ordinated and reliable information system. Associated problems included deficiencies of pedestrian and cycle access and the need to integrate other modes e.g. taxis and private cars. The Freital-Deuben station is located in Freital, a medium-sized district capital next to Dresden. The station provides an important interchange site for rail transit and will become a central interchange point for urban and interurban public transport services with the relocation of Freital central bus station to Freital-Deuben.

The final site, Dresden-Klotzsche, has a railway station which served as an interchange site for suburban rail services and urban and interurban bus services. The station's role within the City's transport network will become even more significant when it also becomes a landing stage for the airport shuttle in the near future. The issues to be addressed at this site included the need to redesign the infrastructure of bus stops to enable easy access and egress of vehicles, pedestrian and cycle access, problems associated with car-public transport interchange, and deficiencies in the quality and co-ordination of passenger information for different routes served by different operators.

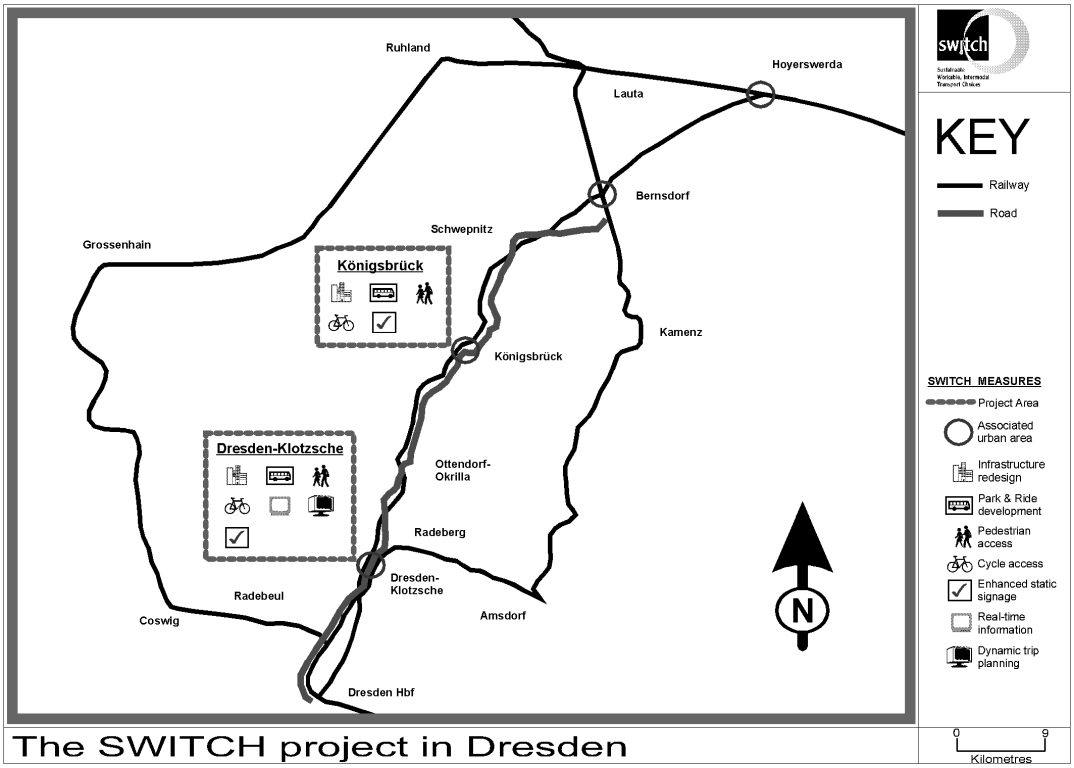

Figure 1 SWITCH Demonstration Sites and Technical Measures in Dresden

3.1.2 Newcastle and Gateshead

Newcastle and Gateshead are situated within the Tyne and Wear region of North East England. The region comprises five districts which cover an area of 209 square miles and has 1,100,000 inhabitants, of whom 200,000 live in Gateshead and 260,000 live in Newcastle.

The region is characterised by densely populated urban and suburban land around the Rivers Tyne and Wear, surrounded by a small number of satellite towns which are all connected by thousands of miles of roads and a few major rail lines. 430,000 people are employed within the Tyne and Wear region, the majority (higher than the UK average) travel to work by public transport. In Gateshead, 7% of commuters travel to work by metro/train, 23% travel by bus, 0.6% travel by bicycle and 44% travel by private car. The modal split for work related travel in Newcastle is 6%, 25%, 1% and 41% respectively.

In Newcastle and Gateshead, the SWITCH corridor ran along one route towards the city centre from the south east. It comprised two parallel road and rail routes linking the demonstration sites to the city centre. Two demonstration sites were chosen for study within the project – the interchanges at Heworth (see Figure 2) and Gateshead (Figure 3) stations on the Tyne and Wear Metro network

The major problem to overcome at Heworth was traffic congestion caused in particular by personal commuter traffic (private cars) associated with the need to increase the capacity of the existing Park and Ride facility. Other problems to be addressed included deficiencies in passenger information for multi-modal journeys, conflicts and unsafe conditions regarding the flow of pedestrians and vehicles within area of the bus station, environmental and waiting conditions (e.g. vandalism and crime), and the need to integrate other modes e.g. taxis and bicycles.

At Gateshead, the main problems were associated with deficiencies in passenger information involving direction signage, real-time information and dynamic trip planning, security and waiting conditions, and the need to integrate other modes e.g. taxis and bicycles. A major barrier to be overcome related to infrastructure design as existing conditions made access and egress from the interchange station unsafe for pedestrians.

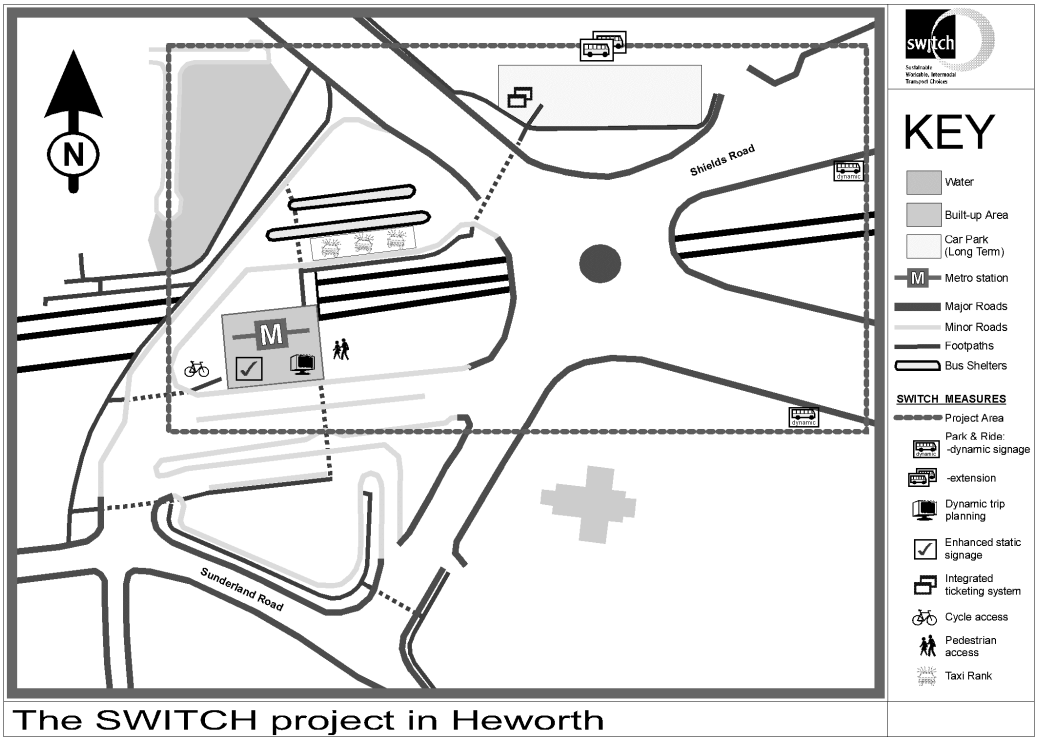

Figure 2 SWITCH Demonstration Site and Technical Measures in Heworth

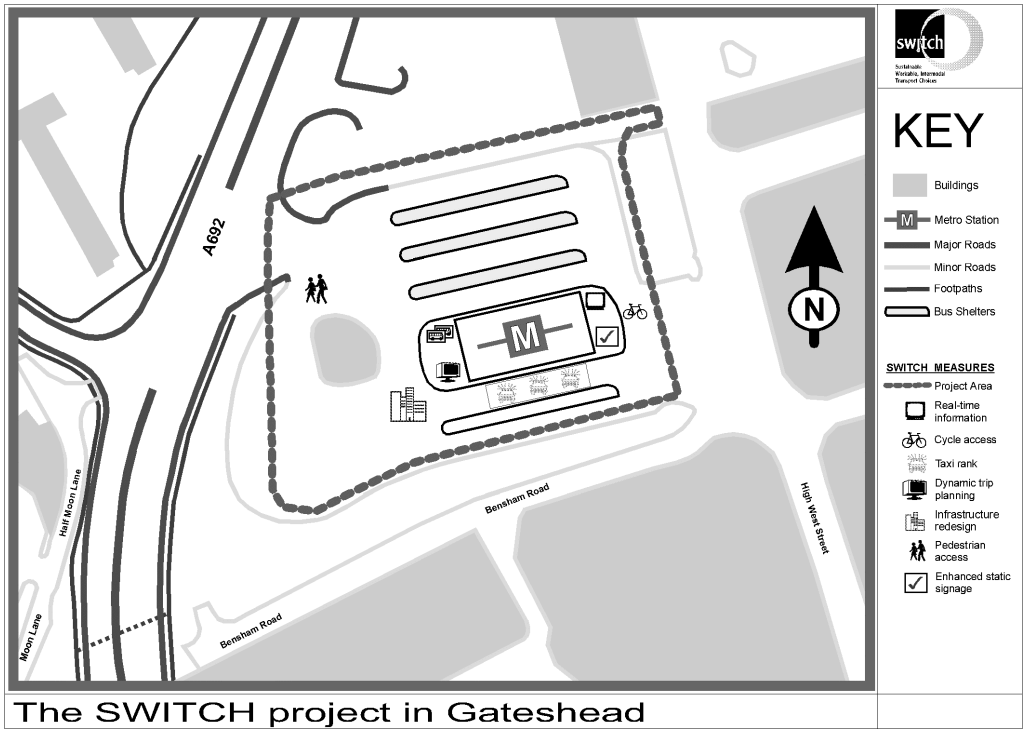

Figure 3 SWITCH Demonstration Site and Technical Measures in Gateshead

3.1.3 Rotterdam and Dordrecht

Rotterdam and Dordrecht are both situated within the province of Zuid Holland. Rotterdam is the second city and the industrial heartland (with the biggest harbour in the world) of the Netherlands. The Rotterdam region has a population of over 1.2 million.

Rotterdam possesses an extensive urban road network with many major roads, which include highways, national and regional roads. The River Maas runs through the city and two bridges and a tunnel connect the northern and southern areas. The city has an airport and has easy access to Amsterdam International Airport. The majority of the population travel by bicycle or walk for journeys within 5 km of the city centre, 24% travel by car and only 12.4% travel by public transport. For longer journeys, car and public transport use increase to 39% and 23% respectively.

Dordrecht is a historical city, situated at the mouth of the river Oude Maas, 20 km south-east of Rotterdam. It has recently suffered from industrial decline, but has become a major cultural region of the Netherlands and is currently undergoing large-scale social and economic urban regeneration. Car ownership has grown considerably and accounts for almost half of all work-related journeys. A large proportion of journeys are also made by bicycle or moped and only 11% of journeys are made by bus or train.

In Rotterdam, the major problems to be overcome related to the levels of traffic congestion and low occupancy / misuse of Park and Ride facilities by car drivers who do not Park and Ride. Other problems to be addressed included the need to enhance cycle access and deficiencies in the provision and quality of passenger information on changing modes especially for waterborne-land public transport and car-public transport connections.

In Dordrecht, the problems to be addressed were associated with deficiencies in accurate and reliable passenger information for land-waterborne and car-public transport connections.

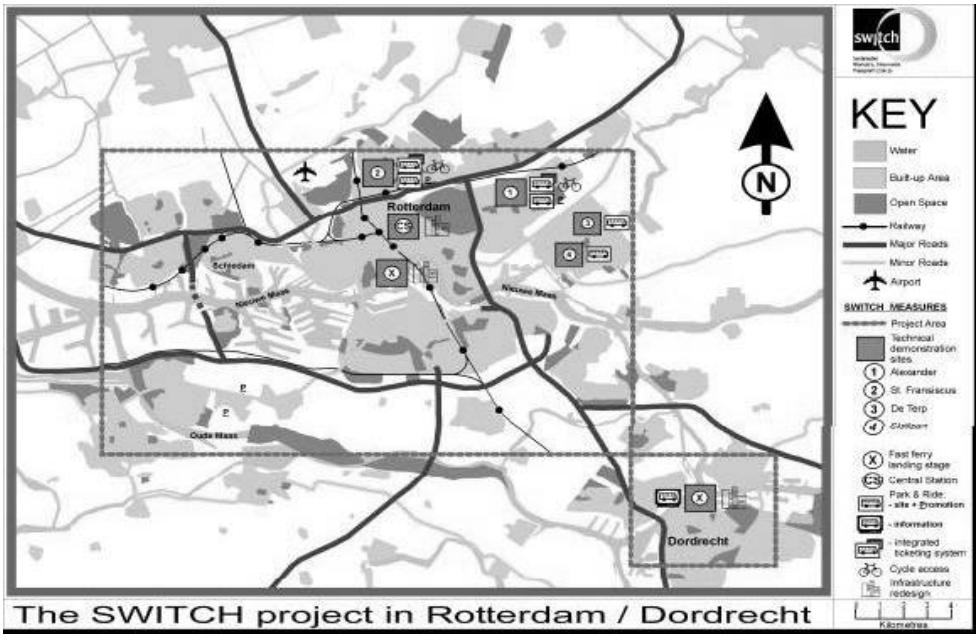

Figure 4 SWITCH Demonstration Sites and Technical Measures in Rotterdam/Dordrecht

3.1.4 Venice

Venice is a historic city and a major tourist destination (14 million visitors per annum), situated in the north east of Italy. It comprises 13 districts with 292,600 inhabitants. The majority (180,000) of the population live within the surrounding mainland, 45,000 live on the islands in the lagoon and 68,180 live in the historical centre which is built on small islands that are connected by bridges.

The international Marco Polo Airport receives a high influx of tourists and visitors every year, of whom 70% are Italian. Two thirds of journeys are business related. 11.5% of visitors travel to the airport by boat, 12.9% travel by bus, and 17.2% travel by taxi. Congestion generated by commuters and visitors is a problem, especially on waterbuses during peak hours.

The two sites which were the focus of SWITCH work within Venice were Piazzale Roma and Fondamenta Nuove (see Figure 5).

Piazzale Roma is the terminal area for cars and buses within Venice; beyond this point, travel was only possible on water or by foot. Prior to SWITCH there were no information systems to provide information regarding parking availability and interchange with public transport. In addition, there was no integrated ticketing system, which meant that travellers had to queue and pay twice in order to park their car and to catch a waterbus, thus increasing the overall journey time, and acting as a major disincentive to travel by public transport.

Fondamenta Nuove had suffered as a result of only having a conventional waterbus stop for existing ACTV waterbus services. The challenge was to make Fondamenta Nuove the key focus for the new waterborne intermodal public transport connection between Marco Polo airport and the city centre.

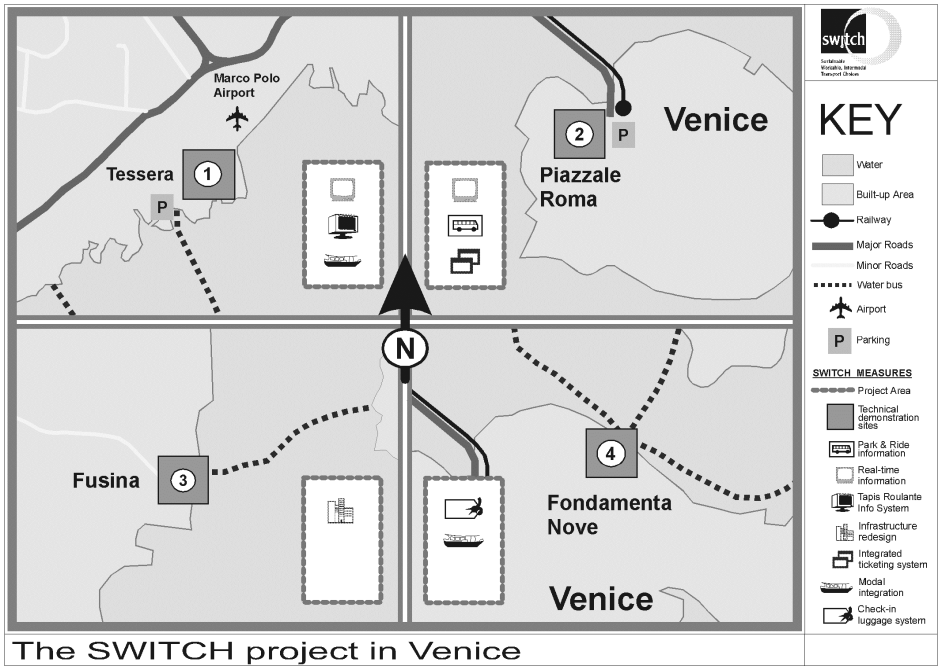

Figure 5 SWITCH Demonstration Sites and Technical Measures in Venice

3.1.5 Pilsen

Pilsen is a small historical city, situated south west of Prague in the Czech Republic. It has an area of 125 km^2 and a population of 169,000. The City has become an important regional centre for industry, commerce, administration and culture. 115,170 people are employed within the Pilsen region, of whom 27,400 commute into the city every day.

