HiTrans Best practice guide

1

Public transport & land use planning

Development of principles and strategies for introducing **Hi**gh Quality Public **Trans**port in medium sized cities and regions

hi-trans

Interreg North Sea Region

HiTrans Best practice guide 1

Public transport & land use planning

HiTrans 2005

ISBN 82-990111-2-4

An introduction to HiTrans

HiTrans is an abbreviation for "the development of principles and strategies for introducing high quality public transport in medium size cities and urban regions". Examples of high quality public transport may be light rail, guided busways or frequent, comfortable buses. But the defining criterion of "high quality public transport" is the ability to compete with the private car for everyday travel in circumstances where car ownership is widespread. Established by a partnership of cities and transport agencies in the United Kingdom and Scandinavia, HiTrans is specifically aimed at cities and urban regions in countries bordering the North Sea that have populations between 100,000 and 500,000 people.

The project is jointly funded by the European Commission's Interreg IIIB North Sea Programme and the following partners:

- Rogaland County Council, Norway, (lead partner)
- Aarhus County Council, Denmark
- Edinburgh City Council, Scotland
- Helsingborg City Council, Sweden
- Stavanger City Council and Sandnes City Council (in partnership), Norway
- Sunderland City Council, England
- Jernbaneverket, the Norwegian National Executive for building and maintaining railways
- NEXUS, which operates the metro in Tyne and Wear, England
- NSB BA, the Norwegian National Railway operator
- Oslo Sporveier, which plans and operates the bus, tram and metro network in Oslo, Norway
- Statens vegvesen, the Norwegian Public Roads Administration.

The North Sea region is characterised by urban networks with few large but many medium sized cities and urban regions. Urban land use is generally low density when compared to other parts of Europe. There are also similarities in terms of urban culture and climate in the North Sea region that can affect the use of different transport modes. Car ownership and usage in European cities is generally increasing, and providing public transport that can compete with the private car is a challenge throughout Europe. But there are some challenges that particularly apply to medium sized cities and urban regions. In contrast to that of large cities, public transport in medium size cities and urban regions tends to be based on relatively low quality bus services. Smaller populations and thus lower passenger demand mean that expensive infrastructure such as heavy rail or subways cannot normally be justified.

Medium size cities that are looking for alternatives to normal bus services rarely have the resources to adequately research the advantages and disadvantages of emerging technologies and concepts of high quality public transport, particularly as these would apply in their circumstances.

HiTrans is a cooperative research effort to obtain this knowledge; to find suitable and cost effective solutions for such cities, and to learn from the best examples of relevant cities throughout the world.

But the aim is not just for high quality public transport. The aim is for high quality cities.

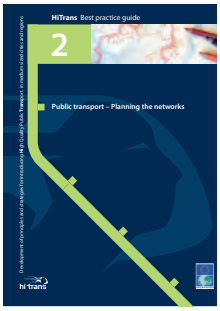
Most new concepts of high quality public transport require new infrastructure. It is a challenge to make such infrastructure fit into – and better still, enhance – the qualities of the urban landscape.

High quality public transport can also be used to restructure our cities to enhance the accessibility of the people who live in them without the choking traffic that diminishes our quality of life. At the same time it is expected that spatial planning oriented towards a city's high quality public transport network can be a critical factor in building patronage that in turn can justify more service.

HiTrans' work has been organised through 5 work packages called *strands*. This work has resulted in 5 best practice guides.

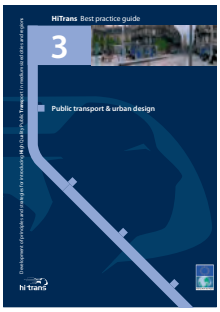
Best practice guide 1
Public transport & land use planning

How can we reshape our cities to facilitate the use of public transport? A series of case studies provides some inspirational illustrations of what can be done – as well as some salutary lessons of what to avoid. There are examples of cities regenerating run-down areas, curtailing urban sprawl, building successful public transport oriented communities, ridding themselves of traffic-chocked city streets, as well as examples of cities reinventing themselves as attractive places in which to invest and to live.
Main consultant: Lynn Devereux (WSP, Cambridge)



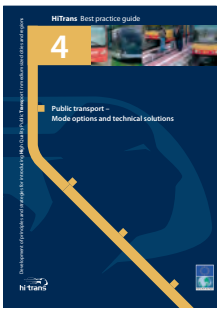
Best practice guide 2
Public transport – Planning the networks

Medium size cities face special challenges when introducing high quality public transport. How can the patronage be raised to generate the frequencies needed to make public transport a viable alternative to the car? This challenge is on top of well-known dilemmas that lie behind questions such as how far apart stops should be and whether resources should be spread between dense network of routes, or concentrated in a few, higher frequency routes. Illustrations and graphs demonstrate principles of network design, introducing concepts that simplify and clarify the planning public transport services. Also the report gives an overview of various legislative frameworks and their effects on the provision of public transport.
Main consultant: Gustav Nielsen (Civitas, Oslo)



Best practice guide 3
Public transport & urban design

The introduction of high quality public transport can have profound implications for a city's urban design. It may be introduced with-out any thought about how it will look or its impact on people's ability to move about and enjoy the city's public spaces. On the other hand, it may be carefully designed to reinforce or en-hance these aspects – or to play a crucial part in the reinvention of the city's image. This guide uses case studies to examine the variety of urban design factors that should be considered when introducing high quality public transport: overhead wiring, rails, signs, stations, stops, guideways, safety barriers, as well as the vehicles themselves. It also provides advice on advertising and preventing vandalism.
Main consultant: Marie Burns (Burns+Nice, London)



Best practice guide 4
Public transport – Mode options and technical solutions

There is a wide range of options available for those planning the introduction of high quality public transport. Rail-based options range from ultra light rail to heavy rail, with various permutations and combinations such as tramtrains, light metros, metrotrains and so on. Cities opting for bus-based transport will have to choose between different forms and combinations of propulsion, as well as whether to use bus only streets, busways, and/or to adopt one of the evolving technologies to guide buses. The experiences of numerous cities are used to provide lessons of how to introduce cost effective solutions that suit the local circumstances, and avoid costly mistakes.
Main consultant: Trevor Griffin (Interfleet Technology, Derby)

Best practice guide 5
Public transport – Citizens' requirements

This report investigates what the citizens of medium sized cities require from the public transport system. The report is split into two parts. Part 1 is a desktop study analysing the findings of previous research into the requirements of both users and non-users of public transport. Part 2 presents case studies of medium sized cities and regions that are perceived as being successful in providing high quality public transport. The study identifies the qualities that have made a difference, as for example fare structure, speed, reliability and frequency.
Main consultant part 1: Alan Howes (Colin Buchanan and Partners, Edinburgh)
Main consultant part 2: Tom Rye (Napier University, Edinburgh)

About this Best Practice Guide

The objectives of this guide are to investigate how land use planning can support the introduction of high quality public transport as well as give an overview of various mechanisms to finance high quality public transport. The report also gives an overview of various methods to model accessibility.

This guide is an edited short version of the WSP report; *Land use planning as a means of increasing public transport patronage*. The original report can be downloaded at *www.hitrans.org/WSP*. Especially the chapters on funding mechanisms and accessibility modelling are elaborated in more detail in the original WSP report.

Contributors

Original research for this report has been undertaken by Lynn Devereux of WSP, Cambridge, UK. Based on the original research Ian Radbone of QED, Adelaide, AU, has been the editor of this report, and Rob van der Bijl, of RVDB, Amsterdam, NL has provided additional case study information.

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Rob van der Bijl has given expert advice.

The HiTrans international steering group (ISG) is the main responsible body of the HiTrans reports. All HiTrans partners have a member in the ISG.

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1 Introduction

1.1 Best practice guide 1

This report looks at how land use planning can contribute to the provision of a high quality public transport service. "Land use planning" in this context is not simply about saying what activities should go where. It incorporates the way both public and private space is used that make places attractive to be in and easy to use. It is broadly concerned with the activities and interests of people who live and work in the area.

While examining the role that land use planning can play in increasing public transport patronage, a key reality is that the relationship between transport and land use is two way. Land use patterns help to shape where and how people travel. Where people live, work and carry on other activities are themselves at least in part shaped by the transport infrastructure and services that are available.

This symbiotic aspect of the relationship between transport and land use planning has helped to frame the objectives of the research – to examine how an integrated approach to public transport and land use planning can:

- contribute to the effectiveness of public transport systems,
- improve levels of social inclusion and overall accessibility, and
- enhance the overall quality and vitality of urban areas.

This report will use a series of case studies to explore this relationship. The concluding chapter will draw lessons from the case studies about how the relationship can be used to increase public transport patronage.