The City's public transport network comprises of three main modes including bus, tram and trolley buses. However, the use of public transport in the city is gradually declining as a result of increasing car ownership, which has greatly facilitated a rise in traffic congestion. 28% of the City's population travel by tram, 15% travel by trolley bus, 11% travel by bus and 15% travel by private car.

The transport and intermodal problems to be addressed by the SWITCH studies were, traffic congestion generated by rising car ownership and a decrease in the use of public transport, deficiencies in the quality and design of passenger information for bus, tram and trolley bus services, financial and management barriers to integrating the region's bus network, barriers to developing an integrated ticketing system for multi-modal travel, and deficiencies in the quality and provision of passenger information for Park and Ride facilities.

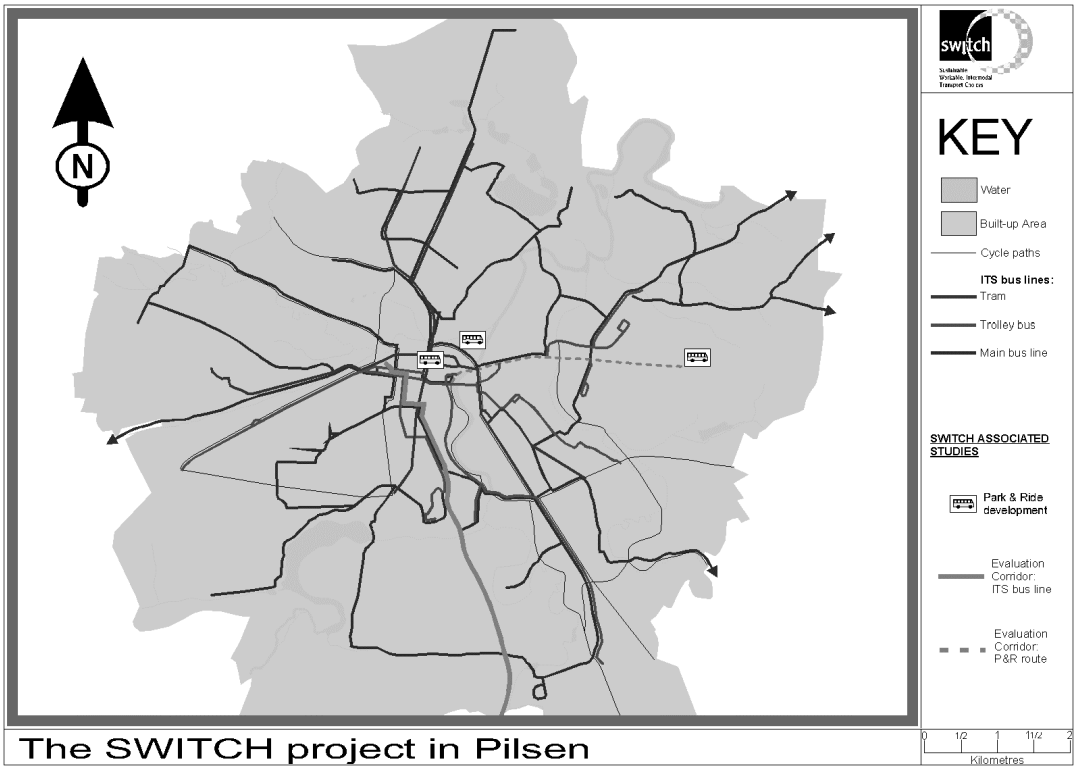

Figure 6 SWITCH Study Area in Pilsen

3.1.6 Pardubice

Pardubice lies at the confluence of the River Elbe and Chrudimka, 100km east of the City of Prague in the Czech Republic. Pardubice's neighbouring city and the subject of much of the work undertaken within SWITCH – Hradec Králové – is located 22km away from Pardubice. Pardubice and Hradec Králové are served by a well-developed road and rail system linking them to other countries in both eastern and western Europe. In addition, both Hradec Králové and Pardubice have an airport, and Pardubice is within easy reach of Prague's major international airport.

The key problems experienced were the lack of co-operation between Hradec Králové and Pardubice, in terms of information, ticketing and network integration. These were to be addressed by the University of Pardubice via a study to consider the barriers to intermodality in the Czech Republic.

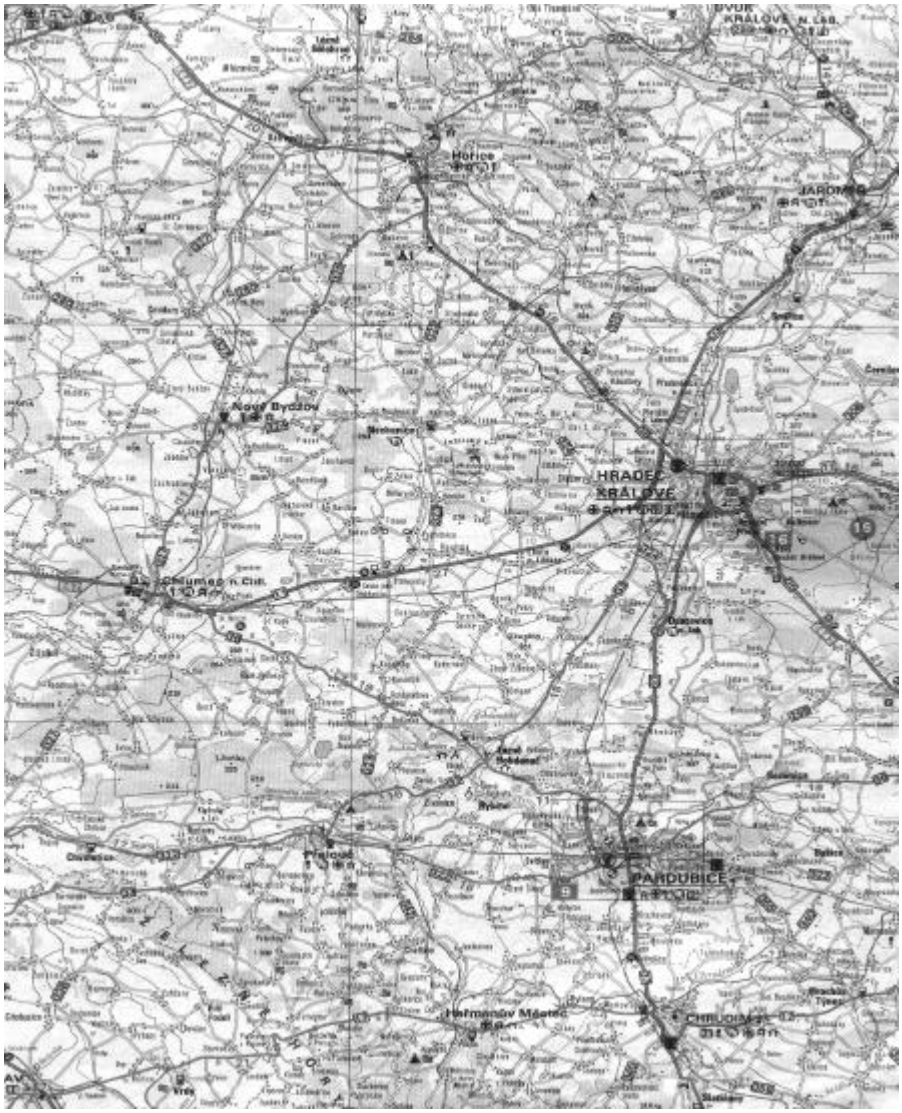

Figure 7 Location of Pardubice and Hradec Králové

4 THE EVALUATION PROCESS – A KEY ELEMENT IN THE DESIGN OF USER-FRIENDLY INTERMODAL NETWORKS

4.1 Introduction

The evaluation methodology was intended to guide partners throughout all phases of SWITCH, including the design, implementation and evaluation of the technical measures. The evaluation process, based on the MAESTRO phases of evaluation[1], is shown in Figure 8. The initial design of the measures was based on the needs and requirements of both users and non-users of existing public transport systems, expressed within the 'user needs assessment' – the first phase of the evaluation process. Once these needs had been incorporated within the designs, the detailed designs were validated and verified. This was the second phase of evaluation, which involved conducting technical assessments of the designs and ensuring that they met the expressed user needs.

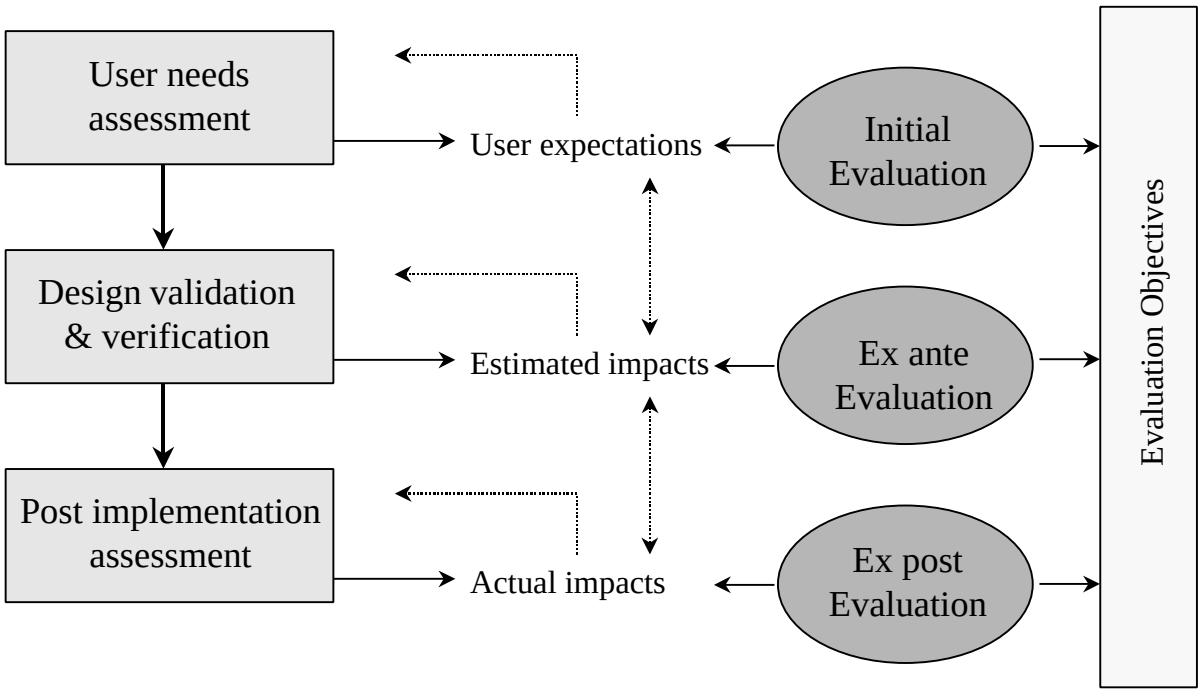

Figure 8 The SWITCH Evaluation Process

Once the detailed designs had been verified, the partners implemented the measures. Finally, the post implementation assessment involved assessing the impacts of the measures and identifying the extent to which the overall objectives of the project had been achieved.

The objectives of the evaluation process were:

- to assess the needs of existing and potential users of public transport in the SWITCH cities in respect of information, network integration and ticketing;
- to assess how well the existing situation matches these needs;

[1] MAESTRO Deliverable 6, The MAESTRO Guidelines

- to ensure that the designs for information, network integration and ticketing meet the expressed needs of users;
- to assess the impact of the SWITCH measures on selected indicators in the areas of transport system operation, economics, quality of life and the environment;
- to investigate how the revised systems perform in terms of meeting user needs.

4.2 The Evaluation Plan

The Evaluation Plan was established at an early stage of the project. It was designed as a practical working guide for all partners to help them with the user needs assessment, design validation and verification, and evaluating the implemented measures. It included procedures for quality assurance within the data collection process, identified barriers to implementation and limitations for data collection, and defined the methods to be used and sample sizes for the three phases of the evaluation process. The aim was to ensure that the evaluations conducted within each partner city were as consistent as possible.

The SWITCH partners used the methods detailed within the Evaluation Plan to undertake market research and collect the relevant data needed for evaluation throughout the project. Data collection within the evaluation process occurred in three phases:

- at the inception of the project, (user needs surveys and collation of existing data);
- early in the project as part of the design phase, (validation of the proposed designs);
- at the end of the project after implementation of the measures.

Each of the three phases involved collection of ‘soft’ data about user and operator opinions and ‘hard’, technical data about technical specifications, operating performance and impacts on the transport system in the SWITCH cities.

4.3 The Design Process

The design process was an integral component of the project and one of the most important tasks in achieving the project's aims and objectives. The design of the measures influenced their effectiveness in meeting user needs and aspirations. The SWITCH technical measures were designed according to the results of both the user needs assessments and an accessibility audit, thus ensuring that they satisfied user needs and expectations, and incorporated a 'design-for-all' approach. The process also included technical assessments (to determine technical and operational requirements), and design validation and verification..

4.3.1 User Needs Assessment

The user needs assessment took into account the requirements both of those people who are already using existing intermodal transport options and of people who may in the future become users. The Evaluation Plan provided a framework to be followed in the assessment of user requirements by the use of discussion groups. Certain cities chose to use an alternative mechanism to obtain the required information, but in all cases the topics covered were consistent.

The user needs assessment was designed to identify the needs and aspirations of key target user groups.

Target User Groups

The SWITCH target user groups were categorised according to the following types of journey purpose:

- Commuting/education
- Personal business (including shopping, health, social purposes etc.)
- Holiday/day trip/business trip

These groups were sub-categorised as follows based on frequency of travel:

- Travellers who use public transport and services along the SWITCH corridors regularly
- Travellers who use public transport regularly but infrequently use services along the SWITCH corridors
- Travellers who do not use public transport, are uncertain of the services, or who only infrequently use services along the SWITCH corridors

User Needs and Requirements

The user needs assessment collected data about the travel behaviour and on-journey needs of the target groups. The following factors and issues were defined in the SWITCH Evaluation Plan to consider whilst assessing user needs and identifying intermodal barriers:

- **Logistical and operational:** timetables, journey times, average waiting time at interchanges (from the arrival of one mode to the time of departure by another)
- **Economic:** cost of tickets and affordability
- **Psychological and social:** users' fears and feelings for personal security; the need to overcome language, cultural, physical or sensory barriers; feelings of social exclusion due to socio-economic status
- **System information:** information or instructions on how to operate ticketing machines
- **Physical design:** accessibility and pedestrian flow, vertical and horizontal physical obstacles between modes, availability of physical amenities, lighting, security cameras, ease of transfer, cleanliness, access to information, ticketing systems
- **Local planning and land use:** physical accessibility to places/centres of employment (services/industry) and services, leisure and recreation, shopping, other facilities e.g. health, residential areas, education

The user needs assessment evaluated these factors in terms of the following aspects:

- comprehensiveness

- convenience
- accessibility
- affordability
- reliability
- personal safety and security

User Needs Surveys

The first phase of the user needs assessment involved collecting qualitative and quantitative data in the individual SWITCH demonstration projects. The methods adopted to collect these data differed in each partner city. A more detailed account of the SWITCH city's objectives and purpose of using these methods is provided in the SWITCH Evaluation Plan, Deliverable 2.

4.3.2 Technical Assessment

This is the more quantitative assessment of the design, whereby the 'operability' or 'functionality' of the preferred designs is tested. This is a vital stage in the project process, as it is not possible to progress beyond this stage to the implementation of any technical measure if it does not function efficiently. Partners carried out testing processes where necessary in order to ensure that the designs they were planning to implement, while meeting both the needs of and being accessible to all users and potential users, would operate in practice. This was particularly important in the case of electronic measures such as real-time information and dynamic signage systems.

It was appreciated within the project that despite the best efforts to obtain the views of users of users and non-users, it would not necessarily be possible to meet all their expressed needs, as they may well be too diverse to reconcile, but this would not necessarily result in the design not being implemented. If however the technical specifications for the proposed designs were not met, it would not be possible to progress beyond this stage, as the applications would not function sufficiently. Rather than aborting applications whose designs did not meet technical specifications, partners were encouraged to return to earlier design stages and reconsider the operation of the applications.

4.3.3 Accessibility Audit

It was considered imperative that the SWITCH technical measures incorporated a 'design-for-all' approach to ensure that they were accessible and user friendly and did not in any way restrict particular groups from using public transport services within the SWITCH corridors. This approach promoted social inclusion, one of the primary project objectives.

The SWITCH accessibility audit paid particular attention to the needs and requirements of disabled and elderly travellers, taking into account design accreditation criteria and legislation established by national and European disability organisations and advisory groups, including DiPTAC, EDDIT, RNIB, COST219 and INCLUDE. Projects under the European

Commission DG XIII TIDE (Technology Initiative for Disabled and Elderly people) programme also provided design specifications and guidelines, methods of ergonomic analysis, recommended software and technology for passenger information, integrated networks and ticketing systems. These projects include DISTINCT, INFOPOLIS 1 & 2, TELSCAN, and TURTLE.