Some themes reoccur throughout the case studies and these will be introduced in this chapter, before discussing the methods we have used to explore them. And before turning to the case studies, some attention is paid to a key question that underlies discussion of the relationship – the importance of urban density in determining the performance of public transport.

The report also contains two appendices dealing with related issues:

- the use of GIS as a tool for analysing transport / land use interactions, and for planning public transport and land use, and
- innovative ways to capture some of the gains in land use values to help fund public transport.

Accessibility – a key concept

Broadly, accessibility refers to the ability that people have to reach and use the facilities needed to undertake their day to day activities. Accessibility has a very important role in shaping where people live, work and undertake other day to day activities. Where these things occur will be a key factor in determining both the individual person's level of access and the morphology of a city.

Proximity – how close together the various activities are – is the most obvious determinant of accessibility. But it is not the only one and in fact there may be natural and man-made barriers that mean a more distant location is more accessible than a close one.

Another critical factor determining accessibility will be a person's ability to use various modes of transport. Historically, the city centre grew to have a dominant role because of the good accessibility provided by the predominantly radial public transport networks, whereas today the relative availability of parking will often make activities on the outskirts of the city more accessible to people who travel by car.

It is levels and forms of accessibility that help determine where different housing markets locate and where different industries locate. Changing transport technologies cause changing accessibility patterns, which in turn will promote change in the location of these activities. On the other hand, where government establishes particular localities, such as for social housing or for open space, particular attention should be paid to the accessibility needs of those involved.

The relationship between land use and transport is dynamic, with interactions and feedback taking place through time. Accessibilities in one time period influence locational patterns in the next. The important thing to note here is that whereas the impact on travel demand of changes in land use (development) may be fairly immediate, the land use system typically responds more slowly to changes in transport supply. This has implications for planning practices, as it means that where land use and transport policies are implemented simultaneously the land use effects can be expected to lag behind the transport effects.

Software in the form of geographical information systems (GIS) is available to help transport planners map accessibility patterns. Planners now have powerful tools to help them in both adapting to and shaping future accessibility patterns, with the aim of producing efficient and equitable cities.

Apendix 1 is an explanation of GIS that outlines developments in the area.

1.2 The relationship between transport and land use

During the last 50 years the growth in car ownership has dramatically affected the way we organise our daily lives and use the land around us. Before the advent of the car, people travelled much shorter distances. Local communities were served by neighbourhood schools and other services that were accessible on foot or by bicycle. Work opportunities that could not be accessed locally were served by commuter bus and train services. The car has changed all of this, bringing new levels of mobility and accessibility and breaking down the time and distance barriers to travel. It has encouraged the decentralisation of jobs and other activities from city centres and supported patterns of dispersed, lower density settlement that could not have been achieved with the available public transport choices.

It is common to divide the history of city morphology into three stages, each defined by the dominant mode of transport:

- **the walking city:** settlements are limited in physical size to distances that can be easily walked. Space is so valuable that houses and shops are crowded on top of one another, and streets are narrow and crowded with activity. Density will be 10,000–20,000 people per square kilometre.
- **the transit city:** the vastly greater distances that trains and trams enable city dwellers to travel allow the city to spread out in "fingers" along the rail corridors. Overall, the densities of the transit city are between 5,000–10,000 people per square kilometre.
- **the automobile city:** cars have combined flexibility with the ability to cover long distances to enable the space between the "fingers" to be filled in. This has created an amorphous mass of suburbia, with a density of 1,000 to 2,000 people per square kilometre.

Many European cities have retained their transit-oriented form and some even have retained city centres shaped by walking. However this historical legacy has been weakened or broken down as the introduction of the car has encouraged dispersal of development. The process has been taken much further in North American cities. The dispersed nature of both residences and traffic generators that the car encourages has created conditions where it is very difficult to provide a high quality public transport service – except at enormous cost.

It is important to appreciate that although these changes have been driven by changes in transport technology, they have been facilitated and accelerated by changes in transport and planning policy. Transport engineering practices have been established that accommodate the growth in motor vehicle traffic. Land use policies have supported and encouraged the reduction in densities, the zoning of land uses and the changes in the urban street scene to allow traffic to flow freely. But by allowing fast moving traffic, they often create an unwelcoming environment for slow modes and those wishing to access public transport.

1.3 Changing land use to promote public transport

In recent years there has been a great deal of interest in western cities in reversing the process; to reshape the city so that it is once again conducive to public transport. The measures themselves can be grouped using Cervero's "3 Ds" (Cervero, 2002):

- **increasing urban *density*** – the number of people or jobs in a given area.
- **increasing *diversity*** – the mix of land uses
- **exploiting urban *design*** – in this case, the configuration of the local transport network.

Policies pursuing the 3 Ds are inter-related. Density and diversity can be measured at various scales: region, county, municipal, neighbourhood, block or site level. Design is usually dealt with at street level. What follows is a broad outline of the measures being taken, using these headings:

High Density housing alongside tram Line A in Strasbourg

Increasing urban density

Urban growth boundaries ("green belts") are being used to limit the spread of town and cities. While not necessarily expressed as growth boundaries, other planning policies will delineate carefully what areas will be developed and what will not; for example the Urban Development Zones (ZACs) of France.

As well as protecting our rural heritage and agricultural productivity, these methods are aimed at increasing the density of existing urban areas. "Smart growth" (particularly associated with Portland, Oregon) encompasses a variety of citywide measures to increase density while at the same time overcoming the problems that this creates.

"Brownfield" sites – the legacy of industrial change – are being used as opportunities for infill development and urban regeneration. Planning standards are being relaxed to allow higher density development.

Particular attention is being paid to increasing density in those locations that can be easily serviced by public transport and limiting development in areas that cannot be easily serviced. The approach is known as *public transport supportive development*, or "transit oriented development" in North America. New development at higher densities is being located close to key transport nodes, such as train stations and interchanges. This development includes a variety of traffic-generating activities, as well as high density housing.

Transit oriented development is popular in North America because it is seen as the easiest way to change land use in cities that are characterised by dispersed or low density development patterns. It can be used to link existing suburban growth patterns into the public transport network. It also fits well into strategies for urban containment.

Some land uses in particular lend themselves to higher density development, either at transport nodes or within public transport corridors, because of the opportunities to increase potential ridership for public transport. These include:

- higher density residential uses,
- social housing,
- secondary and higher education establishments,
- office and other intensive employment uses,
- hospitals,
- hotels and large scale leisure/recreational facilities, and
- restaurants and entertainment facilities, such as theatres and cinemas.

Governments can often create a supportive development environment by locating administrative /

institutional buildings adjacent to stops on the high quality public transport network. This practice is popular in France, where regional and local government buildings are often located next to tram stops, adding support to patronage and enabling government employees to get to work easily.

Increasing urban diversity

Another feature of these public transport supportive nodes is a diversity of land use.

Mixing land uses by concentrating jobs, housing and services in nodes or at stops on the high quality network is fundamental to the concept of node-based development and empirical research indicates that diversity in the development environment influences the mode choice of travellers in favour of non-motorised journeys (Cervero, 2002).

Planners are now looking at ways to combine different land uses harmoniously. For example, "shop-top" housing is being re-introduced in centres. As well as creating a more vibrant feel to cities, mixing land uses in this way can have important transport advantages. It can shorten the distance that people have to travel in order to undertake their everyday activities, thereby encouraging walking and cycling, and reducing the need to travel by car. It can also facilitate the multi-purpose journeys/trip chaining that reduce the number trips that need to be made.

A hierarchy of influences operates at different scales:

- Mixing or clustering shops and offices into a small commercial centre at a stop may make them more convenient to pedestrians and users of public transport.
- Locating housing near to a public transport node with commercial facilities plus a good pedestrian environment may reduce the need to own / use a car.
- Mixing a large volume of retail and office uses, or a major attractor, into a commercial district will make them more convenient for pedestrian access and can create the critical mass needed to support an efficient public transport service.

As noted above, some activities are better suited to high intensity locations than others. *Appropriate* uses are those that attract many people and do not need much space. *Inappropriate* uses include large space users such as warehousing and bulk distribution. Here there may be an economic case for a location on the strategic road network.

The Netherlands' "ABC" policy divided locations into three categories: those that are easily accessible by public transport only, those easily accessible by both public transport and the car, and those that are easily accessible only by car. Land uses were categorised to fit in each.

Another component of a supportive land use policy is a regulatory regime to ensure that the varying uses make good neighbours. The separation of land uses through zoning has come about because different land uses have been regarded as incompatible. For example housing has been relocated away from industrial and entertainment activities that may be noisy, smelly, etc.

These problems can be overcome through regulatory standards requiring measures to contain noise and other forms of pollution, and/or residential building standards that can insulate inhabitants from them. Performance-based regulation that focuses on the limiting the harmful impacts of differing land use locating near each other is replacing old policies that simply prevented them from locating together.