The SWITCH accessibility audit provided a checklist for the individual demonstration projects to follow in the design and implementation of the SWITCH technical applications. The checklist was developed taking account of issues that govern the ease of access to public transport through the control of physical and psychological barriers, including:

- physical access to and through the interchange
- access between the interchange and the vehicles
- the ease of understanding information
- access to tickets

The accessibility audit considered the needs and requirements of disabled persons with various impairments and of user groups whose mobility is, or might be restricted. These groups were defined in the Evaluation Plan as follows:

- the elderly
- persons using wheelchairs and pushchairs
- persons with heavy luggage
- pregnant women
- persons who are overweight
- persons who are particularly tall or short
- persons with visual and hearing impairments
- persons with learning difficulties

4.3.4 Design Validation and Verification

Designs were assessed against four sets of criteria:

- the technical assessment;
- any applicable national technical standards;
- the SWITCH accessibility checklist;
- the user needs assessment.

4.3.5 Implementation

Although structured guidance was provided to assist partners in evaluating their demonstrations, no such assistance was made available for partners to implement their

technical measures. Early in the project, a decision was taken to allow partners the flexibility they needed to implement their demonstrations, as each partner approached SWITCH from a different position in terms of the intermodal infrastructure which was already in place in individual cities.

Partners were however encouraged to adopt sound project management techniques, including appointing a project manager to oversee the implementation of the measures and establishing a timetable for implementing the measures in light of the fact that certain measures may be dependent on the prior implementation of other applications.

Having implemented their demonstrations, partners provided information regarding both the positive and negative experiences of implementing the technical measures and demonstrating them under real-life conditions. These experiences were reported in Deliverable 6 – the Technical Report on Implementation and Demonstration – and are reflected in the conclusions and recommendations in Section 7 of this report.

4.3.6 Post Implementation Assessment

The post implementation assessment was based upon data collected through the course of the project. Comparison between the situation before and after the SWITCH implementation was carried out according to the methods defined in the Evaluation Plan, supplemented by interviews designed to assess if the expressed user needs had been met.

5 SWITCH MEASURES

5.1 Introduction

The European Commission's Green Paper *'The Citizen's Network'* (1996), indicates that efforts must be made to improve the effectiveness of existing modes of transport, including more appropriate pricing mechanisms, to integrate them and to promote exploitation of the respective comparative advantages. According to the paper,

'*The three most important elements of an integrated system are co-ordinated timetables, through-ticketing and multimodal terminals'*(1996:23)

It was recognised that the scope for improvement of interconnectivity between modes involves the physical design of interchange points and integration of passenger information and ticketing systems covering the whole of the journey. Within SWITCH, applications in all three areas were designed and implemented in order to achieve the project's primary objective; to promote and develop urban and inter-urban transport networks which support sustainability.

The three key areas addressed within the project were:

- **Information**
- **Integrated network development**
- **Ticketing**

5.2 Information

A range of passenger information facilities were implemented within the individual SWITCH demonstration projects. These included:

- Dynamic Trip Planning
- Dynamic Park and Ride Signage
- Enhanced Static Signage
- Real Time Information

These measures were intended to improve the quality of travellers' experiences of undertaking intermodal / multimodal journeys by increasing their certainty and awareness throughout the journey. Within SWITCH, it was considered important to provide travellers with assistance from before they leave home, through to their passage through an interchange point, and onwards to their final destination. The demonstration measures are summarised in Table 1.

Table 1 Summary of 'Information' Applications in SWITCH

City	Application
Dresden	Feasibility study into Real-Time Information
	Dynamic Trip Planning in Königsbrück
	Enhanced Static Signage in Königsbrück
Newcastle	Dynamic Park and Ride Signage at Heworth
	Real-Time Information for Metro at Heworth
	Extension of Real-Time Information for Metro to Gateshead Interchange
	Dynamic Trip Planning: Extension of Travelog System to Gateshead and Heworth Metro Stations
	Enhanced Static Signage at Gateshead and Heworth Metro Stations
Rotterdam / Dordrecht	Dordrecht Real Time Information Computer Installed
	Technical Design of Dordrecht Real Time Information for Fast Ferry
	New Central System for Park & Ride Guidance installed
	Technical Design of Dynamic Park and Ride System in Dordrecht
	Development of Park and Ride Promotion Strategy in Rotterdam
Venice	Information Kiosks, including software development
	Static signing update

5.2.1 Dynamic Trip Planning

In order to assist travellers in making decisions regarding their mode of travel and whether interchange is necessary / feasible, trip planning systems were developed in Dresden and Newcastle.

In Dresden, a new dynamic trip planning system was developed and the existing timetable database was updated and maintained. The database contained timetable information provided by operator members of VVO and was available via the VVO mobility offices and the VVO website on the Internet. Within SWITCH, the design of the VVO website was improved and the timetable information search facility was simplified in order to make the service more user friendly.

Similarly in Newcastle / Gateshead, an internet journey planning system was developed and installed at the travel centres located within Gateshead and Heworth interchanges. A website was established to enable passengers to plan their journeys by providing up-to-date multi-modal travel information. Staffed help desks were also introduced within Heworth and Gateshead interchanges to enable travellers to consider the options for the next stage of their journey.

A number of issues arose during the implementation of the trip planning systems which highlight the importance of inter-agency working. In the case of Dresden in particular, problems were encountered whereby different operators called stops by different names, which resulted in steps being taken to standardise the names of stops for entry into the database.

The trip planning systems developed in Dresden and Newcastle / Gateshead now provide travellers with the information they need to make informed decisions before they set out on their journey, including examining options for interchange to enable them to play a role in making their intermodal journey (theoretically) as seamless as possible. In addition, the systems in Newcastle / Gateshead enable people to reconsider or amend journey choices decided previously, to respond to changing operational circumstances.

5.2.2 Dynamic Park and Ride Signage

In order to encourage car drivers to reconsider the final stage of their journey into the city centre, dynamic Park and Ride signage was introduced in Newcastle / Gateshead. Two dynamic signs were installed on a by-pass prior to the turning for the park and ride site at Heworth interchange. The dynamic aspect of the site included a variable message sign to display information regarding the availability of parking spaces and comparative journey times via car, metro and bus to the city centre. The introduction of such a system is innovative as it provides comparative options based on journey times, to enable drivers to make considered decisions regarding whether to remain in their car or transfer to public transport.

In Rotterdam the new central P&R system was installed. Communication problems from the central system to the two dynamic P&R signs caused a delay, but the total system is expected to be functioning before summer. The dynamic signs display information about the availability of parking spaces at the P&R sites, and additional information on the frequency

of public transport. The modular approach of the central P&R system provided the opportunity to extend the number of dynamic P&R signs.

5.2.3 Enhanced Static Signage

Clear and uncomplicated signage was considered to be vital for guiding travellers through interchanges, to direct them from one mode of transport to the next. In Dresden, in order to enhance the existing signage and improve passenger orientation, a decision was taken to adopt a standardised information layout at all interchanges and the static signage system which had been developed by DB AG, the German rail operator, was implemented.

The adoption of a network-wide signage system was also explored in Newcastle / Gateshead. The existing static signs within both interchanges were improved to guide passengers easily through as they disembark from the Metro and transfer to bus, train, taxi or cycle. The signage was illuminated and colour coded to make the signs more distinctive and legible.

5.2.4 Real-Time Information

Two Metro information displays were installed on the bus concourse at Gateshead interchange. These displays were located at the top of the main escalators leading down to the Metro station in a position where they were visible to a large proportion of passengers using the interchange. The two displays – one for northbound and one for southbound Metro trains – indicated the final destination and time of arrival of Metro trains at Gateshead interchange.

Although the original intention was to provide a real-time system for bus services using the interchange, the Metro RTI system was considered to benefit more people and as a result was implemented within the project. The Metro displays were deemed to be so successful, that they will remain in place once the bus RTI system is installed following completion of SWITCH.

5.3 Integrated Networks

Truly integrated networks are achieved through the co-ordination and synchronisation of various public and private transport modes which work together as one combined system. Within SWITCH, the key objective of developing integrated networks was to achieve seamless journeys for passengers, whereby journeys which require interchange between modes are as simple and straightforward as journeys which only require one mode of transport.

The development of integrated networks within the individual city projects focused on the following measures:

- Infrastructure redesign of stations and interchanges
- Park and Ride development
- Pedestrian access
- Cycle access
- Improved vehicles
- Integration of taxi services

These measures are summarised in Table 2.

Table 2 Summary of 'Integrated Networks' Applications in SWITCH

City	Application
Dresden	Redesign of three interchanges to upgrade them to formal interchange transport nodes
	Park and Ride development
	Enhanced Pedestrian Access
	Enhanced Modal Integration
	Enhanced Cycle Access and Facilities
	Königsbrück Interchange completed
	Freital-Deuben and Dresden-Klotzsche interchanges - pre-design completed
Newcastle	Infrastructure Redesign to Gateshead Interchange
	Extension of Heworth Park and Ride Development
	Application of Bike and Ride Facilities at Gateshead and Heworth Metro Stations
	Application of Pedestrian Access, Egress and Flow Integration at Gateshead and Heworth Metro Stations
	Further Modal Integration of Taxis at Gateshead and Heworth Metro Stations
Rotterdam / Dordrecht	Fast Ferry / Enhanced Waterbus in Dordrecht and Rotterdam
	New Land and Water Interchanges in Rotterdam – design completed and installed
	Study into the Design and Potential Impact of Redeveloping the Central Station in Rotterdam
	Enhanced Cycle Parking & Facilities Implemented at Public Transport Interchanges in Rotterdam
	Cycle Parking at Public Transport Interchanges Study
Venice	Implementation of Fast Ferry Service

5.3.1 Infrastructure redesign

Stations and interchanges were redesigned in order to facilitate transfer between modes and improve waiting conditions and the overall travel experience (particularly the public transport experience) for passengers.

In Dresden, the objective of redesigning the station at Königsbrück was to remove existing parallel public transport services between Hoyerswerda and Dresden by providing an intermodal interchange at Königsbrück. A number of requirements were defined in advance which the final design had to meet. These included the need to minimise distances between modes within the interchange, and to avoid disadvantages for accessing and egressing passengers.

The core of the new interchange was a 100 metre long platform which was used by rail on one side. The other side had three bus stops which were integrated and could be served independently of each other. The resulting distance that passengers had to walk which changing from rail to bus or vice versa was 4.7 metres, which was undercover. Seats were provided on the platform which were sheltered with transparent walls on three sides. At both sides of the platform, the floor level was amended in order to ease boarding and alighting from vehicles.

In addition to the physical improvements to the interchange, operational changes were implemented. The urban trains from Dresden and the regional buses from Hoyerswerda in Königsbrück were terminated and it became mandatory for all services to stop at the interchange.

In Newcastle / Gateshead the existing layout of both interchanges was redesigned to improve safety, accessibility and bus operations. Bus stands were reorganised to enhance the access and egress of vehicles. Where possible, pedestrian and cycle access was also improved in order to minimise walking distances and improve accessibility to bus and Metro services. Adequate seating and lighting was implemented as an additional measure.

In order to provide a more tangible representation of the planned improvements, virtual reality models of both the existing and proposed interchanges were produced. The models were used during the User Needs Assessment and Design Validation process in order to obtain maximum input from both users and non-users based on the total interchange concept.

A Fast Ferry land – water interchange was developed in Rotterdam to connect the Rotterdam to Dordrecht ferry service with land-based transport systems. The vessels which were brought into operation on the fast ferry route were catamarans with the capability to carry both passengers (150 in total) and 20 bicycles, to encourage passengers to travel by bicycle to and from the fast ferry interchange. The choice of location for the fast ferry landing stage was based on the range of modes offered for passengers travelling to and from the ferry. The chosen location provided passengers with options including a metro station, a tram stop, a taxi rank and additional cycle parking facilities close to the landing stage.

In addition to the Fast Ferry project, two studies were conducted in Rotterdam examining the redevelopment of the Rotterdam Central Station area, which is to be integrated with the High Speed Train Station by 2010. The objective of the redevelopment scheme is to integrate all transport modes, including train, tram, metro, bus and bicycle, and to make optimal use of the

available space by integrating leisure and commercial uses. The SWITCH studies examined the attributes and conditions required for the redevelopment of the Central Station as a major mobility node for a range of public transport modes and other transport services, including taxi., touring car, car sharing, bicycle, scooters and cars (both owned and rented). The studies also assessed the accessibility of the new High Speed Train Station to private cars and the potential benefits to be achieved as a result of creating new parking facilities.

5.3.2 Park and Ride Development

At Königsbrück interchange in Dresden, a total of 50 Park and Ride spaces were provided within the interchange. They were located at distances of between 20 and 70 metres from the interchange platform. This was as a result of topographical factors making it impossible to locate parking closer to the central section of the interchange. The location of the P&R spaces at Königsbrück was intended to encourage intermodal travellers rather than attract non-public transport users.

The majority of spaces were reported to be occupied during the day which suggests that the P&R facility has been a success. Problems relating to misuse of the facilities were not expected, as the interchange is located some 600 metres from the town centre. However, the free P&R parking system will be monitored and if there is evidence that the system is being abused, or indeed demand for parking spaces exceeds supply, the integration of parking fees into the existing tariff system will be considered.

The Park and Ride site at Heworth was extended by 150 spaces to encourage a positive modal shift from car to public transport. The new ticketing system introduced at Heworth is discussed in section 5.2.4. The User Needs Assessment conducted within the project identified that users and non-users of Heworth interchange strongly supported the extension to the car park for the purposes of P&R and especially approved of proposed measures to improve security, such as lighting and CCTV. In addition, the increase in the number of parking spaces for disabled travellers was welcomed. Since becoming operational, the car park has operated at around 75% capacity, rising to 98% during November and December. Early indications were that this had had a positive impact on Metro patronage.

5.3.3 Pedestrian and Cycle Access

At Königsbrück interchange in Dresden, sheltered bicycle racks were installed for the storage of 30 bicycles. The illuminated shelters were designed according to the latest standards for secure bicycle storage. Any sheltering walls were made of Plexiglas in order to ensure full visibility of the stored bicycles and the shelter itself. The racks were situated adjacent to the old station building in an open area which is visible from all around the interchange.

Experience since the opening of the new interchange demonstrated the attractiveness of the facility to both users and potential users. The storage racks operate at between 30 and 50% capacity, although observations during the first year of operation suggest that interest in Bike and Ride is increasing. This example demonstrates that importance of providing for both present and future demand, as the provision of new facilities may well encourage non-users to consider cycling to an interchange and leaving their bicycle there, when they may otherwise not have considered it as an option.

In addition, the reconstruction of the interchange at Königsbrück took full account of the needs of passengers with reduced mobility. The platform level was adjusted to facilitate access to and from the trains and buses which serve the interchange. A ramp was provided at the southern end of the platform in order to provide easy access from the disabled parking spaces for mobility-impaired drivers.

Bike and Ride facilities were established at Heworth and Gateshead interchanges. This involved improving the existing cycle routes to and from the Metro and installing new cycle lockers to provide better security. During the User Needs Assessment, concerns were expressed regarding the location of the cycle lockers and the issue of security. Users and non-users felt it would be more appropriate to install the lockers in a position adjacent to the taxi rank in order to improve security. As it is not possible to carry bicycles (apart from the folding variety) on Metro trains, it was important to provide secure lockers to encourage cyclists to consider cycling to the Metro station. Four secure lockers were provided at each site.

In both Newcastle / Gateshead, cycleways were also established at main entrances to the interchanges, to link into the existing cycleways which comprise part of the adjacent highway network. Where necessary, shared footpath / cycleways were provided, specifically through a previously pedestrian-only subway linking Heworth long-stay car park with the interchange.

Pedestrian access was also improved at the interchanges. Crossings were introduced and improved, which were painted green in order to differentiate the crossing from the carriageway and to encourage passengers to cross at the designated crossing points.

In Rotterdam, cycling is an important mode of transport used by a significant proportion of the population. A large number of enhanced bicycle parking facilities were implemented at a range of public transport locations in the city. In effect, these locations formed the link between public transport and the use of bicycles to travel to and from such services. Two main varieties of facility were introduced – the tulip stand and the special fences to which bicycles can lean. The bicycle parking facilities implemented within the project were well received and had achieved a 100% occupancy rate during the day prior to the end of SWITCH.

In order to assess current provision and future cycle parking needs at public transport locations, an inventory was created within the Rotterdam city boundary. An action plan was produced which formulated basic assumptions to which cycle parking must comply, particularly facilities at public transport locations. These included cycle parking being situated as close as possible to the entrance, sheltered parking facilities being provided at public transport locations with long-term parking provision, and parking facilities not interrupting the main footpath to the interchange. The study revealed that the positioning of facilities and the level of security, as well as a range of other factors are important to encourage cyclists to bike and ride to and from public transport interchanges. Many of the finding of this study have been incorporated into the guidelines in section 7 of this report.