Exploiting urban design

Local level design features are receiving new attention for a variety of reasons. One of these is their role in encouraging people to walk rather than drive. If the walk to the local bus or tram stop is seen as a pleasure, the perceived disadvantage of public transport – the need to walk – is overcome.

"New Urbanism" (also known as "neo-traditional urban design") is an architecturally based school of thinking that aims to re-create the urban design features of by-gone eras, in the belief that these urban forms encouraged the use of transport modes that dominated before the Second World War.

Mixed land use plan for Baselinine station, Ottawa

Features of new urbanist developments include street details that are designed to encourage walking, street layouts based on variations of a grid pattern, local shopping centres and so on. Walking is made pleasurable by the provision of good quality footpaths and interesting, safe routes. Houses that orient themselves to the street, with low fences, encourage passive surveillance and so safety, as well as make the street more interesting. The grid street layout, with small block sizes, ensures people can take a variety of routes if they wish.

As a self-conscious movement to create neo-traditional housing forms, new urbanism is very much a North American phenomenon. However the princi-

Factors affecting public transport use

Internal factors	Complementary transport factors	External factors
Fare levels	Pedestrianisation	Socio-economic
Frequency	Parking policies	Demographic
Quality of vehicles	Traffic priorities	Land use density
etc.	etc.	etc.

ples of using urban design to create safe, interesting public spaces are being adopted widely. By promoting the ability to walk locally, especially to the local public transport node, people are being given more access to the places they want to visit.

Complementary transport policies to promote public transport

The success of a public transport service will depend on a combination of factors about which the public transport service has control (internal factors) and factors about which it does not have control (external factors).

Examples of internal factors include the quality of vehicles, fares and ticketing systems, frequency, marketing etc.

External factors include the socio-demographic characteristics of the population, ease of car use, health of the local economy and so on. Land use is one of these external factors.

A third category can be identified; transport measures that can be taken to alter the balance between car use and other modes. This lies between the other two in the sense that it is more subject to influence by the public transport planner than the external factors, but less than the internal factors.

The mix of factors that will determine the performance of a public transport service is shown in a multivariate analysis of light rail systems in 24 cities and regions in Europe, North America and Australia (Hass-Klau and Crampton, 2002). The analysis suggested that the three most important factors determining success were one associated with the quality of the public transport service itself (the use of travel cards and fare levels), one associated with land use (corridor density), and one complementary transport measure (pedestrianised street length).

As noted above, the external factors are less amenable to change by governments than are the internal factors – or at least they take longer to change. The form these factors take will often be shaped by history and geography. But some at least can be shaped by contemporary political action, if there is the political will and governance structures to enable integrated policies to be implemented. The land use policies referred to earlier are examples of attempts by governments to change some of these external factors. Complementary transport policies that alter the balance between car and public transport are another form of integration. Examples are:

- designing streets to give priority to public transport and non-motorised traffic over cars,
- parking policies that discourage car use in urban areas,
- pricing policies that make the cost of using public transport attractive when compared to the cost of using a car, and
- park and ride schemes at key points along the network to improve access.

1.4 Using high quality public transport to promote urban regeneration

It has been pointed out earlier that the relationship between transport and land use is symbiotic. While transport can shape cities, patterns of land use will also affect what sorts of transport modes will be used. Modes of transport and the infrastructure related to them influence the location and intensity of economic activity and hence the patterns of land use. In general, the influence of a particular mode on transport use will depend on how dominant it is.

While this points to the influence of road infrastructure on land use, high quality public transport infrastructure can also be important in areas where access by car is relatively difficult due to congestion and other space constraints, such as areas surrounding the CBD. Often these areas have been left behind by economic change and are in need of urban regeneration. These include central commercial areas, which may have suffered competition from the development of more attractive out of town shopping centres.

New, high quality public transport such as light rail has been used by a number of cities to promote urban regeneration. The introduction of high quality public transport infrastructure creates opportunities for remodelling as well as improving the urban environment. This can be especially important for redevelopment and regeneration areas. Particular opportunities to be exploited include the following:

- re-planning public spaces and local connectivity.
- creating a new balance between car traffic, public transport, walking and cycling,
- restoring and improving pedestrian routes, and
- renovating properties adjacent to the network.

The impacts of such a strategy are threefold.

First, the image of quality and new technology conveyed by modern transit systems can be important in helping a city to sell itself to business investors and to compete for investment. As shown in Guide 3, high quality public transport can also be used as part of an effort to sell a city by creating an icon. There are five main areas in which modern transport systems can contribute to city image by supporting a marketing initiative as part of an overall regeneration strategy:

- Providing an indication of civic pride
- Sending out a message of serious intent about investment in a locality
- Putting up a marker for the acceptance of modern technology
- Injecting a 'European' / international flavour
- Creating a signpost of forward thinking.

Second, by making the adjacent land more accessible, a quality public transport service will increase the value of the land, so encouraging investment. If the adjacent land is residential, it will increase the ability of residents to access other parts of the city. If the land is commercial or industrial, it will make the land easier to access by employees and customers. The improved land values may also be captured to fund the capital costs of the public transport service and/or its operations.

Third, the establishment of new transport infrastructure is frequently the catalyst for complementary urban design measures designed to lift the appearance of an area. Improvements in public spaces can attract people, in turn attracting investment.

Planning authorities can support the associated image-building process by providing a positive and well-coordinated planning framework to facilitate the marketing and regeneration strategy and attract investors. Clear roles, well coordinated responsibilities and a minimum of red tape will also help.

Unfortunately, it is difficult to measure the actual impact of new public transport infrastructure in urban regeneration. It will typically be part of a package of measures, of which the precise impact of any one will be hard to identify. Also, since the response of the land use and labour markets takes time, it may be many years before the impacts of transport investment can be identified.

Later case studies will highlight the way in which local planning authorities can work with the development industry to create successful and well-balanced development schemes that are attractive to the market, and make the most of newly created transport opportunities.

The challenge of urban regeneration

Throughout the history of human settlement, transport has been a key factor in determining the fortunes of our cities (Clark, 1957). Of course, it is not the only factor. For a variety of reasons, the manufacturing industries that created the wealth of modern Europe have declined, with sometimes devastating impacts on the cities in which they were located. The more successful have been able to reinvent themselves in order to catch the winds of economic change and develop new industries to replace the old. But finding new industries – new sources of employment – has been only part of the challenge. What to do with the old industrial parts of the city (the so-called "brownfield" sites) is another.

Particular challenges have been created by changing freight transport technologies, particularly shipping. Containerisation and more efficient land transport technologies have combined to make many traditional ports redundant. Ports located in cities on a river a long way from the coast have been particularly affected. Port facilities that have not been able to handle the huge container ships, or which have not had the economies of scale to justify ships visiting, have also lost out to ports that have had the economies of scale. A shipping network with many ports has been transformed into a network with just a few huge ports. Goods are transported to and from these overland. The result in Europe has been hundreds of wharfs and warehouses that have become idle.

The regeneration of these old industrial and shipping areas has become an important urban planning objective, particularly as these areas are often located near the centre of the city, which – as we have noted earlier – has itself been in need of regeneration because car-based accessibility has encouraged the relocation of shops and businesses to the suburbs. The motivation for regeneration is very strong because these centrally-located areas will have a crucial role in shaping the image of the city.

Urban regeneration is being pursued on many fronts: economic incentives to establish and relocate businesses, the renovation of public infrastructure, the establishment of public facilities to catalyse new private investment, planning measures to promote new residential living, urban design measures to transform the localities into attractive public spaces, etc. As will be seen in this report, high quality public transport features prominently.

How to pay for these measures is a particular challenge. With land values being dramatically increased as a result of successful urban regeneration, one strategy is to somehow capture some of this increasing value to pay for the public costs involved.

Levies can be imposed on businesses and/or residents that benefit from the new services. A special charge may also be imposed on greenfield developers when they are given permission to develop. Government bonds may be issued in the expectation that increased revenue from higher property values will enable the bonds to be repaid. Brownfield land adjacent to a new service may be purchased beforehand and sold later, when property values rise as a result of the new service. There are many other mechanisms.

Appendix 2 is a table outlining the various approaches that have been used to achieve this. Further elaboration is contained in a draft report that is on the HiTrans website.

It is important to note that some of the revenue-raising mechanisms that are summarised can be used to contribute to the demand for the new service, thereby making it more viable. For example, allowing higher densities in areas close to railway stations will increase the potential number of users as well as result in higher revenue because of the increased number of building units. Workplace parking charges that are earmarked for public transport (e.g. those at the airports serving London) will also increase demand for the public transport service. On the other hand, some charges may have the opposite effect – for example, charging developers for the right to build walkways to connect their development with train stations will discourage development that could easily promote public transport use.

1.5 How the research has been undertaken

There has been an enormous amount of research testing the relationship between transport and land use patterns, particularly emanating from North America. Much of it focuses on the relationship between land use factors such as density, mixed use and urban design on public transport use.

The huge amount of this research, the varying methodologies and assumptions and the varying settings in which it has been conducted, have combined to produce a veritable morass of conflicting results. While there is general agreement that there is a relationship between land use factors and transport activities, there is conflicting evidence over:

- the causal nature of that relationship,
- the relative influence of any particular factor, when in any real world situation they tend to be associated,
- the relative influence of non-land use factors, such as demographics and socio-economic factors, and
- the impact of changing travel patterns. (For example, it is difficult to compare the environmental impact of trips when they vary on three dimensions: number, length and mode.)

Fortunately, there have been several worthy overviews of this literature (van Wee, 2002; Frank, 2000; Crane, 2000; Brunton and Brindle, 1998; Stead and Marshall, 1998). Suffice to say that there is agreement that – whatever the causal nature of the relationship and the impact of other factors – land use factors are important in enabling people to make better use of public transport, even if whether or not they choose to use it might be influenced by other factors.

Rather than produce yet another literature review, the current research has sought to provide evidence that relates specifically to the provision of high quality public transport in medium sized cities in countries surrounding the North Sea. This has been undertaken in three ways.

Firstly, we have sought to extend important research on the impact of density on the provision of high quality public transport, supplementing work done by Hass-Klau and Crampton (2002). A discussion of some of their findings, supplemented by data relating specifically to additional medium density cities in countries bordering the North Sea, appears in Chapter 2.

Secondly, the research has also been informed by a focused literature review and a small survey that was carried out during summer 2004. The latter involved contacting practising transport and planning professionals and experts with a working knowledge of the case study areas and the associated transport systems. Interviewees were asked to respond by completing a questionnaire or, if preferred, by participating in a structured telephone interview. Details of the questionnaire can be found in Appendix 3.

The information collected in this way included the following:

- Form and structure of development
- Land use policies in support of public transport (e.g. densification, mixed use)
- Use of pre-existing public transport corridors
- Complementary transport policies used
- Impact of high quality public transport on mode share
- Impacts on economic development or regeneration
- Public transport catchments and densities
- Main successes
- Lessons to be learned.

The HiTrans partner cities were also asked to supply a limited subset of the information covering densities.

Although most of those contacted were prepared to help, the information required to answer some of the questions was rarely available, either because it was not being collected or because it required too many resources to extract it from existing records.

Thirdly, the bulk of this report consists of a series of case studies drawn from Western Europe and North America, each examining a high quality transport service in terms of the themes outlined above. In addition to desk-based research most sites have been visited and structured interviews have been undertaken with key officials.

The case studies have been focused mainly, but not exclusively, on medium sized cities and transport regions. Where possible they have been limited to

examples with a minimum of three years' operational experience. With one main exception, they have also focused on experience with light rail systems, though a number of the cases must be viewed as examples of integrated public transport systems and one case provides an example of a high quality bus system.

The case study selection was the subject of some debate amongst the HiTrans partners, their expert panel and the consultants. The final choice was governed by the requirement to consider a range of different systems, circumstances and experience, both successful and otherwise. While the availability of reliable supporting documentation has also been important, the case studies were not restricted to those for which hard evidence was available to demonstrate success. This would have eliminated some of the more interesting and innovative examples.

The final list of case studies includes three French, four German, one Austrian, two British, one Canadian and two North American examples. The results are reported using a fairly standard format to simplify comparisons.

Patronage will be the most consistently used measure of performance in this report. Ideally, the evaluation of any undertaking should be ultimately based on the objectives behind that undertaking. The success or otherwise of a public transport service should be based on the objectives of the service: reducing congestion, providing accessibility for the transport disadvantaged, or whatever. Unfortunately, the real objectives may never be clearly articulated, and the existence of varying objectives from city to city makes any comparative evaluation along these lines impossible.

Patronage itself can be measured in a number of ways: as a percentage of local residents, as a mode share, the number of passengers per kilometre for a corridor of a given width, etc.

While using patronage as the dominant measure of success in this way is arguably simplistic, there are several factors to commend it. Most importantly, it is very hard to find a public transport service that does not measure itself by the number of passengers it carries. And as Hass-Klau and Crampton (2002) point out, public transport is unlikely to contribute to any broader objectives unless it attracts good passenger numbers on it. Patronage is also a relatively easy thing to measure – all the case studies have relevant figures. Other performance indicators are not consistently reported and so comparisons cannot be made. Nevertheless, these other factors will be reported and discussed where they relate to specific objectives.

The case studies will be presented using some common headings:

- The reason for the selection
- The institutional framework
- The planning policy framework
- Principles adopted in the use of land use planning to support public transport, and
- Key best practice features.

In addition to these, there will also be specific headings relating to particular themes of the case study, such as regeneration, innovation, etc.

	Country	Transport Area	Scheme	Year Opened	Target Development	Development stimulii: Land use	Transport	Regeneration	Regeneration Interest
Nantes	France	Urban	Tram	1985		x	x		**
Orleans	France	Urban	Tram	2000		x	x		*
Strasbourg	France	Urban	Tram	1994			x		*
Freiburg Rieselfeld	Germany	Urban-District	Tram	1994	New District		x		
Freiburg Vauban	Germany	Urban-District	Tram	2003	New District	x			*
Oberhausen	Germany	Urban-District	Tram	1996	Retail Centre			x	***
Stuttgart	Germany	Urban	Tram	1976		x	x		*
Graz	Austria	Urban	Tram	1970s		x	x		
Salford Quays	UK	Urban -Metropolitan	Tram	1999	Docklands			x	***
Sheffield	UK	Urban	Tram	1994	Regeneration Area			x	***
Ottawa	Canada	Metropolitan Area	Bus Rapid Transit	1973		x	x		
Portland MAX	USA	Metropolitan Area	Light Rail	1986		x	x		**
Portland Streetcar	USA	Urban	Tram	2001			x	x	***

2 The impact of urban density on public transport

In considering the potential influences of land use, an important question is whether there is any evidence that high quality public transport systems have benefited from a dense urban form. Certainly one of the concerns about light rail projects in regeneration areas is that as a result of economic restructuring and decentralisation, these areas have suffered from depopulation and so a loss of potential patronage.

This brief discussion of the relationship between the density of land use and public transport will first focus on densities of broad localities (such as cities as a whole), and second on densities within corridors served by public transport.

City densities

Newman and Kenworthy have carried out a number of studies in this area (1989, 1996) and have pointed out that, generally speaking, the more dense a city is, the less petrol is used per capita. This is not only helpful as a means of understanding the basis for the land use patterns that exist today. It also provides some clues about the policy levers that can be used to bring about positive changes to the present day land use / transport environment.

There are obvious reasons to expect that the denser a city is, the more viable will be its public transport. Most clearly, the denser a locality is, the more people there will be within walking distance of a stop to fill a bus or tram. Pushkarev and Zupan's research based in North America is frequently cited as evidence of the importance of density to produce viable public transport (Pushkarev, and Zupan, 1977; Steiner, 1994).

But city and regional governments do not have to rely on density to make the provision of a high quality public transport service a success. The evidence of some European cities, which will be discussed below, reveals this. In fact, Pushkarev and Zupan's work and findings were more sophisticated than a simple assumption that higher density equals less car use. While they produced scatter diagrams of American cities indicating a relationship between persons per square mile and the likelihood of using public transport to get to work, they also noted quite strong variations in public transport use among cities with a similar gross density. "Obviously, average area wide density does not tell us much about transit use" (Pushkarev and Zupan, 1977, p. 26).

They found that the strength of the CBD was necessary as an additional important explanatory factor. Put together, the factors could explain half to two thirds of the variation in trips to work by mode.

Hass-Klau and Crampton have studied 24 cities, which amongst other things examined the link between successful high quality public transport and density (Hass-Klau and Crampton, 2002). Most of the cities are European and a number figure in the case studies of this report.

Measuring the densities of cities as whole is hazardous. Differences in the spatial definitions of urban areas, city boundaries and transport service areas all make it difficult to draw together a consistent set of results on which to base firm conclusions. Moreover, information on which to base potentially useful density indicators, such as employment, dwellings and settlement envelopes, are not readily available from published sources.

With these limitations in mind, one of the most accessible indicators of urban form is gross population density. Putting together data collected in the HiTrans study with some of the information collected by Hass-Klau and Crampton indicates that very wide variations in gross settlement densities are found in the medium sized cities and regions that are operating high quality public transport systems.