5.3.4 Improved Vehicles

In Venice, a fast waterborne transport system was implemented connecting the Marco Polo airport to Fondamenta Nuove (the historical centre of Venice). An innovative new boat was developed to provide this connection. The fibreglass boat was developed and obtained permission to operate as a public service vehicle during SWITCH. The new fibreglass boat was similar to the traditional waterbus in terms of its general design, although the use of fibreglass ensured that the boat weighed less than a traditional waterbus and as such, was capable of faster speeds with reduced wave motion. The new waterbus was able to carry 124 passengers and travel at speeds of more than 25 km per hour.

5.3.5 Taxi Integration

Although both Gateshead and Heworth interchanges possessed taxi ranks prior to SWITCH, both were located at the outer edges of the interchanges. The User Needs Assessment revealed that in general people felt that the taxi facility required a higher profile status, particularly due to their peripheral locations. Within the project, both ranks were promoted and at Heworth, a new taxi rank was developed which was further integrated with the interchange. Improved signing to the taxi ranks was implemented within the interchange buildings in order to alert travellers to their existence and promote their usage. The new rank at Heworth was provided with a canopy to ensure that travellers awaiting the arrival of a taxi are provided with shelter from the elements.

In order to make the transition from Metro or bus to taxi more straightforward, a free telephone facility will be implemented immediately after the SWITCH project. This service will enable passengers alighting from the Metro or bus to summon a taxi for their onward journey.

5.4 Ticketing

Ticketing is an essential component in transport network development and is especially important in complementing and encouraging multimodal journeys. Integrated payment systems are designed to increase the connectivity of public transport services, increasing efficiency and convenience of payment and reducing the time to undertake a journey. The passenger's journey, which may require transfer from one mode to another, can be treated as one journey with a single ticket. Partners used ticketing as a means of encouraging travellers to leave their car in a secure car park and transfer onto public transport without the need to purchase multiple tickets to do so, which can act as a deterrent to drivers.

The ticketing applications in SWITCH, all of which were based on integrated Park and Ride ticketing, are summarised in Table 3.

Table 3 Summary of 'Ticketing' Applications in SWITCH

City	Application
Dresden	Associated Study to Evaluate the Impact of an Integrated Ticketing System and the User Benefits
Newcastle	Application of Joint Park and Ride / Metro Ticketing System at Heworth Park and Ride Site
Rotterdam / Dordrecht	Application of Park and Ride Ticketing System at Two Park and Ride Sites in Rotterdam – technical design completed, including the new infrastructure layout for the sites. Preparations for installation are underway.
Venice	Park and Ride Application on Smart Cards
	Installation of Card Readers

At Heworth Park and Ride site, an integrated ticketing system was introduced to enable car drivers to purchase a combined ticket for parking and travel by Metro. The combined ticket removed the need for car drivers to enter the Metro ticket office to purchase a ticket. The User Needs Assessment identified additional measures which would improve the proposed ticketing system and requested a system which is easy and convenient to use. Potential users specified that a smartcard or a facility which provides change was desirable, together with information regarding use of the ticketing machines.

Two ticket machines were installed at Heworth car park which provide a single ticket for parking only and a dual ticket for parking and return travel to Newcastle City Centre via the Metro.

In addition to the standard Park & Ride ticketing system that was introduced, a car parking permit scheme was introduced at Heworth car park, which was designed to encourage car sharing by offering travel discounts and guaranteed parking spaces. Sixteen bays were allocated for the project. The system involved the applicant purchasing a permit parking bay and a MetroSaver ticket. The permit guaranteed a car-parking bay between the hours of 7am and 7pm, Monday to Friday throughout the week including Bank Holidays. The MetroSaver ticket offered unlimited travel on the Metro between Heworth and Newcastle city centre. It was possible to share the permit between any of the applicants' cars, as long as the vehicles to use the space are declared in advance. In order to encourage car sharing, the driver and each additional passenger were able to purchase a MetroSaver permit for £15 less than the standard price.

In Venice, it was recognised that an integrated ticketing system was required, as occasional travellers, mainly tourists, experienced difficulties understanding where, how much and how to pay for parking and where to find the waterbus stop. Six new automatic smart card dispensers were installed; two at the Piazzale Roma car park entry gates, two at the exit gates, and the remaining two at other locations within the car park. Drivers arriving at the car park were issued with a smart card from the dispenser which may be used both for paying the car parking charge and for accessing public transport. The smart cards were preloaded with certain tickets / services to reduce queues and waiting time for travellers arriving into Venice, while other tickets / services could be purchased directly from other points of sale in Venice.

In Rotterdam, an integrated ticketing study was undertaken, examining the potential for introducing such a system at the Alexander and St. Franciscus Park and Ride sites in the city. These sites had high occupancy rates as a result of customers using the parking facilities but not using the public transport system. A ticketing system to be designed would distinguish between 'real' Park and Ride users (those who park their car and transfer onto public transport) and customers who only park their cars. Preparations are underway for installation of the system. Parking fees were to be imposed on car drivers who simply park their cars, whereas those who parked and transferred onto public transport would have free access to parking facilities. As was the case in Dresden, this situation would be reviewed and plans were developed to tackle misuse of the facility should it arise.

6 RESULTS OF THE EVALUATION

6.1 The Evaluation Experience

The three-stage evaluation process described in Section 4 was a new experience for the SWITCH partners. Traditionally, transport authorities and service providers have viewed evaluation as a method of confirming (or otherwise) that their design experts' opinions had devised a scheme that benefited the organisation and the travelling public. By changing the focus of the evaluation process from the outset of SWITCH, this traditional approach has been challenged.

SWITCH set out to demonstrate that intermodal urban and inter-urban transport systems could be significantly enhanced through the implementation of a number of improvements to three technical areas. This restricted the measures implemented by the cities, but did not restrict the areas in which user needs and opinions have been investigated. By putting user opinions regarding the three pre-defined technical areas in the context of other measures which could improve the intermodal transport system, conclusions have been drawn not only about the success of the SWITCH measures, but also about how they could be combined with other improvements that fall outside the realms of information, ticketing and network integration. This provides the opportunity to further improve intermodal transport systems through the optimum package of measures.

User Needs Analysis

The concept of actually asking transport users in detail about their needs was a new experience for many of the SWITCH partners and was judged to be a particularly valuable process that helped target the SWITCH measures and will assist developments in the future.

Many of the factors that were shown to be important to users are likely to be common to all intermodal transport systems across Europe. However, cultural differences, differences in national regulations and variations in the provision of different types of transport within a city's transport system mean that the results of the user needs are not guaranteed to be 100% transferable. Nonetheless, the indications from the detailed SWITCH user needs analyses do provide a useful and wide-ranging start to this process, which can form a basis for the majority of cities across Europe. In order to complete the picture of local user needs, cities would need to conduct analyses which focused on local issues. The most widely applicable way of investigating such local issues would be through focus groups. The focus groups should follow the guidelines laid down in the SWITCH Evaluation Plan and include a true sample of the local population rather than focusing on interest groups and people who have strong, fixed opinions.

Design Validation and Verification

The design validation and verification process provided internal quality control, and determined user acceptance and operational efficiency. Design validation is normally a brief, technical stage of the project process where the designers take a step back and consider if the final design is likely to succeed in meeting the objectives set out at the start of the process. As such, it would not be included in the evaluation process. However, by checking that the

users actually considered that their needs would be met by the design, SWITCH incorporated a feedback loop that helped to optimise the project output.

Traditional methods of consultation at the design stage have been based around table-top models, artists' drawings and photographs of similar measures in other locations. These methods are difficult for the public to visualise and give a true opinion about. Clearly they cannot provide a picture of how separate elements of an interchange upgrade combine to ease a passenger's passage through the interchange. The use of a virtual reality model in the design validation stage of SWITCH proved very popular with the public in helping them to visualise the proposed design changes, and should be considered as a useful addition to projects where user input is truly valued.

Post Implementation Assessment

The two-year timescale of the SWITCH demonstration made it very difficult to conduct a reliable, quantitative assessment of the project measures. The timescale proved barely enough for the design / planning and implementation phases, leaving little or no time to collect post-implementation data for many of the applications.

The growth in patronage of the Heworth Park and Ride site following expansion of the car park at a relatively early stage of the project provides a useful lesson in this respect. Although the extension of the Park and Ride site was the subject of a strong promotion campaign and the measure was welcomed, its impact in terms of patronage took several months to manifest itself. The full scale of the impact is unlikely to be felt until 18-months after implementation. This suggests that if realistic assessments of project impacts are required then sufficient time should be built into the project timescales after implementation, in order to allow for data collection and analysis.

6.2 Individual City Evaluation

6.2.1 Dresden

Basis for Evaluation in Dresden

The evaluation in Dresden was focused around the planned implementation of measures at three regional interchanges. In practice, implementation at Dresden Klotzsche and Freital Deuben was delayed and the final stage of evaluation focused on the impact of the improvements at Königsbrück as well as the evaluation corridor that links both the Königsbrück and Dresden Klotzsche demonstration sites to central Dresden.

Surveys and Methodology

The previous experiences of VVO (Verkehrsverbund Oberelbe) show that people invited to discuss their general opinions about public transport are not really representative of the people living in the region. VVO has also found that it is especially difficult to learn about the opinions of people that are non-enthusiastic users or non-users. VVO's preferred method was to run household interviews. Their advantage is that the sample is chosen purely by chance and thus represents users and non-users against the background of the existing mix of

ages, social groups, gender, etc. In order to compile information about user needs VVO relied on two surveys that have been carried out recently but not within the framework of the project itself:

- A study regarding individualised marketing in public transport;
- A study regarding user acceptance of public transport services in the VVO region.

The individualised marketing study consisted of two surveys and promotion campaigns aimed at identifying the potential impact of improved and tailor-made public transport information. The second phase of the experiment showed an increase in public transport use of 2% among those who had received individual public transport information compared to the fresh sample, confirming the impact that an effective information strategy can have.

The user acceptance study was mainly aimed at analysing the recently implemented integrated public transport ticket and tariff system. Emphasis was placed on identifying trends in user needs to ensure that the public transport services are kept as up-to-date as possible. Concern stemming from the unreliability of bus services towards Dresden, which suffered a great deal as a result of congestion within the city boundaries, prompted a decision to provide regional public transport services on a rail link into the city, as rail is considered to be a more reliable mode.

Design validation at the test sites ensured that the designs met the German technical standards for interchange infrastructure and accessibility. After technical approval of the design the consultation was undertaken with the responsible authorities, operators and general public. In a public event close to the interchanges in question, the new design and expected impacts were introduced and discussed and any feedback was taken into account during the development of the final design.

Results and Analysis

The key lesson learned by VVO from the user needs surveys was the role that operational integration plays at regional interchanges. In order to develop a truly intermodal transport system, attempts should be made to make the system work as a whole.

The revised timetabled journey time between Hoyerswerda and Dresden of 115 minutes is longer than the previous rail journey time but shorter than the previous timetabled bus journey, and is no longer subject to the severe delays at the latter stages of the journey due to traffic congestion. The time allowed for interchange between bus and rail at Königsbrück has been reduced from 5 to 2 minutes. This reflects the greater emphasis placed on ensuring a truly intermodal journey. The observers noted that the punctuality of trains and buses has improved after the re-design of Königsbrück under the revised service schedules.

As a result of the individualised marketing survey a large amount of information was requested by households which already included at least one public transport user. This suggested that the usual distribution channels are not meeting the needs of the public. In the future higher quality journey planning information for the whole network will have an increasing priority. In order to improve the intermodal transport system it is crucial to approach all aspects from an overall network point of view, rather than adopting a line or route-based approach.

Overall energy consumption on the evaluation corridor has increased due to the increase in rail transport along the corridor and the greater energy consumption of trains compared to buses. However, energy efficiency has also improved as this increase has been outweighed by an increase in passenger kilometres along the corridor.

6.2.2 Newcastle

Basis for Evaluation in Newcastle

One of the major areas of traffic congestion in Tyne and Wear is where traffic is funnelled into and out of Newcastle over the bridges of the River Tyne. A potential opportunity exists to reduce car movement from Heworth through Gateshead and into the city along this busy corridor. SWITCH has aimed to fully utilise the potential of Heworth Interchange to capture car drivers who currently drive into Newcastle and transfer the final element of their journey to public transport. Additionally, improvements to Gateshead Interchange, which lies directly opposite the City of Newcastle on the corridor, can also be made a more attractive site for public transport users.

Surveys and Methodology

User needs assessment in the Newcastle area was a two-stage process. The first stage involved detailed discussions with local people in a number of focus groups to gain feedback on the existing transport situation at the demonstration sites. The key issues raised in the focus groups were then assessed using questionnaires at various sites in the vicinity of the demonstration sites. As such the questionnaire provided a test for the findings of the focus groups based on a larger sample of opinions, so ensuring a robust input to the design phase. The questionnaires were also repeated at the end of the project, as part of the post implementation evaluation, so providing a quantitative assessment of how attitudes have changed as a result of SWITCH.

Prior to participation in the focus groups the participants were asked about their transport patterns and general attitudes to travel related issues. The following list includes the highest priorities for potential improvements suggested by the respondents:

- Better static signs
- Improved pedestrian access
- Improved P & R facilities (including combined P&R tickets)

In contrast, there was little enthusiasm for the improvement of cycle facilities in the form of cycle lanes or secure lockers.

The questionnaires were organised to collect the opinions of users and potential users of both Heworth and Gateshead interchanges. They enabled a detailed analysis of user needs in relation to the interchange as well as providing useful feedback on user satisfaction in comparison with a repeat set of interviews conducted after implementation of the project.

The use of a virtual reality video image of the interchanges, incorporating the elements of the redesigned infrastructure, received a positive response as it gave the participants a better idea

of where the improvements would be situated within the interchanges and how the positioning satisfied their needs as they negotiated the interchange. This method could form a key element of future consultation exercises as the design process nears a conclusion, to help ensure an acceptable outcome.

Results and Analysis

The response to the questionnaires suggests that travellers were not aware of the potential improvements that could be made to the interchange layout and infrastructure until they were presented to them. Up to this point travellers appeared reasonably satisfied with the interchange, but then welcomed the proposed measures and acknowledged the potential for improvement. The after surveys indicated that there was satisfaction with the improvements that had been made to the Heworth P&R site as well as some of the individual signing measures, but that in other cases there was a feeling that the measures had had a lesser impact than the travellers had expected. In particular there were significant increases in the ratings given to the following factors as a result of SWITCH:

- safety from buses due to segregation of pedestrian access routes;
- ease of walking through the interchange due to improved signs and organisation;
- transit times through the interchange due to improved signs and the option for integrated P&R ticketing;
- the ease of finding a taxi;
- availability of facilities.

However, security at the interchanges remains of great concern to travellers.

It is worth noting that just over 50% of drivers interviewed at Heworth suggested that the P&R improvements at Heworth would definitely or possibly be influenced to change to public transport. Data relating to passenger movements along the evaluation corridor confirmed it to be an extremely busy route into Newcastle. Vehicle counts on the road were between 1,400 and 2,000 vehicles per direction per hour in the peak periods. When combined with public transport patronage observations the following data was estimated for the number of passenger kilometres by mode along the evaluation corridor:

Bus	61452
Metro	98442
Train	12800
Total	172694

The potential modal shift indicated by the survey results would be massive compared with the P&R site capacity. Patronage data was collected at the P&R site during the course of the upgrades and showed that there was a steady increase both in overall site use but also in the proportion of travellers purchasing the combined tickets. Ticket sales within the interchange remained constant, indicating that there was an increase in public transport patronage along the evaluation corridor, which resulted in modelled reductions in the environmental impacts of travel along the corridor.

In comparison with the total passenger flows the increase in P & R patronage is relatively minor. However, it does emphasise that the potential for modal shift is present if the correct measures are implemented and that a wider application of the P&R policy could have further benefits. Analysis also suggested a positive financial impact from the investment in the P&R measures when the full range of external impacts (e.g. congestion, health impacts and road maintenance) were included in the analysis.

6.2.3 Rotterdam

Basis for Evaluation in Rotterdam

Project assessment has been carried out at the qualitative level for each application that has been implemented, looking at the user needs and how they were met. Where implementation has not proved possible during the SWITCH project timescales, every effort has been made to estimate user satisfaction with the eventual implementation and carry out the intermediate design validation exercises. Quantitative analyses were conducted along the transport corridor between Dordrecht and Rotterdam which is served by the new fast ferry service and an analysis of a combination of the possible Park and Ride measures was conducted on a generic Park and Ride corridor.

Surveys and Methodology

The overall aim of the user needs assessment was to investigate travel behaviour, attitudes, motivations, needs and expectations in Rotterdam. This has been conducted using a diverse range of methods for a number of transport options. The full range of combinations included in the Rotterdam qualitative assessment was as follows:

Measure	**User needs study**
Park and Ride integrated ticket system	User needs workshop
Park and Ride promotion	User and non-user questionnaires
Cycle access to interchanges	Action plan for cycle parking in Rotterdam
Central station re-design	Study into the access and interchange needs of users
Fast ferry	Two feasibility reports prior to inception

Many different recommendations relating to the three SWITCH technical areas as well as issues well beyond the scope of SWITCH were highlighted by the user needs assessment. Some of the more common and important issues were:

- Improve accessibility to interchanges and vehicles.
- Ensure proper information availability at all times from before the journey, when negotiating particular elements and for onward connections.
- Improve security and facilities such as staffing and lighting that impact on this priority area.
- Ensure information formats are clear and consistent.
- Improve quality of all aspects of the transport system.