The accompanying table indicates that, of twenty areas examined, the highest densities (in excess of 12,000 persons per square kilometre) are to be found in the new settlements of Freiburg Rieselfeld and Freiburg Vauban in Germany, both of which have been designed to support recent extensions of tram systems and have yet to reach their target populations. Taking Freiburg as a whole (the most successful of the cities analysed by Hass-Klau and Crampton), the gross density falls to a little over 2,600 persons per square kilometre, some way below Nottingham and Graz but still close to the top of the table.

Note that the densities of the French cities appear low in the table, but that they cannot be directly compared with the others because they are presented at the level of the urban community. The corridor densities that are discussed below suggest that a definition based more tightly on the built up area would move them much further up the table.

Of the 14 non-French localities, nine have densities above 2,000 persons per square kilometre, and five (all either British or North American) have densities below this.

Gross population densities

	Urban population (1000s)	Area (sq km)	Gross density population (pop/sq km)	Rank
Freiburg Rieselfeld	12	0.8	15,000	1
Freiburg Vauban	5	0.4	12,500	2
Nottingham	286	74	3,865	3
Graz	240	63	3,810	4
Oberhausen	223	77	2,896	5
Stuttgart	580	207	2,802	6
Freiburg	201	76	2,645	7
Newcastle	276	117	2,359	8
Salford	216	97	2,227	9
Ottawa-Carleton	700	370	1,892	10
Grenoble	419	234	1,791	11
Portland Streetcar	500	320	1,563	12
Sheffield	531	361	1,471	13
Montpellier	288	209	1,378	14
Portland Max	1300	950	1,368	15
Strasbourg	427	315	1,356	16
Rouen	390	291	1,340	17
Nantes	545	497	1,097	18
Manchester	430	402	1,070	19
Orléans	263	298	883	20

Source: Hass Klau and Crampton & own data

Corridor densities

Hass-Klau and Crampton studied the actual routes taken by the tram and light rail services. The associated density maps are complex. The authors suggest that they reveal patterns in which light rail has been routed to serve high population densities and other areas in which light rail is probably the cause of the high densities. But surprisingly, they often found that light rail routes did not serve the higher density parts of the city.

The most common cases were of (i) overall medium density corridors resulting from routes traversing the cities from medium to high density suburbs but passing through lower density areas en route, and (ii) light rail lines running from high density cores through to low density suburbs but without a high density suburb at the terminus.

Unexpectedly, the least common cases were routes serving high density corridors or orbital routes connecting suburbs. The former were found in Zürich, Cologne and Essen. The latter were seen in Basel and again in Cologne and Essen.

Saarbrucken, Birmingham/ West Midlands and Tyne and Wear all have examples of light rail routes that skirt or ignore higher density parts of the city. High quality public transport routes may be routed through low density areas as a regeneration measure. For example, Manchester's light rail corridors were in areas of industrial neglect that it was hoped the light rail would remedy. But also the route of a modern light rail may well be along a line of least resistance. That is, it is determined by political factors rather than considerations of which route would be most effective in generating patronage.

Hass-Klau and Crampton also estimated population densities for corridors 300 metres and 600 metres (equivalent to a 6 to 8 minute walk) either side of the light rail lines. There findings are presented here in a second table. (Note that in addition to the 24 cities examined by Hass-Klau and Crampton some further examples of schemes under consideration or construction have been added for this analysis).

The second table has ranked the cities in terms of

Light rail cities and corridor characteristics

	Track length (km) within city/transport area	0.6 km Line corridor pop within city/transport area	0.6 km corridor pop/track-km	0.3 km corridor pop within city/transport area	0.3 km corridor pop/track-km
Strasbourg	25	195,458	7,818	113,116	4,525
Rouen	14	105,387	7,528	55,920	3,994
Koln	148	709,732	4,795	488,292	3,299
Zürich	68.5	285,012	4,161	214,173	3,127
Essen	70	322,759	4,611	210,321	3,005
Bremen	63	280,829	4,458	186,425	2,959
Croydon	28	124,881	4,460	74,361	2,656
Den Haag	121.4	402,065	3,312	309,538	2,550
Dublin (under constr.)	23.8	119,474	5,020	59,305	2,492
Hannover	98	352,101	3,593	212,466	2,168
Göteborg	80	240,086	3,001	167,867	2,098
Dusseldorf	120.2	358,863	2,986	247,275	2,057
Birmingham/West Midlands	20.4	85,907	4,211	41,499	2,034
Freiburg	27.5	92,117	3,350	55,184	2,007
Tyne & Wear	56	196,905	3,516	101,257	1,808
Melbourne	220	581,198	2,642	373,975	1,700
Saarbrucken	10.3	36,381	3,532	17,157	1,666
Fareham/Gosport/Portsmouth (under constr.)	14.3	46,610	3,329	23,541	1,646
Dresdan	128.3	320,476	2,498	209,584	1,634
Basel	88	172,786	1,964	140,737	1,599
Gtr Manchester	37	115,403	3,119	55,931	1,512
Portland	53	134,805	2,544	71,007	1,340
San Diego	75	193,678	2,582	97,975	1,306
Leipzig	153	305,416	1,996	179,310	1,172
Calgary	29	63,173	2,178	30,861	1,064
Sacramento	29.5	57,343	1,944	28,558	968
Dallas (Starter System)	34	64,280	1,891	27,593	812
Dallas (whole proposed System)	204,773		93,935		

Source: Hass Klau and Crampton (2002)

the density of population living within 600 metres of the track (1,200 metres total width), which seems to be a reasonable walking distance. Note, however, that for both the 600 and 300 metre corridors, the top and bottom rankings are similar. Of the extant lines, Strasbourg, Rouen, Cologne, Zürich and Essen emerge with the highest densities for both corridors.

The cities toward the bottom of the list typically have extensive public transport networks, serving not just the dense inner areas. The exceptions are the North American cities, where the networks are relatively short and serve low densities by European standards.

There were a number of difficulties associated with this task. The most important was the discovery that the scale of the zoning systems used to estimate the densities was affecting the results. In some cases smaller zones raised the estimated corridor populations; in others it reduced it. The process resulted in differences in the results of up to 35 per cent. Overall, the effect of using finer corridors was to reduce the variation in the results. The analysis presented in the table was completed with this in mind and corridor densities were calculated per track kilometre across the whole of each of the networks. The results were then ranked.

The correlations are clear when corridor densities are compared with patronage. Combining a number of patronage-based indicators, Hass-Klau and Crampton produced a ranking of the 24 cities and grouped the rankings into three. Of the top seven – whose rankings the authors described as "quite robust" – only two were ranked out of the top seven in terms of 600m corridor densities. The least seven successful cities all had density rankings in the bottom half, apart from Leipzig. (Leipzig, along with all cities of the former East Germany, experienced big reductions in public transport use after reunification.)

Having said that, density is not everything. For example, Strasbourg's performance ranking is higher than its density ranking. This is probably because of complementary transport policies such as replacing inner city parking with park and ride facilities.

Stop catchments

	Pop/stop 400m	Pop/stop 800m
Montpellier	62,000	103,000
Strasbourg	59,000	110,000
Orléans	50,000	91,000
Manchester (city)	3,818	6,142
Sheffield	3,223	11,654

Calgary's performance indicated that it is possible to have a successful light rail system with relatively low densities, if supportive policies in terms of parking and city centre development are pursued.

Certainly one of the concerns about light rail projects in regeneration areas is that, as a result of economic restructuring and decentralisation, they have suffered from depopulation and a loss of potential patronage. The establishment of high quality public transport in such areas presents a risk based on the expectation that the infrastructure itself will encourage the densities of development that will make the public transport financially sustainable in the long term.

In a study for South Yorkshire PTE, Semaly and Maunsell (2003) compared 400 and 800 metre stop catchments for tram networks in France and the UK. Generally speaking, the catchments of French systems were of the order of ten times those of light rail in the UK.

3 The case studies

3.1 Selection of case studies

As noted in the introductory chapter, the case studies have formed the basis for a large part of the Strand 1 work. Their purpose is as follows:

- To examine the way in which land use planning and related policies have been used in practice to support the use of high quality public transport systems,
- To consider the impact of high quality public transport on economic development and regeneration,
- To consider a range of practical experience, both good and not so good, in order to help establish some common best practice principles.

In total, 13 case studies have been reviewed. These have deliberately been focused on medium sized cities and transport regions, which are of most relevance to the HiTrans consortium. Where possible they also have been based on examples with a minimum of three years' operational experience, in order to allow any initial behavioural responses to new systems or developments to settle down. These conditions have not, however, been applied so as to restrict the final choice. The overall criteria used to guide the selection process are summarised below:

- acknowledged / outstanding best practice example
- 'lessons to be learned' value
- good geographical spread of European experience
- leading edge North American (world class) examples to be considered
- a variety of settlement types to be included to cover a range of population densities
- minimum of three years operating experience
- at least one bus-based example
- examples of regeneration experience to be considered across as many case studies as possible

As indicated in the introductory chapter, the case study selection was the subject of some debate amongst the Hi Trans Partners, their Expert Advisers and the consultants. The final choice was tempered by the requirement to consider a range of different systems, circumstances and experience and the availability of reliable supporting documentation. It is important to note the requirement that the case studies should not be restricted to those for which hard evidence was available to demonstrate success. It was considered that this would eliminate some of the more interesting and innovative examples and would therefore be unnecessarily restrictive.

The final list of case studies includes three French, four German, one Austrian, two UK, one Canadian and two North American examples. These are associated mainly with light rail modes (not by design), though a number of the cases (Stuttgart for example) must be viewed as examples of integrated public transport systems and one case provides an important and particularly interesting example of a successful, high quality bus-based system (Ottawa).

It is important to note that the case studies have been assembled as the end product of a desk-based exercise because project time and resources precluded a visit to all of the cities covered. In fact, the only city visited was Strasbourg. This means that published literature and the Internet have been the main sources used. In the five month phase of the work dealing with the case studies, attempts were made to supplement and verify this material by contacting planners and other key individuals using a structured questionnaire survey. The survey was designed to collect basic information about the urban area, land use planning practices, development impacts and performance of the system. Respondents were also asked to provide maps and photographic material. A number of extremely valuable responses were received, although in many cases resource and time constraints limited the material that could be made available.

Despite these limitations, when taken as a whole the case studies provide a rich source of information. In many instances they illustrate more than one best practice component and viewed together they illustrate both the common features of successful approaches as well as the variety that exists within the different approaches that contribute to success. It is important to grasp this point, as it will become clear from the following pages that with respect to land use planning and regeneration the recipe for success

Overview of case study characteristics

	HQPT Scheme	Year Opened	Transport Area	Population	Transport Area Density	Main Land Use	Best Practice	Lessons to learn
Nantes	Tram	1985	Urban	545,000	L	Mixed with CBD	*	
Orleans	Tram	2000	Urban	263,000	L	Mixed with CBD	*	
Strasbourg	Tram	1994	Urban	427,000	L	Mixed with CBD	*	
Freiburg	Tram	1900s	Urban	201,000	M-L	Mixed with CBD	*	
Freiburg Rieselfeld	Tram	1994	Urban-District	12,000	H	Residential	*	
Freiburg Vauban	Tram	2003	Urban-District	5,000	H	Residential	*	
Oberhausen	Tram	1996	Urban-District	223,000	M-L	Retail	*	
Stuttgart	Tram	1976	Urban	580,000	M-L	Mixed with CBD	*	
Graz	Tram	1970s	Urban	240,000	M-L	Mixed with CBD		*
Salford Quays	Tram	1999	Urban-Metropolitan	216,000	M-L	Mixed	*	
Sheffield	Tram	1994	Urban	531,000	L	Mixed with CBD		*
Ottawa-Carleton	BRT	1973	Urban-Metropolitan	700,000	L	Mixed with CBD	*	
Portland Max	LRT	1986	Regional	1300,000	L	Mixed with CBD	*	
Portland Streetcar	Tram	2001	Urban	500000	L	CBD	*	

Notes:
Nantes: Population of urban agglomeration.
Orleans: Population of urban agglomeration.
Strasbourg: Population of urban agglomeration.
Freiburg: Tram system is pre-war but commenced updating in 1980s.
Freiburg Rieselfeld: Population figure of 12,000 is 2010 target; current figure is 6,000.
Freiburg Vauban: New district and tram system are under construction
Oberhausen: Population of urban area of Oberhausen.
Stuttgart: Population is for city; urban region is 2.3 million.
Graz: Population of urban area.
Salford Quays: Population of 216,000 is Salford Borough (Quays is c6,500); Manchester Met region >2,500 000.
Sheffield Population of urban area.
Ottawa-Carleton: Capital region.
Portland Max: Population of metropolitan region excluding Washington state beyond Columbia River.
Portland Streetcar: Population is for City of Portland.
Density per sq km: H = >10,000; M = 5,000–10,000; M-L = 2,000–5,000; L = <2,000 pers per sq km.

Case study cities with excellent supporting frameworks

	Political will	Inst. Framework & LU-T Coord	Transport Funding from LU
Nantes	*	*	*
Orleans			*
Strasbourg	*	*	*
Freiburg			
Freiburg Rieselfeld			
Freiburg Vauban			
Oberhausen			
Stuttgart		*	
Graz		*	
Salford Quays		*	
Sheffield			*
Ottawa-Carleton		*	*
Portland Max	*	*	*
Portland Streetcar	*	*	*

is a complex one that depends upon a wide number of interacting factors.

The results are reported using a standard format, although where necessary this has been adjusted to accommodate particularly important features of individual systems. This approach simplifies comparisons of best practice and is designed to provide the strategic overview necessary to understanding the contribution of land use planning and policy to the success of the high quality public transport systems in each of the cities reviewed.

Each case study is introduced with the reasons for its selection. This is followed with a brief background to the city/region and its public transport system, together with the institutional framework for its development and operation – factors to which land use planning practices and regeneration approaches are inextricably linked. The case studies then go on to examine the planning policy framework and the core principles used to support high quality public transport, together with any relevant regeneration or redevelopment experience. Complementary measures, again fundamental to the success of the overall land use planning approach, are then considered, focusing on policies which impact on the accessibility of the system and measures designed to promote patronage. Any financing methods of particular relevance are highlighted (development-related funding mechanisms are however the subject of a separate chapter) and any valuable implementation experience is reviewed. Each case study also includes a brief assessment of performance and concludes with a summary of key best practice pointers.

Case studies with best practice in core planning principles

	LU-T Policy Framewk	Corridor-based	Node-based	Local Connectivity	Land Use Mix	Stop-based Attractors	Densification
Nantes	*	*	*	*			
Orleans		*	*		*	*	
Strasbourg	*	*	*			*	
Freiburg	*	*	*				*
Freiburg Rieselfeld	*		*	*			*
Freiburg Vauban	*		*	*			*
Oberhausen			*			*	
Stuttgart	*	*	*	*	*		*
Graz							
Salford Quays	*	*	*	*	*	*	
Sheffield		*					
Ottawa-Carleton	*		*		*	*	
Portland Max	*		*		*	*	
Portland Streetcar	*		*	*	*	*	

Case studies selected to show regeneration impacts

	Urban Remodelling	City Image	Re-use of derelict land	LU & Property Market	Retailing	Business Activity	Labour Market
Nantes	*	*	*	*			
Orleans			*	*			
Strasbourg	*	*		*	*		
Freiburg							
Freiburg Rieselfeld							
Freiburg Vauban			*	*			
Oberhausen			*	*	*		
Stuttgart			*				
Graz							
Salford Quays	*	*	*	*		*	*
Sheffield		*					*
Ottawa-Carleton							
Portland Max	*	*	*	*		*	
Portland Streetcar		*	*	*		*	

Complementary measures used in best practice examples

	Pkg & Traffic Restraint	Pedestrianisation & public spaces	P&R	Modal Integration	Pricing & Fares	Marketing & PR	Education	Public participation	Innovation	Monitoring
Nantes	*	*	*	*	*				*	
Orleans			*	*						*
Strasbourg	*	*	*	*						
Freiburg	*	*	*	*	*	*	*	*	*	
Freiburg Rieselfeld	*				*	*	*	*	*	
Freiburg Vauban	*				*	*	*	*	*	
Oberhausen					*	*				
Stuttgart		*	*	*	*	*	*	*	*	
Graz					*	*	*			
Salford Quays			*	*	*	*	*			
Sheffield										
Ottawa-Carleton	*	*		*					*	
Portland Max		*		*				*	*	
Portland Streetcar				*	*			*		

3.2 Nantes, France, tram

Reasons for selection

Nantes has a strong tradition of integrated regional economic development and transport planning and provides an excellent example of a well-integrated, high quality public transport system. In recognition of its leading planning tradition the city was nominated by the French government to host a demonstration project to pilot the reintroduction of the tram in the 1980s.

The experiment was a success and the city subsequently became the first of many French cities to commit to the tramway as the backbone of a high quality public transport network. Public transport mode share has since increased in Nantes and evidence of the positive impact of light rail can be seen in the restructuring of the urban area and in associated regeneration impacts.

The tramway has had (and still has) a significant impact on urban development and economics of the city. Many stop surroundings have been redesigned and redeveloped, while some big businesses have moved into Nantes' city centre. Place Bretagne clearly illustrates these events. It is one of the nodes focussing new developments and served by a well-integrated new tramway.