Design validation was carried out separately for each application in a manner specifically chosen as being appropriate to the application. In some cases this was limited to a technical review of how the system would operate, taking on board the comments received during the focus groups and other prior consultation exercises. More interactive design validation in comparison with the user needs was possible in a limited number of cases, but in others (e.g. Park and Ride infrastructure and quality of facilities) it was limited to an expert assessment of the improvements needed. In all cases the technical assessment was an essential part of this stage and in the case of the dynamic signing system, highlighted problems in communication between existing systems that required extensive reconfiguration of the system.

Results and Analysis

Analysis of the combined park and ride ticket system, in conjunction with the directional dynamic signing, suggested that these two measures could have a significant impact in raising awareness and patronage of the P&R sites by travellers who wished to use public transport for their onward journey, rather than allowing the P&R car parks to be filled with people who are merely using the facility as a local car park. Analysis of the environmental impact of this measure showed a modest impact on the single route into Rotterdam that was chosen for modelling, but implementation on a wider scale could result in significant benefits.

The user needs assessment of cycle facilities in Rotterdam has highlighted that cycling is one of the major modes used to access transport interchanges in the city and so cycle parking should be given higher status at interchanges with secure cycle parks in preferential locations close to the major entrances becoming the norm.

Implementation of the fast ferry service between Rotterdam and Dordrecht has, in general, been welcomed by its users. Over 50% of the passengers either used to travel by car prior to the implementation of the ferry service or would have made the journey by car had the ferry not been an option, indicating that it has been very successful in achieving a modal shift from private transport. Some operational problems caused by the wake of the boat on existing users of the channel have resulted in the slowing of the service so that it cannot operate to the service specification originally envisaged. This has resulted in lower patronage than original forecasts in spite of the positive user reactions. A financial review of the service has assessed the future patronage levels required for the service to remain viable and the operators appear confident that they can meet the required passenger numbers.

Estimates of the impact of the fast ferry show savings of around 1 - 2 % in total energy use, reductions in emissions and improvements in congestion along the evaluation corridor between Rotterdam and Dordrecht. The exact impacts will depend upon the exact number of existing car drivers who are attracted to use the service. Improved connections at both ends of the fast ferry route would improve the potential to attract passengers from a wider catchment area and further increase patronage.

6.2.4 Venice

Basis for Evaluation in Venice

The SWITCH project in Venice focuses on providing an upgraded link between the city and the airport. The two alternative routes between the airport and the city (road / rail and upgraded ferry link) have been combined to act as a focus for the evaluation. An analysis of the extent and quality of the public transport connections revealed a significant difference in travel times between the land-based and water-based systems. Bus travel times were around 20 minutes compared with travel times of over an hour for existing water-based services. However, the two types of transport are located in opposite parts of the city and therefore tend to serve different users. Car travel appeared to have around 50% of the market for access to the airport, with buses having the majority of the rest (approximately 700 passengers per day) and waterbuses carrying 200 passengers per day.

Surveys and Methodology

When it came to evaluating user needs, the partners in Venice had their own particular set of problems due to the high proportion of tourists present in the city. The Venice SWITCH decided to carry out user needs assessment and design validation using a mixture of techniques including:

- existing survey data (airport user satisfaction survey and quality of the existing bus service),
- surveys implemented specifically for SWITCH (public transport, parking and integrated ticketing user needs studies).
- an expert Delphi study.

Results and Analysis

The surveys confirmed that the range of existing transport options is judged relatively positively overall and thus provides a good basis for an enhanced intermodal transport system linking the whole of Venice to the airport. The surveys identified areas of potential development needed in the transport system and the critical points for improvement in the transport interface between the island of Venice and the mainland:

- improving the level of comfort of water-based transport;
- overcoming the rigidity determined by the low number of destinations and possibilities for interchange;
- improved quality of information about destinations and routes;
- attention to the journey cost;
- the availability of ticket purchase points and a strong demand for integrating the costs of car parking and vaporetto travel.

In particular the possibility of integrating car parking and vaporetto travel received a positive judgement. The proposals for integrating parking with museum visits or payment for purchases received an overall indifferent response. However, the mean score hides the fact that a relatively high percentage were in favour of the idea.

This suggests that there are two types of demand:

- a percentage of clients parking for short periods of less than 3 hours with a demand for limited integration between car parking and vaporetto only;
- a percentage (consisting not just of tourists) parking for more than 24 hours and expressing a high degree of interest in the possibility of integrating the costs of car parking, vaporetto travel, museum admission and purchases.

The Delphi analysis, conducted by a panel of experts, confirmed the need to improve aspects of network integration, ticketing and better differentiation between the needs of tourists and residents to improve the quality of the overall system. This analysis shows that the controlling forces for transport in Venice agree with the general sentiment expressed during the user needs assessment and will ensure that these factors are incorporated in the final designs either within SWITCH or future implementations. In particular, the Delphi analysis focused attention towards improvements in the timetable and route information at Piazzale Roma, the airport and Fondamenta Nuove. It also highlighted inadequacies in the existing waterbus services with the airport which should be overcome by the new fast boat link.

The new fast boat service between Venice and the airport was demonstrated at the very end of the project. Therefore it was only possible to conduct a brief assessment of its performance. Levels of user satisfaction were generally high, especially in terms of quality and how well it was integrated into the overall transport network. There were also indications that it had the potential to induce a modal shift away from road based transport. The service has a potential advantage over land-based transport for visitors due to the "fascination of crossing the lagoon by boat", with 47% of respondents indicating that this was the best means of transport, although not necessarily the fastest.

The overall environmental impact of the service will depend upon how successful it is in attracting passengers and this information will only become available when the service has had time to develop a strong profile. An estimate of the possible impact of the fast boat service showed that it would need to attract around 20% of the car journeys currently made to the airport in order to have a neutral overall impact. The full set of assumptions used was as follows:

- the new service operates 25 times each day between the airport and Fondamenta Nuove;
- all existing public transport services are maintained at the same frequency after the new service starts operating;
- the new service succeeds in attracting 20% of car journeys previously made between Venice and the airport (including taxi journeys);
- the new service attracts an average of one person per trip from other public transport journeys previously made between Venice and the airport.

Clearly these assumptions are arbitrary and the actual impact will depend on many things including journey pricing and service times. However, the estimates do provide a starting point to demonstrate the possible environmental impact of the service.

6.2.5 University of Pardubice

Introduction
Following a detailed analysis of intermodal transport in the Czech Republic, four main barriers to its introduction were identified. These barriers must be overcome in order for co-operation to begin between operators. The barriers were:

- subsidy allocation system - there are defined rules concerning subsidy allocation for operators of general services there are no such rules for intermodal (integrated) transport
- mutual relationships of different operators - Operators mainly work as competitors (or at least they perceive themselves to be competitors) and so it is rarely advantageous for them to co-operate
- legislative framework - Intermodality is an area that is not covered by any legislative acts. Although intermodality and the need for it is mentioned in strategic national transport documents
- Czech Railways - The Czech Railway is very inflexible in providing services for journey connections, making the establishment of an intermodal system within and especially between cities difficult

Information
All operators in Hradec Králové and Pardubice have their own information systems. These systems are not connected and they are not all available at every location. Czech railways and the City Transport Company of Hradec Králové have websites which contain relevant information. Detailed information about all the operators was not available previously. This situation is not ideal for the customer, as without a single database detailing all timetables, it is difficult to obtain journey information, particularly for more than one transport mode or operator.

Integrated Networks
Hradec Králové is currently addressing problems associated with the relocation of the bus station. The tendering procedure will be organised in the near future and the final date of the construction is expected to be 2003.

The railway station in Hradec Králové is located close to the town centre. There is a bus station providing suburban and regional bus services, within a short walking distance. Long distance and international buses and city transport however stop directly in front of the railway station. This is considered to be an advantage for the development of an intermodal transport system.

The railway station in Pardubice is also situated relatively close to the town centre and is directly connected with the city transport system. Currently the reconstruction of the bus station is under way and this is within three minutes walking distance of the railway station.

Historically, due to the preference for public transport over individual transport during the socialist era, most cities are in close proximity to railway and bus stations. This is definitely an advantage for creating an intermodal transport system.

Both towns have a shortage of parking spaces close to bus and rail stations. The situation has been addressed in Hradec Králové by the construction of parking spaces for railway

customers, although the capacity is not adequate. The same situation exists in Pardubice where the number of parking spaces is limited. In Hradec however, there is space to build additional parking places close to the new bus and railway station.

Cycling is probably the most popular transport mode in both cities. According to statistics, both towns have the highest density of cycles in the Czech republic. Cycle parking however is not sufficient. Another important issue to be addressed concerns the security of cycles left at the parking places.

Ticketing
For users of public transport within and between the two cities, it is necessary to have different tickets (one for Hradec Králové, one for Pardubice, one for rail use and a different ticket for bus connections between the cities).

Another disadvantage was the way in which fares are calculated. All tickets are single journey tickets, and only valid for one trip. Once the ticket is stamped on the bus it is valid for this bus only, and if the passenger changes buses they have to buy a new ticket. In some towns "time restricted tickets" are in use, where the ticket is valid for a limited time from when it is first stamped. It was considered that such a system would also be suitable for Hradec Králové and Pardubice.

Hradec Králové possesses 2 tariff zones, which is an advantage when compared to Pardubice which has a flat fare system.

Focus Groups With Operators, Public Authorities, Users And Non-Users
As a result of discussions it was confirmed that there was strong support for creating an integrated transport system in Hradec Králové / Pardubice. Finance was considered to be the most significant barrier to achieving this at the present time. This was confirmed by all groups questioned.

The responses of the focus groups in general were:
- public transport is more favourable to individual transport for 44% of people questioned because it is cheaper;
- individual transport is preferred to public transport by 57% of people questioned because it is quicker;
- almost 35% of those questioned said that price and convenient timetables (33%) would encourage them to use public transport in the future;
- if the relationship between fares for individual and public transport was 2:1, 30% of passengers questioned would be willing to change from individual to public transport.

The most important problems were perceived to be:
- low frequency on the routes (31%);
- co-ordination between timetables (25%);
- reliability (delays) (16%).

Problems relating to information were as follows:
- lack of information (70%)
- uncoordinated information systems (30%)

The main problem related to network integration was:
- poor interoperability of services (52%)

A partial solution on the road to a fully intermodal transport system was considered to be the improved co-ordination of different transport services.

In the areas of information and ticketing, suggested improvements focused mainly on electronic information systems (39%) and a single ticketing system whereby tickets are issued automatically (65%).

Design of an Intermodal Solution
Based on the focus group discussions, an agreement was made by the public authorities and operators, to prepare a proposal for a model indicating how an intermodal system would work. Based on this proposal different parties can make the decision as to whether or not to enter the agreement.

The proposal for a model should covered the following activities:
- single information system;
- single ticketing (the presumption being that a clearing system acceptable for everybody will be developed);
- time limited fares;
- market entry by external operators on the city transport routes.

The ideas raised during individual and group discussions were incorporated into the design of an intermodal solution for public transport in the region. Basic measures that should be implemented in the proposed system were considered to be:
- the establishment of a co-ordinator;
- the implementation of shuttle timetables on interurban lines;
- the implementation of time limited tariffs instead of a single journey ticket;
- improved information provision.

6.2.6 City of Pilsen

Introduction
The research undertaken in the City of Pilsen focused particularly on interchanges, bicycle transport and its integration with other transport modes, and parking, especially the Park and Ride and Park & Go systems.

The issues which were considered in Pilsen were the no. 106 bus service and the issues of integration between a range of modes, including cycle, bus, rail and car.

Currently, the public transport system in Pilsen comprises trams, trolley-bus and bus networks. All three systems operate independently, without any co-operation between operators.

Cycling
Cycle use stands at 2% in Pilsen and the conditions for developing cycling are not currently favourable. Attempts are therefore being made to encourage the integration of bicycle

transport and other transport modes in order to demonstrate the advantages. The market research conducted within SWITCH revealed interesting findings supporting the idea of integrating cycling with other transport modes. Little attention has so far been paid to this issue in the Czech Republic and consequently, it was particularly interesting for Pilsen to benefit from experiences in other SWITCH partner cities.

The greatest opportunity for combining cycling and public transport is in satellite villages near Pilsen that have poor rail and bus services. To encourage integration, final stops on public transport routes should be equipped with bicycle storage and shelters.

Another positive step would be to allow bicycles to be carried on public transport vehicles. This is currently problematic since the combination of overcrowded vehicles and legislation make it practically impossible to carry bicycles on trams, trolley-buses and buses. At the present time, all major train stations offer the opportunity to deposit bicycles in the left-luggage office. Some stations are also equipped with bicycle shelters.

The City of Pilsen is committed to promoting bicycle transport. New cycle tracks are being built, work on a signage system for cyclists has started, market research into user and potential user needs has been carried out and the "Development Plan of Cycle Tracks in Pilsen" is being prepared.

Nevertheless, links between cycling and other transport modes to encourage intermodal trips have so far been neglected. This is one aspect that has made SWITCH very valuable to Pilsen. The important task is not to satisfy all intermodal requirements of bicycle transport immediately, but to consider them in planning the cycling system in Pilsen and the region, so that bicycle transport can be linked with other transport modes in future.

Park and Ride

A survey was conducted as part of SWITCH, to identify the potential for introducing and improving a Park and Ride system in Pilsen. The survey results showed clearly that the Park and Ride concept was not well known in Pilsen - only 5% of respondents were aware of P&R in Pilsen. In addition, the majority of the respondents considered that P&R was not suitable for Pilsen, with only 23% thinking that it should be introduced.

Nevertheless, the respondents were asked their views on what circumstances would encourage use of a Park and Ride site. The majority favoured secure (staffed) parking places and shorter intervals between the linked trolley bus services, with preferential charges for parking and riding and improved parking guidance signage being considered less important.

Limited financial resources, legislation and the Park and Ride study deadline restricted the implementation of possible improvements that were identified in the survey. The only improvement to the P & R system that was taken up during the course of the project was improving the parking guidance signage. P & R signs were placed at the side of main roads into the city and directly at the sites.

Conclusions

In the City of Pilsen and other Czech cities, there is currently no incentive to Park and Ride as there is adequate parking in the centre of the cities. However, care should be exercised for the future, as provision of 'Park and Go' sites at the edge of city centres may well have a negative effect in terms of encouraging motorists to drive rather than to consider public

transport alternatives. Against the present background of poor administrative structures and lack of investment in quality public transport, cities such as Pilsen should make every attempt to consolidate and increase their current levels of public transport use, by continuing to research and develop the potential for intermodal transport networks.

6.3 Key Results

The key results relating to the three SWITCH technical areas from the combined experiences of the SWITCH cities are summarised in the following sections.

Information Systems

The provision of transport information has relevance at many levels. Within SWITCH issues were raised about the following:

- provision of information concerning the overall transport network in an area;
- information about individual modes within an overall network;
- information concerning access routes to an interchange;
- information about the location of particular modes and facilities within an interchange;
- directional information within an interchange;
- the format of information within interchanges to help disadvantaged groups;
- information about specific arrival and departure times.

The above points can be classified into three groups:

- information available to the traveller prior to a journey, e.g. at home;
- information that helps link the various journey stages into a single seamless journey;
- information that helps the traveller to negotiate specific elements of the journey.

Information within all of these groups was addressed in SWITCH.

Information Provision Prior to Journey

The user needs analysis in Dresden identified the need for widespread access to this information as an easy way to influence mode choice without any changes to the existing transport system. By providing this information as part of their user needs study they were able to influence travel choices prior to implementation of other measures. Without the provision of this basic information, people lack the ability to make fully informed decisions about their journeys.

Information that is available prior to the start of a journey can be made available in many forms, including:

- Simple network maps and route timetables supplied in hard copy to people's homes;
- Telephone helplines with the ability for journey planning;
- Interactive electronic journey planning facilities.

This is in contrast to the provision of information at interchanges, which proved to be only partially successful because people need to be committed to the journey before they access it. This was revealed by the low number of people accessing the journey planning possibilities provided at Gateshead and Heworth interchanges.

The more advanced methods of information supply were successfully implemented and well received in Newcastle, Dresden and Pilsen. The most popular method currently appears to be

by phone, but will probably become via the internet once a greater proportion of people have access to it and become more used to the possibility. It is of course essential that all transport modes on offer in an area are included within the information system.

Information Provision Leading to a Seamless Journey

Clear directional information must be provided at all locations where a choice needs to be made. This applies both within an interchange but also on the road network when, for example, accessing a Park and Ride site. Further information should be provided at locations between junctions to help confirm that the choice made at the last junction was correct. The format of the information should be clear and simple. The use of standard symbols and colour coding will help people who are following particular paths through an intermodal network.

The more advanced systems mentioned above, that provide journey planning information in the home, help in this as they can provide information about all legs of a journey as well as details of any changes needed.

The provision of full journey information on a ticket was requested by travellers in Rotterdam as a method by which they could be sure of having this information to hand at all times.

Consistent formatting of information throughout a network in the form of symbols, colour coding, typefaces etc helps to reinforce this in the minds of the travelling public. From the Newcastle user needs study it appears that most travellers are satisfied with the standard of information available within the existing interchanges until they are presented with examples of best practice. At this point they realise that significant, but simple, improvements are possible with little extra initial effort and their expectations are increased.