Place Bretagne

Background

Nantes is the capital of Pays de la Loire and is located at the mouth of the River Loire in North West France. The Greater Nantes urban area comprises 21 municipalities that are grouped together to form an Urban Community. This has a resident population of around 550,000 and covers an area of around 490 square kilometres. With around 1,100 inhabitants per square kilometre, Greater Nantes remains one of the least densely populated urban areas of France. Within the city itself however, population density is high compared to other parts of the district, rising to an average of 3,000 per square kilometre and with parts considerably in excess of this.

Structurally Nantes combines with the port of St Nazaire to form the main industrial pole on the Atlantic coast of France, encompassing a total population of some 850,000 inhabitants. The origins of this industrial region lie in the development of the port and related industries and it was badly affected by structural changes in the economy in the late twentieth century, which resulted in the closure of the Nantes shipyards. The last 10 years have seen an urban renaissance in the Nantes area. Aeronautics, the wood industry and industrial research are all emerging economic and employment sectors. The tertiary sector is growing rapidly; its main areas being financial services, communications and transport industries. After a period of decline in population and loss of traditional activities, an increase in population has occurred throughout the urban area. Between 1990 and 1997 the resident population grew by 9.5%.

A ring road surrounds the city centre and suburbs of Nantes. The primary commercial employment centre is in the city itself, complemented by areas of economic activity on the main routes into the centre and industrial areas on the periphery.

There is little doubt that the degree of control and widespread participation of the public sector has facilitated the development of the high quality public transport system in Nantes. Moreover, as with many French municipalities, the support of the leading public actor, the Mayor, has been cited as an important factor in getting the initial tramway

proposals off the ground and driving them through the system.

The city of Nantes has a well-established public transport network linking the suburban areas with the city centre. The city also enjoys connections to the regional rail network and the high speed TGV network. The tram was reintroduced in 1985. The network is based on three lines totalling around 37 kilometres. The 78 stops have an average spacing of around 465 metres. (Semaly & Faber Maunsell, 2003) Construction of the third line and work on extensions is expected to be completed in 2005, taking the network to 41 kilometres.

Institutional framework and coordination

The Nantaise approach to development is characterised by a strong, well-respected and locally focused, public-sector led tradition of integrated regional economic-land use and transport planning. The approach dates back to the seventies and has been reinforced by more recent changes in the national planning system that focus on sustainable transport and economic development.

In 2001, the Nantes Conurbation District comprising a group of 21 municipalities became an Urban Community, providing a framework for an integrated cooperative structure to manage a wide area development strategy. The Urban Community is based on a decentralised model incorporating 10 local development poles based on municipalities and neighbourhood characteristics.

The District evolved from an earlier, inter-municipal association in the agglomeration of Nantes, the SIMAN (Syndicat Intercommunal à Vocation Multiple de l'Agglomeration Nantaise), which was established in 1982 to work on a more co-ordinated, holistic approach to regional development. This association became the managing authority for public transport and it is under this structure that the development of the quality tram network as it exists today took place.

In 1991, SEMITAN, a semi-public company with elected representatives in which the District is the principal shareholder, developed a mobility plan on behalf of the district and took responsibility for its management. The objective of this was to establish a new balance between transport modes in favour of alternative means of transport and to provide a framework of reference for the local authorities dealing separately with land use and mobility difficulties.

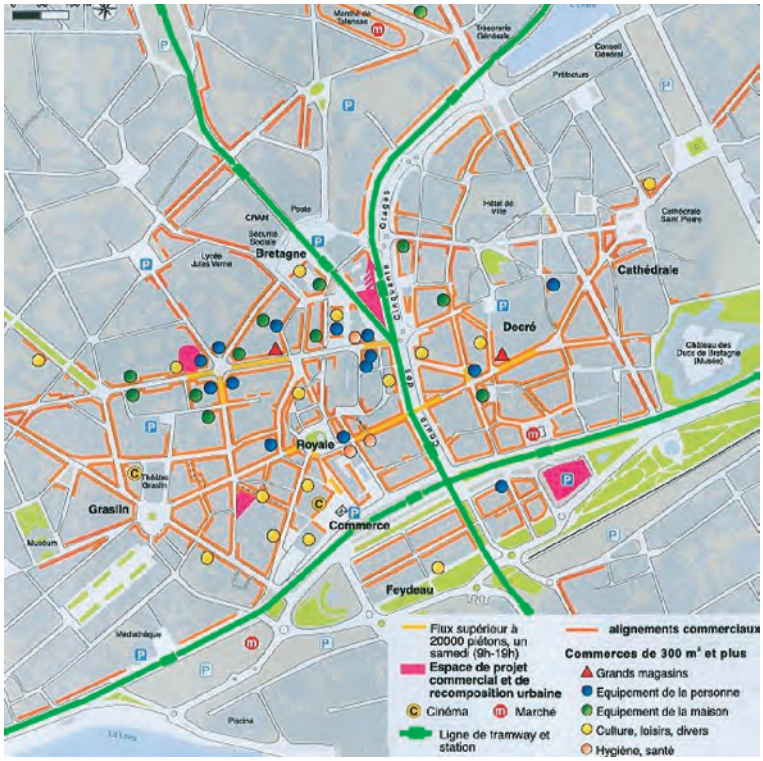
In France, the organisation and financing of urban public transport is the responsibility of local government. Large municipalities may have their own urban transport authority or they may be members of a group of municipalities that share a common authority. The urban transport organisations are responsible for the building and financing of new or existing infrastructure. The public transport network is then operated by an undertaking that is controlled by this authority, which is either a mixed economy public enterprise or a private company. In Nantes, SIMAN has provided the administrative and political vehicle for planning and development and has had responsibility for local, urban, public transport, as well as road transport issues. The building and the operation of the tram system was delegated to a separate mixed economy company, SEMITAN, of which SIMAN holds a 65% share.

Strong state control and ownership of land in France has facilitated the integrated approach to transport network and land use development, removing obstacles and delays that may be posed elsewhere by issues such as land assembly, rights of access and the attendant legal problems.

Planning policy framework

Since the early 1980s, planning and transport policies in Nantes have been integrated to provide a focus on mobility and sustainable development. The development of a high quality public transport system based on the tram is viewed as a central plank in this sustainable development strategy.

At the strategic level the goal has been to guide urban growth towards a polycentric structure. The overall planning and transport strategy is underpinned by four interrelated objectives in which urban form, function and regeneration are linked to public transport provision and the development of the high quality network. The four objectives are:



Map of commercial development

- To preserve the central function of the city of Nantes, whilst facilitating the development of multiple, secondary development poles. The urban area of Nantes offers only limited opportunities for expansion but there is a need to continue to foster commercial, industrial and residential developments. This is a primary objective in terms of guiding urban growth towards a polycentric urban model.
- To develop transport alternatives that offer a real modal choice to compete with the private car. The availability of a high quality alternative in the form of the tram is fundamental to this objective. Both geographical and physical accessibility to the tram system (and buses) for the underprivileged and disabled groups is viewed as important.
- To support the regeneration of docklands and other sites along the Loire.
- To create new housing and employment in derelict areas. To promote social cohesion, the region aims to create housing and jobs in response to the specific needs and skills of the local population in underprivileged and derelict areas. Diversification of the local economy is viewed as essential to strengthen the regional-economic base.

In 1991, well ahead of its time, the Nantes urban area introduced a Transport Plan to support this strategy. The plan was based on four main policy objectives that have been applied to the development of the tram network:

- To make the central area more accessible
- To reduce the use of cars
- To encourage modal split in favour of non-motorised, private modes
- To improve the living conditions for present and future citizens and to inform potential users through appropriate awareness raising campaigns

Essentially, the aim of the Transport Plan was to encourage the of use public transport and to promote slow modes throughout the urban area. This has been achieved by improving the quality of public transport, primarily through the construction of the new tramway and bus lines, improved commuter parking and by offering a reduced fare structure to attract low-income users and regular commuters.

Core principles: land use planning to support public transport

In common with other French cities, Nantes abandoned its original tram system in the 1960s. The city led the way however, when in 1985 it took the decision to reintroduce the tram. This subsequently provided the basis for redeveloping and restructuring the urban area, orienting development towards the use of public transport and maximising the opportunities for housing and commercial developments close to the tramway.

All new commercial developments and urban renewal projects (both in red on the map) are located in reach of Nantes' three tram lines (in green). The redevelopment of Ilôt Boucherie and Île de Nantes, south of the centre (not on the map), is served by tram line 3.

- The corridors of the tram system have a wide catchment, with the first two lines covering the following in a 400 metre corridor either side of the 27 kilometres track (EU Transland, 2000):
- 25% of the resident population
- 40% of the jobs in the area (total jobs c 226,000 in 1990)
- 42% of businesses
- 36% of sales/retail area
- 33% of the subsidised housing stock
- 50% of secondary education pupils
- 86% of university students
- The new tram line 3 certainly will enlarge the system's catchment. Compared to the first, this new line is even better integrated into the city.