Dynamic Park and Ride signage provides a good example of this as it can ensure that people are aware of where empty car parking spaces are located prior to leaving the main road. The possibility of interrupting their journey only to find a full car park was one of the key deterrents to Park and Ride use quoted in Newcastle prior to SWITCH.

Information Regarding Specific Elements of a Journey

Perhaps the best example of this is the provision of real time information relating to arrival and departure times, which has formed a part of SWITCH in Newcastle, Dordrecht and Venice. This is becoming increasingly common as a method of keeping travellers up to date with the progress of their journey. This type of system requires initial investments to equip the vehicles so that they can be tracked, the locations where the information is to be displayed and a central computer that collects the information, compares it with historical data and schedules and then relays the information to the displays. This type of information is very welcome to travellers, but can lead to additional stress if the directional signing is not of a similar standard to the timing information.

Table 4 Summary of Information Results

Measure	Ease of Implementation	Impact	Significance
Real Time Information	Requires a significant initial investment, but subsequent addition of information sites and services is relatively easy.	Reduces stress and gives travellers confidence in the transport network, provided the information is accurate.	Is an essential part of a quality transport network where travellers are fully informed throughout their journey.
Dynamic Trip Planning	Can be complex, especially if a system requires liaison between systems belonging to different operators.	Provision of full journey information prior to the journey can influence the choice of journey, so influencing modal split.	Will be an important element of intermodal transport strategies in the future as the need to influence travel behaviour becomes more significant.
Enhanced Static Signage	Straightforward. Remember that information must be provided simply and clearly.	Ensures that the simple elements of a journey, even in an unfamiliar location, can be negotiated in confidence.	This is a basic element of all transport systems that is frequently overlooked.
Dynamic P & R Signage	Has proved to be straightforward in Newcastle, but problems combining existing systems with different data formats were experienced in Rotterdam.	Has been shown to raise awareness and influence traveller behaviour to completing journeys by public transport rather than by car.	In locations where P & R needs to be promoted this is an excellent way of influencing the people who form the market for the service.

Network Integration

Although the information and ticketing elements of the SWITCH project have been analysed separately many aspects of their purpose and impacts also relate to the concept of producing an integrated network and should be seen in this context.

This section includes a discussion of the aspects of SWITCH that are directly aimed at integrating what are traditionally considered to be separate elements of the transport network because they are provided by different modes.

Infrastructure redesign has formed a major part of all the SWITCH demonstrations. In each city design work has been carried out to reduce the time, inconvenience and distance associated with interchange. In a few isolated cases this has been possible by physically bringing the transport modes or stops closer together. Examples of this include:

- the redesign of the Rotterdam central station where the introduction of new modes to the heart of the station will provide the opportunity to reorganise the existing layout into a more user-friendly orientation;
- redesign of Königsbrück interchange so that the train and bus services use opposite sides of the same platform, so keeping the interchange distance to the absolute minimum;
- in several cases the road-side sections of interchanges have been improved, redesigned or newly introduced in order to ease the flow of passengers who access the interchange by car. Without this work there was quite often a barrier for travellers who arrived by car and wanted to travel onwards by public transport;
- reorganisation of the stop locations to provide a true interchange rather than having stops scattered around the same locality (Pilsen).

In many cases there is little scope to physically move existing elements of the infrastructure. However, by redesigning the access routes between the various elements, improving lighting, providing extra facilities and providing proper signs the feeling of an integrated interchange can bee created where it was previously missing. This has been successfully achieved by a number of simple schemes to improve links between modes. Examples include:

- improved lighting on routes at car or cycle parks and on the way to the interchange;
- CCTV cameras covering car parks and interchange access routes;
- pedestrian priority routes between car or cycle parks and the interchange;
- improved static signs.

The use of alternative modes for access to public transport can be encouraged by giving them priority or increased emphasis at the interchange. Examples of this include cycling in Newcastle and Rotterdam, taxis in Newcastle and cars for Park and Ride in Dresden:

- The use of bicycles to get to the station is relatively uncommon in Newcastle. By providing priority cycle access routes and cycle lockers cycling has been given a significantly increased profile in the area.
- In Rotterdam cycling is a very common mode of access to public transport. However, the facilities have frequently not been of a standard suitable for such a common mode. By providing a secure storage area in a prime location it is expected that cycling can become the most common access mode within the city.

- In more remote areas the final link between home and public transport may be missing and may therefore mean that travellers do not consider public transport as an option for their journey. By providing a taxi service that is integrated with the local public transport system this final link can be provided and public transport use increased.
- The introduction of improved car access to public transport interchanges in Dresden is a parallel to taxi integration around Newcastle. By providing car parking facilities at regional interchanges it is hoped that people who currently make their whole journey by car can be persuaded to change their journey patter to one of Park and Ride, with the largest element of the journey now being by public transport.

The use of new modes of transport can fill obvious gaps within the transport system. In SWITCH this is evidenced by the introduction of new waterborne services in Rotterdam and Venice that provide a more direct link and avoid congestion than the existing road-based services.

The incorporation of signage or information on one mode about other transport modes that are available at the different stations helps considerably in the creation of an intermodal transport system. This can be achieved by simple measures such as:

- indicating on trains what bus routes are available from different railway stations,
- providing information in an airport arrivals hall about the onward transport options to the city (Venice),

or more complex technical measures such as:

- dynamic Park and Ride signs on the approach roads to the city (Heworth & Rotterdam)
- real time information on a bus concourse about the next metro services (Gateshead).

There is a need to ensure that the services available at an interchange reflect the time spent at the interchange. In an ideal world the time for interchange will be minimised. However, even with the best of efforts, operational influences and scheduling will dictate that travellers sometimes have to wait for lengthy periods of time at an interchange. Airport services already reflect this, with plenty of facilities available for passengers between checking and departure times. From this extreme situation there will be a range of services that should be available as the typical waiting time decreases, so that at an interchange such as Königsbrück where the interchange time is 2 minutes a minimal service requirement is required. This reflects the fact that at Königsbrück the purpose is to provide a seamless journey with minimal disruption in the intermodal journey between Dresden and Hoyerswerda.

Table 5 Summary of Network Integration Results

Measure	Ease of Implementation	Impact	Significance
Infrastructure Redesign	Complex	The need to change modes is frequently a disincentive to travel by public transport. By minimising the disruption caused to the journey at an interchange the disincentive to public transport use can also be minimised.	Infrastructure redesign can be an enormous undertaking. This is reflected by the fact that for a major interchange such as Rotterdam Central Station the designs are being produced now for a reconstruction that is due to be completed in 10 years time. Even for small regional interchanges the impact on the catchment area can be significant and major, unforeseen barriers can be encountered that take months or years to overcome.
P & R Development	Straightforward	The P & R development within SWITCH is representative of a wider issue - the need to ensure quality in all aspects of the service. The P & R audits carried out in Rotterdam aimed to remedy any elements of the service that might have acted as a disincentive for repeat use.	The issues tackled were simple and generally obvious, both to users and operators alike. Simple and relatively cheap attention can be given to many aspects of the transport system so that people who are inclined to use public transport are not put off by relatively simple issues.
Cycle Access	Straightforward	The potential impact of cycle access measures is significant as it may mean that a non-polluting transport mode is introduced into the transport chain rather than car access to the interchange.	The relative importance of cycle access varies with many cultural and geographic factors. A huge contrast in attitudes can be seen between the UK, where the use of a handful of cycle lockers can be viewed as a relative success and The Netherlands, where cycling is the norm and where SWITCH has aimed to raise the profile of cycle access to be the main mode of arrival.
Improved Vehicles	Straightforward	Improving the vehicles used to provide the transport is an essential element of providing a quality service. New vehicles have a good image, improve comfort and reduce	The experiment with line 106 in Pilsen proved that, without investment in new vehicles, the planning and service upgrade that went into the ITS bus line was ultimately unsuccessful because the service was unappealing compared with the option of private car use.

Measure	Ease of Implementation	Impact	Significance
		environmental impact due to the use of new technology.	
Taxi integration	Straightforward	By ensuring a good taxi link in remote areas, people may be encouraged to use public transport where if the link was not available they would resort to car use.	The issue is to ensure that taxis are integrated into the transport network in a manner appropriate to local conditions. In dense urban areas, where public transport is common, taxi integration is less appropriate than in rural areas where public transport services tend to less frequent o even non-existent.

Ticketing

Integrated ticketing initiatives offer a significant step towards a truly integrated intermodal transport system. Within SWITCH substantive ticketing initiatives have been limited to combined parking and travel tickets at Park and Ride sites in Newcastle and Rotterdam, although interest has been expressed at the prospect of using smartcard technology to pay for a range of services including intermodal journeys and user needs analysis showed a demand for integrated parking and travel by waterbus in Venice.

The integrated P & R ticket system in Newcastle has proved to be very successful. Two new ticket machines with the capability of issuing either separate or combined parking and travel tickets were installed in the new car park extension. It has taken a few months for people to get used to the new ticketing option, but now around 50% of the tickets sold by the new machines combine parking and travel elements. This provides a time saving to travellers, who no longer have to purchase a separate travel ticket in the interchange, and also saves them just over 10% of the total parking and travel cost. In combination with the car park extension and dynamic P & R sign on the access route this has contributed to the 35% increase in patronage at the Heworth P & R site.

The integrated ticket system deployed at Heworth P & R has received some criticism because it is difficult to understand how to purchase a combined ticket rather than simply purchasing a parking ticket in the car park and then buying a separate travel ticket in the interchange. The ticket machines were manufactured to a specification that produced tickets that could be used in the local council's existing parking ticket readers and that was of a similar format to existing metro tickets. This highlights one of the major problems encountered in all aspects of intermodal transport - the need to satisfy the requirements of many different institutions, particularly if the new initiative needs to be compatible with existing systems with differing data formats. Both the system in Heworth and the smart card system in Venice experienced delays while efforts were made to simplify the user interface. The criticism levelled at the Heworth system suggests that this was only partially successful and it would be expected that future ticket machines would provide a simpler user interface so that they can more easily benefit from the new service.

The investigation of integrated Park and Ride ticketing in Rotterdam has yet to be implemented due to ongoing negotiations between politicians at the city and local levels. However, the user needs and design validation work has suggested that the initiative would have great success in ensuring that the P & R car park was used by people to travelling onwards by public transport, rather than people accessing local facilities and merely using the P & R site as a local car park.

Co-operation between partner organisations in the area of integrated ticketing introduces joint financial responsibilities. The framework for revenue allocation amongst the partners needs to be specified clearly and at an early stage of the project. In Heworth lengthy discussions were required between Nexus and the local council regarding the split of revenue on the combined P & R ticketing scheme even though this is a relatively straightforward situation with two partners. The issue of revenue allocation was highlighted as a major barrier in the Pardubice study where such co-operation has been unheard of up to now and the transport system to which it would be applied is more complex with many different modes and operators.

Although the driving force behind these two initiatives is to increase the number of people travelling by Park and Ride, the starting points are very different. In Newcastle the existing system was one where the car park was saturated with P & R users and where the decision was taken to expand capacity and then attract new users to fill it. In Rotterdam, because there was no existing charge for parking the car park was used by people who did not subsequently travel by public transport, so preventing other people using the P & R site. In the former case the integrated ticket provided a discount that was intended as an incentive for P & R travel. In the latter case the integrated ticket is not intended to provide a discount for P & R travel, but will mean that people who park in the P & R site car park are no longer able to benefit from free car parking. This emphasises the need to tailor the chosen solution to the existing problem.

The prospect of using smartcard technology for intermodal journeys has been under investigation for some time. Investigations within the SWITCH cities have suggested that it would be looked upon favourably, provided that it had been thoroughly tested and was only fully implemented as a system that was guaranteed to work correctly. By providing a ticketing system that covered all journeys by all modes within an area a smartcard-based system would be a significant contributory factor towards the truly seamless, intermodal transport network. The inclusion of other services such as payment for shopping and tourist attractions did attract some interest, but such services are always likely to be peripheral to the main purpose of the system.

One of the main advantages of smartcards is the time saving that can be achieved for the traveller. However, there is a trade off between increasing the speed of the system in accepting the transaction and the risk of fraud if insufficient checks are not built into the system. Optimising this balance has been one of the factors that delayed final system specification in SWITCH and will need further investigation in subsequent applications once operational feedback is available.

6.4 Barriers to Implementation

One of the major benefits of a full-scale demonstration project compared with laboratory tests and small-scale fieldwork is that it provides experience of the barriers that must be overcome in order to achieve successful implementation. The experience of other European demonstration projects has been that the interaction between the measures and the institutional framework within which they must operate can lead to more significant problems than technical difficulties with the measures themselves. SWITCH has confirmed this observation. The following paragraphs describe some of the barriers that have been encountered by the SWITCH demonstrations.

Land ownership / legal difficulties: Both Dresden and Newcastle experienced difficulties in implementing their original proposals due to problems with ownership of the land needed for the demonstration. In Newcastle the problem was relatively straight forward, in that Nexus knew that the land they wanted to use for a P & R site at Pelaw was owned by the local council. During initial discussions it became clear that this land would not be made available for the SWITCH project, and so Nexus quickly transferred their attentions to expanding the Heworth P & R site which had a similar impact to that expected at Pelaw. The situation in Dresden was similar in that extra land required for the extension of the access and parking facilities at Dresden Klotzsche was not owned by VVO. Unfortunately the exact legal

position took a long time to resolve because land ownership had become confused during the previous regime. In order to put the SWITCH designs into practice VVO had no alternative but to wait until this matter was properly resolved.

National regulations play a large part in all such demonstration projects. At a simple level national standards are set for many aspects of everyday transport operation and infrastructure which the project partners are entirely familiar with, for example technical requirements for access and emergency routes. However, the nature of research and demonstration projects is that they push the boundaries either of existing regulations or partners' experience of them. Within SWITCH the clearest example of this was the UK regulations that cover the content of road signs in respect of public transport information. Nexus' design for the dynamic P & R sign at Heworth included the option to display free text messages, but their desire to direct passengers to the P & R site is regulated by the national regulations which that it is not allowed to 'advertise' public transport on a road sign.

Inter-agency co-operation is a key element if intermodal transport is to succeed due to the large number of bodies that are involved in the provision of transport services (especially in a deregulated environment), infrastructure, information, car parking, law enforcement and co-ordination. Many of the SWITCH measures involve co-operation between agencies to facilitate co-ordinated timetables, provision of accurate information or the offer of combined tickets. At a superficial level it may appear that with favourable management attitudes within the organisations concerned and a strong framework for revenue allocation success can be achieved in such projects. However, two problems remain:

- Frequently co-operation between the various organisations attempts to integrate the existing separate entities without looking at the overall system as a whole. However, if this approach is taken, then in times of crisis each individual organisation tends to protect its own element, rather than considering the system as whole. In order to overcome this the transport system must be considered as a single integrated, intermodal network, and all decisions at every level must be taken in this context.

- Even when such a mindset is in place and the future development of the transport system is taken forward as a co-ordinated entity various elements of the existing systems will probably need to be brought together in order to provide a unified service. This can produce technical difficulties, as has been discovered in two of the SWITCH demonstrations. In Rotterdam confusion over the communication protocols and data formats of various elements of the system resulted in the dynamic P & R signs not functioning correctly and as a result failing their site acceptance tests. In Dresden the production of a single journey planning and customer information system involved considerable efforts to combine the initially incompatible databases of the various operators.

Political delays are inevitable when new ways of addressing the transport situation are being implemented. This has been evidenced in Rotterdam where their P & R integrated ticketing system has been delayed due to an ongoing need to convince local politicians in the area of the demonstration that the scheme, agreed at the city level, should go ahead.

Institutional factors: Each of the SWITCH partners had a different project management structure governing the SWITCH project implementations. It is not part of the SWITCH project's remit to define the project management structure that should be adopted within each

partner organisation. However, it does seem that the best results, in terms of sharing information at a European level, occur when there is a strong technical as well as project management link between the city and the consortium.

Throughout the SWITCH project the technical performance of the measures has proved to be very good. However, incorporation into a real-life context has sometimes revealed problems that would have been difficult to predict. Examples of this include the communication difficulties encountered by the P & R dynamic guidance system in Rotterdam and the degree to which the waves created by the Rotterdam - Dordrecht Fast Ferry disrupted the existing uses of the river, resulting in the downgrading of the service from a 25 minute to a 40 minute journey time.

6.5 Transferability

The benefits of European demonstration projects come from the many effects of practical implementation of transport solutions in a range of environments. The multi-site implementation achieved in projects like SWITCH provides additional information about the interaction between the measures and the local transport system, legal situation and institutional framework.

Within SWITCH particular emphasis was placed on discussions and dialogue between the partner cities about the implemented measures and how their experiences can help each other to improve the local transport system. The following tables indicate the extent of this process and degree of success achieved so far. However, the short timescale of SWITCH means that there has been little time for this transfer to be translated into full-scale implementation. However, the degree to which ideas have been shared indicates that this will occur in due course.

Co-operation between the partners led in some cases to improvements to the original systems, extensions to the planned scale of implementation or introduction to a whole new area that had not previously been considered.

Table 6 Summary of Transfer of Ideas Between Partners

Main SWITCH category	Measure	SWITCH cities that initially planned to implement measure	SWITCH cities that have already adopted measures / changed their plans as a result of participation in the project	SWITCH cities that plan to adopt measures / changed their plans as a result of participation in the project
Information	Real Time Information	Newcastle Dordrecht Venice		
	Dynamic Trip Planning	Dresden Newcastle	As a first step towards this Pilsen have published public transport timetables on the internet.	
	Enhanced Static Signage	Dresden Newcastle Rotterdam Venice	Venice identified further problems with existing static signage during design validation phase.	
	Dynamic P & R Signage	Newcastle Rotterdam		Rotterdam have requested information on the specification of the Newcastle system for comparison purposes with a view to future system expansion. Pilsen have improved static signage to P & R sites and are interested in the concept of dynamic signs, although implementation may be some time away.
Developing Integrated Networks	Infrastructure Redesign	Dresden Newcastle Rotterdam	Pilsen have recognised the need to improve connections by removing barriers to changing modes within diffuse interchanges.	Other partners are intrigued by the use of virtual reality at the design validation stage.

Main SWITCH category	Measure	SWITCH cities that initially planned to implement measure	SWITCH cities that have already adopted measures / changed their plans as a result of participation in the project	SWITCH cities that plan to adopt measures / changed their plans as a result of participation in the project
Developing Integrated Networks	P & R Development	Dresden Newcastle Rotterdam	Rotterdam and Newcastle have compared notes about the process of simple P & R quality reviews to ensure provision of a quality product.	Venice have expressed an interest in this review and quality improvement strategy.
	Cycle Access	Dresden Newcastle Rotterdam	Newcastle have used Rotterdam's experiences in planning cycle access and storage at stations in their plans for improving cycle access and storage throughout their area. Pilsen have plans to improve the conditions for cycling in Pilsen both as a mode in its own right and as a feeder mode for public transport through a network of cycle tracks and cycle racks	
	Improved Vehicles	Rotterdam Venice		The poor quality of vehicles was identified as a factor that let down the integrated bus line 106 in Pilsen. Newcastle investigated the feasibility of a waterborne public transport link between North / South Shields and Newcastle city centre following the example of Rotterdam and Venice.
	Taxi Integration	Newcastle		Dresden
Ticketing	P & R Ticketing	Newcastle Rotterdam Venice		

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Overall Project Conclusions

The overall aim of the SWITCH project was to demonstrate good practice in the provision of intermodal passenger transport and to assess the impacts on transport operation, traveller behaviour, environment and economics. The city partners set out to achieve this aim by developing technical measures in the areas of information, integrated networks and ticketing, which when taken together as a package of measures, would facilitate the delivery of seamless interchange between modes.

At the end of the SWITCH project, a wide range of high quality technical measures has been implemented in four cities across Europe. Each of these demonstrations has made a positive contribution to the elimination of barriers to intermodality. The partners have further developed the existing intermodal infrastructure within their respective cities in order to deliver seamless journeys for interchanging public transport users and to provide attractive options to encourage private transport users to transfer to public transport.

Operational efficiency in terms of transfer between modes, movement within the interchange and integration of different modes has formed an important part of SWITCH and is reflected in a diverse range of applications. Successful examples include:

- Integrated parking and travel tickets which reduce the time needed to queue for tickets in the interchange and can give a discount compared with the individual tariffs, so providing an incentive for park and ride over the alternatives.

- Improved access to the interchange has been provided at several interchanges for people arriving on foot and by bicycle. Pedestrian priority was provided within the curtilage of the interchange in areas where there was potential conflict with motorised modes. Cycle access comes in the form of dedicated cycle routes on the approaches to the interchange, as well as the introduction of a more widespread cycle network in some cities.

- Linked to the previous point is a recognition that the thoroughfares between parking areas (cycle or car) and the interchange need to be easy to negotiate. Where possible the interchange should be visible from the parking area. Where an interchange is being newly designed or redesigned an effort should be made to locate the cycle parking in a high priority position close to the main entrance of the station.

- Dynamic Park & Ride signage has been designed and implemented in Rotterdam and Newcastle. This has a number of positive effects for Park and Ride as an integrated mode combination. Firstly, it raises awareness that P & R is available on a particular corridor. The sign give confidence to travellers that parking spaces are available if they divert from the main road to the car park. It also provides directional information (which can be backed up by additional static signs) to the car park, and if national regulations allow, can also provide information about the public transport service available from the P & R site.

- The provision of clear and frequent static signs is a basic element of ensuring easy passage for travellers between different parts of an interchange. Within SWITCH the format of the information has been investigated in several of the demonstration sites. The user needs assessment confirmed that travellers tend to have an ambivalent view of existing signs, considering them to be adequate until state-of-the-art alternatives are provided when they realise the potential for improvement. In order to ensure continuity

within an intermodal transport system a consistent set of symbols should be used throughout the network. This should be implemented at least at the level of the regional network. It might be preferable to implement consistent symbols at a national or European level, and an investigation into a European set of standard symbols should be the subject of further research.

- Real time information (RTI) relating to the performance of individual services within the network provides travellers the highest possible quality of information relating to the specific journey that they are making. If there are problems with the particular service that they are scheduled to use then RTI provides this information at the earliest possible opportunity, so allowing the traveller the maximum time to consider alternative services. Even when services are running to time RTI has a function as it can take a lot of the uncertainty and stress out of a multi-leg journey.
- Currently it is not common for information about bus services to be provided on trains, or vice versa. However, if this type of information were commonly available then the concept of a truly integrated network would be much closer to reality. In the first instance the level of information would not need to be complex - for example, merely the bus services and destinations served at each railway station.
- New segments within the transport network that link destinations that were not previously linked in the optimum way will always improve the structure of the transport network. In many urban cases this may prove difficult due to the fact that the existing network already consists of a dense network of services. However, within SWITCH, two cities have produced a novel approach to the problem by instigating fast boat links on highly used routes, so providing an alternative to existing routes.

In order for an intermodal transport network to be successful it must ensure that all aspects of the network, both individually and as a whole, are of the highest quality. SWITCH has attempted to highlight areas where existing networks fall short and also to improve quality standards in many areas. Examples include:

- The provision of journey planning information that is available to the traveller before commencement of the journey. Experiments in Dresden have shown that even ensuring basic timetable information is available can influence travel patterns. The SWITCH partners have used this information as a basis for developing journey planning systems that incorporate all aspects of the transport network. Many different formats and access routes have been provided. The most successful current option appears to be telephone bureaux although it is expected that internet applications are likely to become more common and popular as more people gain access.
- The SWITCH partners have conducted quality audits as part of the user needs and design validation process. The audits have been concentrated on two aspects within the project - P & R facilities and interchange access routes - but there is no reason why this could not be expanded to other areas as well. Within these audits the aspects in need of improvement are clearly evident to the auditor. Examples have included poor lighting, dangerous road / path surfaces, poor signage etc.
- The use of design standards such as national regulations and the accessibility audit / checklist designed specifically for SWITCH will help to ensure that interchanges are designed to be accessible and negotiable by all. In effect, by designing for disadvantaged

sections of the community improved conditions can be achieved for all, and by including these standards at the start of the process this can be achieved at minimal extra cost.

- The quality of the vehicles that provide the integrated transport service is an extremely important aspect of the success of the system. This was an important conclusion from the experiment with the ITS line 106 in Pilsen. Although the users appreciated the improvements made in the scheduling and coverage of the operational side of line 106, they eventually rejected the service because the vehicles were old, uncomfortable and perceived to be unreliable. The user needs research in Newcastle has confirmed that this is an issue. Although users generally do not find fault with the public transport vehicles that are used, they give much higher ratings to the comfort and facilities available when they use their own car and this becomes one of the key factors in the choice of private vehicles rather than public transport.
- Personal security is an issue that is at the top of people's concerns when travelling on public transport. Travellers are keen to see evidence that this is taken seriously by operators. Closed circuit TV cameras are becoming more common and were deployed in several SWITCH locations. However, travellers also want to know that staff are available, both in the event of an emergency but also as a deterrent. Charges for the car parking element of P & R are not always popular. However, travellers can see justification in terms of paying for an added security element if they can be assured that security is taken seriously at the car park through proactive measures including patrols, CCTV and security fencing. In addition to these measures, simple elements incorporated into the design can have significant benefits. These include ensuring good lighting, clear sight lines through the interchange and help points in remoter parts of the interchange.

In order to assess the impacts of the technical applications, an evaluation plan was established which guided the partners in deciding which impacts to consider and the necessary data to collect. The three-phase evaluation process, consisting of User Needs Assessment, Design Validation and Verification and Post Implementation Assessment was a new experience for many of the partners, but helped to ensure that consistent evaluation was undertaken.

The user needs assessment was undertaken by all partners and ensured that the needs of both users and potential users were taken into consideration by asking them what they required of the intermodal measures to be designed. Partners referred back to the users during the design validation and verification to ensure they were content that their needs had been accounted for in the detailed design of the measures. Reference to an accessibility checklist also ensured that 'design for all' principles were adhered to in the design and implementation of the measures.

The user needs analysis in SWITCH produced some generic concerns that appear to be common across all sites. However, it is recommended that a short series of focus groups should be employed in cities wishing to implement this type of measure so that these generic concerns can be verified and any additional requirements due to local conditions are also taken into account.

Post implementation evaluation proved to be difficult within the project. All partners experienced barriers to implementation of their technical measures, whether financial, political or institutional. As such, it was not possible to implement all proposed measures.

The measures that were implemented were assessed in terms of their impacts on transport operation, traveller behaviour, environment and economics. Due to the short timescale of the project, the post implementation evaluation was undertaken when the measures had only been in place for a short period of time and, as a result, it was difficult to assess the full impacts of the measures. In effect, the evaluation process has assessed the short-term impacts of the intermodal measures – the longer-term impacts will only be clear after completion of the SWITCH project.

The evaluation within SWITCH has identified several barriers to the completion of a truly integrated intermodal transport network. These can be summarised under the following three headings:

- **Perception**: there is an underlying perception that public transport is by definition a second choice option. This presents a significant barrier to the use of any public transport system. Basic information about the possibilities offered by a new generation of truly integrated intermodal transport system would help, but there will need to be increased effort placed in marketing if the new system is to be successful.
- **Institutional**: many of the SWITCH measures involve co-operation between agencies to facilitate co-ordinated timetables, provision of accurate information or the offer of combined tickets. A truly intermodal transport system requires a change in attitude on behalf of all the involved organisations so that the benefit of the whole is put before the benefit of the individual operator.
- **Technical**: the combination of what were separate information systems, databases and the like into a single co-ordinated entity can often be more technically taxing than building a system from nothing. This type of technical problem has been encountered in some of the more technical SWITCH applications and has been overcome in the majority of cases.

The estimated impacts of SWITCH measures on the evaluation corridors have been relatively small, frequently lying in the range of 1 - 2% in terms of reductions in energy use and emissions. However, due to the nature of the applications, these analyses have had to be focused on the impact of a selection of individual measures rather than the effect of the packages as a whole. Furthermore, the timescales of the project have been such that time has not been available for the full impacts of the measures to take effect. Without a large marketing effort and a project launch it takes a long time for staggered improvements to have an impact on traveller behaviour. The real test for the impact of the SWITCH measures, and any other intermodal transport system, on energy use and the environment will be the degree to which they can alter travel choices and induce a modal shift. If a sizeable shift can be achieved then a corresponding change in the environmental impact can be expected.

A great deal of knowledge and experience has been gathered during SWITCH, much of which is directly transferable to EU cities and beyond. The inclusion of Czech partners in the project has helped to ensure that any good practice examples developed during the project may be replicated in Eastern European countries. The recommendations formulated at the close of the project bring together the key findings from the project in terms of general interchange principles, the development of interchanges and the process of delivering intermodal measures, to ensure that others may learn from the SWITCH experience.

The evaluation process established in the early stages of the project has proved to be successful and has helped partners to conduct as consistent an evaluation of their technical measures as possible. The practice of asking users to state their needs and requirements

regarding new intermodal measures has been shown to be invaluable in ensuring that the measures implemented reflect these needs, and should serve to encourage their use by both existing public transport users and potential users.

The SWITCH project has been extremely successful in meeting its objectives and in implementing and evaluating technical measures which will improve the passenger's experience of intermodal travel. The positive work undertaken within the project has provided a sound basis for the future development of both intermodal and multimodal transport solutions across Europe.

In addition, a great deal of local knowledge has been gained via the introduction of the SWITCH measures. Although many of the partners had existing working interchanges within their cities, experiences within SWITCH has provided valuable information and a deeper understanding of the problems, to facilitate the future development of intermodal transport solutions. This ranges from the use of new interchange designs as blueprints for other interchanges on the same network, to the new experiences of developing waterborne transport as part of an intermodal transport solution.

Within SWITCH, there has been a great deal of internal transferability. Partners have been provided with the opportunity to discuss their similar intermodal transport problems and share ideas and experiences regarding their resolution. The SWITCH demonstrations are of a higher quality as a result of the sharing of experiences.

7.2 Recommendations

Quicker and easier interchanges can help to attract new passengers to public transport by improving the convenience, security and speed of public transport in comparison to the private car. In addition, reducing the complexity and uncertainty experienced by interchanging travellers will improve the overall journey experience and should help to retain existing public transport users.

The intermodal demonstrations developed within SWITCH have provided in many ways prototypes for the development of future interchanges. A number of important aspects relating to seamless transfer between modes, whether from private to public transport or from one mode of public transport to another, have been considered by the city partners and implemented within their technical designs.

These recommendations have been developed based upon the experiences of the SWITCH partners in designing and implementing their own intermodal measures. They are intended to provide assistance and advice for the design and redesign of intermodal interchanges in the future. The recommendations cover three key areas as follows:

- General interchange principles
- Interchange / Network Design
- The Processes

7.2.1 General Principles

Recommendation 1: Intermodal interchanges should be designed with the needs of users in mind

As a fundamental principle, interchanges which provide priority access for passengers whether they are travelling on foot within the interchange, arriving at or leaving the interchange on foot, arriving at or leaving by bicycle, arriving at or leaving by taxi and kiss and ride, or using the car park, will be attractive to both public transport users and potential users.

In some cases, however, the system can be designed so that the incoming and outgoing services connect with a short transfer time and the transfer distance is minimised (for example, when two modes share the same platform). This is an extreme case because the scenario is relatively simple - one incoming arterial service with one or more feeder routes linking directly to the arterial service. It does, however, provide an indication of what can be done.

The majority of interchanges will be served by many more services than this, which will in turn introduce a much greater number of possible origin and destination combinations, resulting in some travellers needing to spend extended times at the interchange. Operational efficiency would require that the services were scheduled in a manner that optimised vehicle and passenger flows according to demand. Such scheduling has generally been outside the scope of SWITCH. Therefore it is recommended that planners should always try to minimise waiting times, although it must be recognised that at larger interchanges longer waits will be

inevitable, which is why SWITCH had a broader scope that included the facilities provided at interchanges.

Recommendation 2: Intermodality should be approached from a network rather than site-specific perspective

Partners within the SWITCH project adopted different approaches to the provision of intermodal measures. In Rotterdam and Venice, a more site-specific approach was adopted. Alternatively, in both Newcastle and Dresden a network-wide approach was adopted, whereby the interchanges that were redeveloped were to be used blueprints for the future development of other stations and interchanges along the network.

The network approach is recommended, as it will provide a standardised design of interchanges, in terms of for example signage and ticketing systems.

Recommendation 3 Intermodality should be promoted as a new concept in order to encourage public transport use

In order to encourage existing and potential users to travel more via public transport, its profile as a flexible option, which is well connected to and as reliable as private transport, must be emphasised. If non public transport users can be persuaded that the development of intermodal transport measures will provide a standard of service which single public transport modes are unable to provide, they may be more inclined to consider changing their travel habits.

Within SWITCH, partners adopted differing strategies in order to promote their new technical measures. In certain cases, the individual applications were introduced on a piecemeal basis over a period of time, while other partners chose not to present their new developments until all the measures had been completed.

If the introduction of new intermodal measures is to have the desired effect in terms of promoting a fully integrated system, a publicised launch is likely to have a greater impact on the travelling public than the introduction of individual measures. Presenting a package of measures which taken together will serve to facilitate interchange between modes, is likely to produce a more positive reaction and serve to encourage people to consider interchanging, as it makes transfer between modes seem more achievable. In comparison, the introduction of individual measures does not help people to think intermodally and may result in feelings that expectations raised by the promise of a new interchange have not been met.

In order to ensure that the intermodal message is spread as widely as possible, a comprehensive marketing and dissemination campaign is important. Such a campaign should begin before any physical works have begun in order to raise the interest of the public. Once the measures are complete and deemed to be fully operational, the new development should be launched as a new concept, in order to instil confidence in users and potential public transport users that what has been developed will improve their travel experience.

7.2.2 Interchange Design

Information

Recommendation 4 Pre-trip information should be provided in a range of formats

Passengers travelling by more than one mode of transport are vulnerable to problems such as missed connections and require more certainty that the journey they plan to make will be as seamless as possible. Experience within SWITCH has demonstrated that intermodal travellers are likely to plan their journey prior to setting out as well as en route. It is therefore recommended that journey planning information should be provided for travellers to access both before travelling (via the internet and / or telephone enquiry lines) and during their journey (in the form of internet access at interchanges and enquiry desks). In this way, the uncertainty of intermodal travel may be reduced, by allowing travellers to make informed decisions as a result of more complete information.

The requirement for provision of timely and accurate information can only be achieved as a result of co-operation between transport agencies and operators. Operators must work together to ensure that passenger information is kept up to date, necessary timetable amendments are well publicised and information is shared between all relevant parties. In this way, travellers will be more assured that the intermodal journey they have planned will be achievable, as they are in possession of complete information for all stages of the journey.

Recommendation 5 High quality, standardised signage should be developed throughout interchanges / networks

The importance of adequate signage was indicated by many focus group participants in the partner cities. Signage within an interchange has a number of important functions. Firstly, it provides directional information: whenever a passenger has to make a decision about which direction to choose, options should be clearly signed to provide guidance and reassurance.

Secondly, signage provides information about specific services using the interchange. The use of approved pictograms is recommended to assist and reassure passengers that they are travelling in the right direction to reach their intended mode. In general, signs should provide a consistent hierarchy, providing more information about the upcoming mode or service as the passenger moves closer to it, for example, in Newcastle, signage to indicate the location of bus bays was installed at the point where passengers exit the Metro and additional signage was positioned to indicate the location of the specific bay from which each service departs. Any signs should be legible in terms of their typeface and size and should not be obscured by other signs or pieces of equipment. Illuminated signs may also assist visually impaired travellers to move through an interchange without the need to seek assistance.

Signage also provides information to travellers about all the transport services using the interchange. It is recommended that all interchange facilities should have at least one information point displaying information about all services that depart from and arrive at the interchange. The type of information provided will usually depend on the volume of passengers using the interchange and the type of journeys they wish to make.

Adopting a network-wide approach to signage will help passengers to move through interchanges from one mode to another. It will also assist passengers as they will become familiar with the signage used on the network and feel more comfortable in using other interchanges on the network.

The experience of SWITCH has indicated that there may be a need for a European standard for the provision of signage. Such a standard could specify the type of signs to be installed, including the symbols to be used, guidance for the provision of a signage hierarchy and the accepted location of such signs within interchanges and at interchange points. A standardised approach would benefit travellers across Europe, promote the concept of integration between modes and help to encourage use of a standard, Europe-wide public transport system.

Recommendation 6 Real-time information should be installed in order to reassure passengers

Real-time information (RTI) has a key role to play in intermodal interchanges. Firstly, RTI is important in busy interchanges where service frequencies are high, as passengers require reassurance that the service they are awaiting will arrive shortly. The absence of such information simply serves to frustrate passengers and does not promote confidence in the services provided.

Real-time information is also necessary where waiting times are significant and travellers require reassurance that their onward service will arrive. As a general rule, real-time information is a valuable tool for instilling confidence in travellers and enabling them to make productive use of their time whilst waiting (e.g. utilising ancillary facilities and services).

The location of real-time information is particularly important in intermodal interchanges. In Newcastle for example, an RTI display providing information about the arrival and departure times of Metro trains was located on the bus concourse, thus enabling travellers to decide when they go down to the Metro station. Careful placement of real-time displays is important to enable people to make decisions regarding how / where they spend their time waiting for onward services.

Integrated Networks

Recommendation 7 Access issues must be foremost when designing and implementing intermodal measures

Appropriate access to and between modes is essential for ensuring that services are available to all. All four partners who implemented intermodal measures produced them based on ‘design for all’ principles. In terms of access, Dresden introduced shared use of a platform by rail and bus, in order to reduce walking distances between modes and provided obstacle-free access to platforms. In Newcastle, segregated walking and cycle access was provided, to prevent collision between these two modes and with other private and public service vehicles. In both Rotterdam and Venice, access to and from the ferry / waterbus was improved to ensure that mobility impaired travellers could board and alight the vessels without assistance.

In general interchanges should be designed to provide clear routes between services or modes, which minimise the time and effort involved in making a transfer. Wherever possible, transfer should be equally convenient in both directions. Clear sightlines should be provided along pedestrian desire lines in order to simplify way-finding. In addition, the use of transparent materials can enable passengers to see the place they wish to walk to and promote feelings of personal security.

It is recommended that as far as possible, pedestrians should be segregated from road vehicles including cars, taxis, buses and cycles. Guard rails and glazed panels should be provided to ensure that pedestrians do not stray into the path of vehicles, and pedestrian crossings should be clearly marked and give priority to those travelling on foot.

Within SWITCH, the accessibility audit which was developed paid special attention to the needs and requirements of disabled and elderly travellers, taking into account design accreditation criteria and legislation established by national and European disability organisations and advisory groups. The audit provided a checklist taking account of issues that govern the ease of access to public transport through the control of physical and psychological barriers, including physical access to and through the interchange, access between the interchange and the vehicles**,** the ease of understanding information**,** and access to tickets. The audit considered the needs and requirements of disabled persons with various impairments and of user groups whose mobility is, or might be restricted.

It is recommended, based on work conducted within SWITCH, that there is a need for a European standard to govern access requirements when designing intermodal transport measures. Although much research has been conducted in this area within SWITCH and other EU projects, there is a need for further work in this area to explore the possibilities for establishing a standard.

Recommendation 8 High quality Park and Ride car parks should be provided to encourage interchange from car to public transport

In order to encourage travellers to use public transport for the final leg of their journey into the city centre, park and ride facilities must be provided at intermodal interchanges. However, car drivers will not use the facility unless it meets certain standards. In general, motorists need to be convinced that if they leave their vehicle in a park and ride car park for any period of time, it will still be there and intact upon their return.

Within SWITCH, the city of Rotterdam developed a set of quality standards for the provision of park and ride facilities, based on a review of existing local facilities. The standards refer specifically to expected levels of security, maintenance and lighting to instil confidence in potential users of park and ride sites.

Recommendation 9 Car drivers should receive benefits for interchanging

The issue of use of parking facilities by motorists not intending to transfer onto public transport is one which requires careful consideration. Within SWITCH, the Park and Ride facilities provided in both Dresden and Rotterdam were to be provided free of charge for

motorists interchanging onto public transport, but charges were to be incurred by those simply using the facility as a car park.

The systems in operation in Dresden and Rotterdam may work for a time, in the longer term, charging issues may become more important as demand for parking spaces exceeds supply. Although it would be wrong to deter drivers from interchanging onto public transport, it may be that the only effective way to ensure that the Park and Ride facilities are not abused is to charge for all drivers to use them, with significant discounts being available to interchanging drivers. In this way, drivers simply wishing to use the facility as a car park rather than to interchange, will be discouraged from doing so due to the high cost attached. Any revenues from parking charges should be used to improve the security of facilities and may be used, for example, to fund an attendant to patrol the car park.

Recommendation 10 Kiss and Ride spaces should be provided at intermodal interchanges

It is anticipated that the provision of kiss and ride spaces at interchanges will encourage people to consider interchanging onto public transport. In one sense, the provision of kiss and ride spaces is more sustainable than the provision of park and ride facilities, as it promotes car sharing rather than single occupancy car use and may help to reduce the need for families to own and run two cars.

Kiss and Ride spaces should be provided as close as possible to the main entrance to the station / interchange, but not obstruct access for pedestrians and cyclists. At interchanges where space for parking is limited, priority should be given to Kiss and Ride, rather than Park and Ride provision.

Recommendation 11 Cycles should be fully integrated with public transport

Although cities across Europe experience differing levels of cycle use, it is important that provision is made for interchange from bicycle to public transport. The city of Rotterdam experiences particularly high levels of cycle use, in common with most Dutch cities. Within SWITCH, Rotterdam undertook a study of cycle parking at public transport interchanges, including rail and metro stations and tram and bus stops. A series of recommendations was developed for the provision of cycle facilities at such interchanges.

Although cycle parking is more of an issue in Rotterdam than in any of the other SWITCH cities, both Newcastle and Dresden followed the example of Rotterdam in providing cycle parking at their interchanges, although on a smaller scale. Dresden provided secure parking, covered by clear perspex for weather proofing purposes, within view of the main station platform. Newcastle went a step further in providing cycle lockers for hire at the rear entrance to Heworth interchange.

As a general rule, the number of cycle parking facilities should take account of existing and potential demand. Cycle facilities should be easy to use, located so that they are convenient from the points of access to the interchange but do not impede pedestrian movement, secure through being in public view, protected from the weather, well lit and clearly signed.

Recommendation 12 Consider the role of waterborne solutions in an intermodal transport network

Within SWITCH, waterborne transport was considered in intermodal terms by the cities of Venice and Rotterdam, both of which are sited next to water. The experiences of both cities within the project will provide valuable information for European cities with the potential to exploit their waterways as part of intermodal transport solutions. Both cities experienced operational problems when implementing their demonstrations, due to the wave motion created by the increased speed of the vessels, but these problems have been addressed by the cities within the project.

Although it is not an option for many European cities, for those which have such a natural resource available to them, waterborne transport options should be considered in order to connect regions across water.

Recommendation 13 Taxis should be fully integrated into intermodal interchanges

Taxi provision at intermodal interchanges is an important factor in delivering seamless transfer between modes. In Newcastle, an existing taxi rank was relocated from the perimeter to a more central location within the interchange. In addition to physical integration, taxis should be integrated into interchanges via a telephone system, similar to the one established in Newcastle, to enable passengers arriving at the interchange to call a taxi to collect them almost immediately. One possibility, which was not explored within SWITCH, may be to provide a free telephone service on trains, whereby passengers may book a taxi to ensure that it will be waiting for them when they alight. This would involve co-operation between taxi and train companies, to ensure the smooth transition between modes.

In general, taxi ranks should be located in safe, accessible, well lit and appropriately signed locations which are convenient to passengers.

Ticketing

Recommendation 14 Intermodal ticketing should be offered to travellers to facilitate transfer between modes

Intermodal ticketing is an important feature of a truly intermodal transport system for two main reasons. Firstly, it helps passengers who only use public transport to make more efficient use of the network, as they have the freedom to move from one mode to another without the need to purchase separate tickets for each stage of their journey. Secondly, the option of travelling by multiple modes of transport simply from the purchase of one ticket is a valuable incentive to encourage people to transfer from private to public transport.

Within SWITCH, the demonstration in Newcastle involving a combined ticket for both car parking and travel by Metro provided an insight into the feasibility of joint ticketing options. The experiences in Newcastle indicated that ticket machines need to be uncomplicated and user-friendly, to ensure that potential users are not deterred due to the complexity of the system. The focus groups participants requested that the ticket machines provide change and display adequate information regarding use of the machine. The location of ticket machines

is also important, and placement within the car park to remove the need to enter and queue within an interchange building is highly desirable.

Integrated parking and public transport tickets may also be made more attractive if they offer discounts to travellers which result in interchanging for the last leg of the journey being a cheaper option than remaining in the car.

Within SWITCH, Venice took the integrated ticketing concept a step further by providing a smartcard to offer travellers an electronic means of payment for both parking and using public transport. Currently, smartcards offer the latest generation of ticketing systems to facilitate intermodal travel. They provide an electronic means of ticketing which is quicker and more convenient than paying with cash and may be used for a range of additional goods and services. Contactless smartcards are gradually replacing magnetic stripe cards and they have been used to facilitate multi-modal travel within multi-operator environment.

For the future, it is recommended that smartcard technology is introduced in order to enable passengers to move around a public transport system and from private to public transport with minimal interruption. In common with existing paper-based ticketing systems, smartcards should be user-friendly and offer a range of facilities and services both within and beyond the transport arena.

7.2.3 The Process

Recommendation 15 The needs of users and potential users should be identified in the design process

Although within the SWITCH project partners had differing opinions regarding the format of user needs identification and assessment, overall the concept was recognised to be a vital stage of the project process. Certain schools of thought believe that identifying generic needs in terms of what any intermodal interchange should provide is the way forward, whereas others consider that the identification of specific needs in relation to each individual application or interchange. The SWITCH Consortium recognises that the identification of user needs can be culturally dependent, and as such cannot dictate which approach to adopt. However, it is recommended that a thorough user needs assessment is conducted which should ideally include the finer detail of interchange design.

Recommendation 16 Co-operation between organisations is vital for the delivery of a range of intermodal measures

By definition, intermodal transport systems involve organisations from a number of different transport modes. The management of a single interchange may fall within the responsibility of several organisations. Poor co-operation and differing priorities between these organisations can often result in barriers to interchange and the creation of physical and organisational divides, where passengers perceive a change in the level of service that they receive as they pass between areas controlled by different organisations. This in turn can make the journey feel difficult, complex and disjointed and interchanging passengers may not know who is responsible for dealing with any problems they experience. The challenge is to

ensure that passengers are provided with consistent levels of service as they move from one mode to another.

Co-operation is essential to ensure that all organisations are committed to the provision and operation of intermodal systems. This co-operation begins with basic information sharing, timetable co-ordination, sharing of facilities, and integrated ticketing.

In addition to co-operation, co-ordination across organisational boundaries is essential to delivering seamless interchange. It is important that all relevant agencies accept and share responsibility for the provision of integrated networks if the systems are to work in practice. There is a fundamental need for 'joined-up thinking', among those operating the system. The system should be considered as being greater than the sum of the component parts and all actors involved in the process of operating the system on a day-to-day basis, should act in the interests of the system for the benefit of the travelling public, rather than for their own individual part of the system.

Recommendation 17 Project planning is important to ensure technical applications are delivered on time and within budget

The process of redesigning and redeveloping an interchange is complex and many project stages are dependent upon the successful completion of previous stages. It is important that the complexity of delivering a range of measures is recognised and correct planning processes and procedures are adopted to ensure the timely delivery of applications. Contingency planning is also recommended in preparation for any problems or barriers which may arise, for example the land ownership and political issues experienced by the SWITCH partners.

Recommendation 18 A dedicated project manager should be employed to deliver the technical measures

In line with the previous guideline, it is recommended that a dedicated project manager has the task of overseeing all design and implementation processes to ensure that they are delivered as intended. The project manager should have a certain degree of technical knowledge to enable them to have critical input to project processes and to ensure the smooth running of the project. It is advisable that the entire process is undertaken by a technical team, with one manager having overall responsibility for the project.

Recommendation 19 Intermodal measures should be evaluated to ensure that they have the desired impact(s)

It is often the case with any new transport development that resources are spent on the design and implementation stages, with little if any money left for evaluating the success of the measures. Although it is recognised that evaluating the impacts of a package of measures may not be straightforward, it is vital if an assessment is to be made regarding whether the measures do in fact meet the needs of users and potential users. It is recommended that the evaluation process advocated within SWITCH, based on the MAESTRO Guidelines, is utilised in the evaluation of intermodal transport measures in the future. The three-stage

process should help to ensure that the impacts assessed at the end of the project have been planned for and are anticipated.

The positive results of the evaluation process should be widely disseminated in order to encourage non-users to consider intermodal options.

7.3 Key Areas for Further Work

During the project, a number of issues arose which it was not possible to study in more detail within the remit of SWITCH. However, these issues were considered important for further research, as they were seen as significant for the future development and growth of intermodality. The key issues are:

1. There may be a need for a European standard to specify acceptable access levels for new intermodal measures. Such a standard could contain guidance and measurements to regulate for example, the dimensions of walkways, acceptable distances between public transport modes and access between platforms and vehicles.

2. Further research is needed to investigate the acceptability of a set of intermodal signage standards, which may as a result, instil confidence in intermodal travellers across Europe when making intermodal journeys.

3. A European review of the role of taxis would help to clarify the issues surrounding taxi integration and in the longer term, taxi integration may well become a selling point of intermodal interchanges.

4. The establishment of a set of minimum standards for cycle provision, based on average levels of usage and the expressed needs of cyclists should be considered.

5. The question of whether interchanges should predominantly strive to provide the shortest connection times or offer a comfortable waiting environment is one which should be given a great deal of consideration in the future.

6. It is recommended that further demonstration research is undertaken with regard to waterborne and other innovative transport options to ensure that multimodal transport, in practice, includes all available modes.

8 PUBLICATIONS, CONFERENCES AND PRESENTATIONS

SWITCH Launch in Newcastle February 1999

Norman James - SWITCH paper presented at the 'Moving On' Conference held at Nexus House, Newcastle upon Tyne, October 2000

Ray Taylor - SWITCH paper presented at the 'Moving On' Conference held at Nexus House, Newcastle upon Tyne, October 2000

Rotterdam workshop - Involving The User In The Design Validation And Verification Process, March 2000

David Blackledge – 'The SWITCH Project: Transport Choices for a Seamless Intermodal Journey'. Paper presented at the CARISMA TRANSPORT Conference on Connecting Local and Regional Transport Networks to the Trans-European Transport Network, Budapest, April 2000

SWITCH Transferability Workshop - Promoting SWITCH and the Concept of Intermodality to Central and Eastern European Countries, Prague, May 2000

Final SWITCH Workshop - 'SWITCH into Action', Newcastle, December 2000

9 REFERENCES

SWITCH Deliverable 1 **Inception Report**

SWITCH Deliverable 2 **Evaluation Plan**

SWITCH Deliverable 3 **Dissemination Plan**

SWITCH Deliverable 4 **Technical Report on Design Phases**

SWITCH Deliverable 5 **Position Statement**

SWITCH Deliverable 6 **Technical Report on Implementation and Demonstration**

SWITCH Deliverable 7 **Evaluation Report**