A newly developed site around the new terminus Sillon de Bretagne of Line 3 illustrates tramway's supporting of land use outside the city centre, in this case the municipality of Saint-Herblain. An extension from Plaisance to Sillon (opened April 2004) serves the new shopping mall of Auchan. The tramway project and the mall project are well integrated. According to Philippe Petitprez ('directeur de l'urbanisme' of Auchan) the management of both projects was closely interrelated during the construction phase. Since the installation of tram line 3, Auchan attracted an additional 10% customers using the tram, despite being served very well by private cars.

More specifically, the objectives of tramline implementation in relation to remodelling the urban area were to:

- revitalise the central commercial area, which in common with many European cities has suffered from the development of large out of town shopping centres
- Establish new offices and housing
- Link the upper and lower city

Auchan shopping centre is served by the tram of Nantes

- Create a new balance between car traffic, public transport and cycling
- Restore and improve pedestrian spaces

The introduction of the high quality system was accompanied by traffic calming and pedestrianisation measures and the creation of cycleways. The whole has been supported by combining aesthetic considerations with practical transport measures, using the introduction of the tram to transform busy streets into spacious promenades punctuated by pleasant open spaces and squares designed to a high standard as attractive places to be in.

Regeneration

The introduction of the tram system has undoubtedly contributed to the improvement of the urban fabric and structure of Nantes. Some 136 improvements have been linked directly to the first two lines. They include:

- Cours de 50 Otages, an important boulevard in the central city area that has benefited from traffic management and property improvements. These benefits will continue via the Feydeau site initiative, which will involve further traffic management, pedestrianisation and green spaces linked to general improvements proposed as part of the Île de Nantes regeneration scheme.
- Improvements to the docklands area along the Erdre river
- Refurbishment of town squares
- 85 construction and major renovation projects (totalling 430,000 sq metres)
- 13 urban planning projects involving a mix of land uses.

The re-working of the local street scene to accommodate and integrate the tramlines has facilitated many of these impacts. However the impact of the tram has also been to trigger or accelerate new planning proposals and projects leading to changes in the local character of the areas affected and attracting economic activity and new life into neighbourhoods in the direct vicinity of the tramlines. These impacts have changed the image of Nantes and have created the confidence needed to attract investment to areas that were previously unattractive to the market. This renewed confidence is in turn triggering new developments and proposals linked to the extension of the high quality public transport system.

These include the Bretagne scheme, which takes advantage of works on the third tramline in the Bretagne-Calvaire sector of Nantes. It is a good example of a multi-site development that demonstrates the practice of urban remodelling. This transit-oriented, mixed use development promotes multi-purpose trips and provides for the creation of two new buildings (Ilôt Boucherie and Ancient Trésorerie générale), which will contain shops on the ground floor, offices on the first floor and flats (20% of which will be social housing). The development plans involve modifications to the Place Bretagne to reduce the number of lanes for cars from 4 to 2 and to divert remaining traffic away from the site. They also provide for the creation of a new tramway stop in a pedestrianised area and the creation of an underground car park for residents and service sector workers located in the area (central Post office, Social security, Bretagne Tower offices, Trésorerie Principale).

The Île de Nantes initiative is a further example of growing investor confidence associated with the tramway. It is a vast urban renewal project covering the banks of the Loire and the islands in the estuary. The scheme started in 2002, covers 13 municipalities, representing some 10,000 hectares of urban, business and open space, 110 km of riverside areas, 6 natural islands and the Île de Nantes urban island. Île de Nantes lies at the heart of the conurbation between the river and maritime zones but currently suffers the legacy of its industrial past. The initiative aims to give the 350ha urban island a core role in metropolitan development terms and a unique identity. The development strategy aims to introduce new strategic functions to complement the Île de Nantes' existing framework of major administrative, cultural and sporting facilities, services and industrial and commercial activities. New housing will eventually be complemented by development of tourism and leisure-related activities, and there have been proposals for new technology space and a multimedia centre.

The development plan proposes high standards of urban design and its success depends crucially on major improvements in multi-modal accessibility based on upgraded traffic interconnections between neighbourhoods and a new tram route that will act as a development spine along the entire length of the island.

Key Best Practice pointers

The city of Nantes has played a leading edge role in its strategic approach to the integrated planning of land use and public transport. This approach has

been used to develop and support a polycentric growth pattern and to foster regeneration. This approach has been successful in an urban region characterised by a wide range of densities of development, including on its periphery some of the least densely populated urban areas in France.

At the more local level Nantes demonstrates best practice in the way the introduction of the new light rail system has been exploited firstly to provide a vehicle for wider urban design solutions and secondly to shift the overall mode share away from the private car by introducing traffic calming and pedestrianisation measures, together with the creation of cycling facilities. The whole approach is one in which aesthetic considerations have been combined with practical transport measures.

The introduction of the tram has been used to transform busy streets into spacious promenades punctuated by pleasant open spaces and squares designed to a high standard as attractive places to be in and to make the city a better and more attractive place to live and work.

Many of these impacts have resulted directly from the re-working of the local street scene to accommodate and integrate the tramlines. However the impact of the tram has also been to trigger or accelerate new planning proposals and projects leading to changes in the local character of the areas affected and attracting economic activity and new life into neighbourhoods in the direct vicinity of the tramlines.

These impacts have changed the image of Nantes and have created the confidence needed to attract investment to areas that were previously unattractive to the market. This renewed confidence is in turn triggering new development proposals linked to the extension of the high quality public transport system.

3.3 Orléans, France, tram

Reasons for selection

Orléans follows many of the basic planning practices that characterise French public transport and land use policy. It is however a particularly interesting example of a high quality public transport system for three main reasons. Firstly, it is the smallest town in France that has a tramway. Secondly, by French standards Orléans is a low density urban area and in this respect the role of the tram is to connect the inner and outer parts of the city in order to channel growth and limit the future pattern of suburbanisation and further sprawl. Finally, as well as being a small town, Orléans is an important historic centre so that the introduction of the tramway has presented a challenge with regard to preserving the heritage of the area.

Background

Orléans is located around 125 kilometres south of Paris on the River Loire. It forms part of a network of towns that are located on the edge of the Paris Basin at around an hour's travelling time from the capital. The urban area covers 298 square kilometres and has a population of around 263,000. With a gross density of some 880 inhabitants per square kilometre, it is around one-third less densely populated than other French towns with tramways, such as Strasbourg and Rouen, and one fifth less densely populated than Nantes. A little over 40 percent of the residential population is located within the city itself.

Orléans has been one of the fastest growing conurbations in France. Population has grown by around 25% since 1975 and this growth has been characterised by an increase in the proportion of elderly inhabitants plus a reduction in household size, both features which potentially create increased demands on the transport system. In the 1960s, the new town of La Source was built 10 kilometres south of Orléans. The town was designed with low density residential and office development, plus a university and a regional hospital.

The growth in population has been paralleled by reasonably strong economic growth. There are around 120,000 jobs in the conurbation, with almost all of these based in the service sector (71%) and industry (27%).

The journey to work area for Orléans is broadly organised into two concentric rings of suburbs. The first ring comprises municipalities where 50% or more of the population goes to work every day in one of the conurbation's 20 municipalities. The second ring comprises municipalities where only 20 to 50% of the population work in the conurbation. This latter area has been progressively spreading towards the east and south.

Changes in household structure and journey to work patterns have been accompanied by increases in private motorised journeys and a sharp drop in the number of pedestrians (from 26% in 1986). The estimated mode share in 1998 was private cars 62%, public transport 15%, walking 16% and two-wheeled vehicles 6%.

The tramway was conceived in 1992, against this background of spread in population and employment and growth in less sustainable modes of transport. It was envisaged as a vehicle for limiting the sprawl of development by connecting up the different areas of activity and helping to channel future growth into public transport corridors, in particular linking La Source in the south to the centre of Orléans and thence to the centre of Fleury les Aubrais in the north.

Line 1 is 18 kilometres long and was opened in November 2000, following two years of construction. The line runs north-south from its northern terminus at Jules Verne, via Fleury les Aubrais and the administrative centre of Orléans to the new settlement at La Source, terminating in the south at the regional hospital complex.

The catchment of the corridor is high. A 400 metre buffer either side of the tramway covers 21 per cent of the resident population, 29 per cent of workplaces and 70 per cent of educational establishments (schools and university). The corridor also includes a number of other major attractors including the afore-mentioned regional hospital and the Zenith Exposition Centre. There are 24 stops en route with an average spacing of approximately 750 metres. The

Orléans historic centre

line is fully segregated from traffic and the trams run at a speed of 23 kilometres per hour.

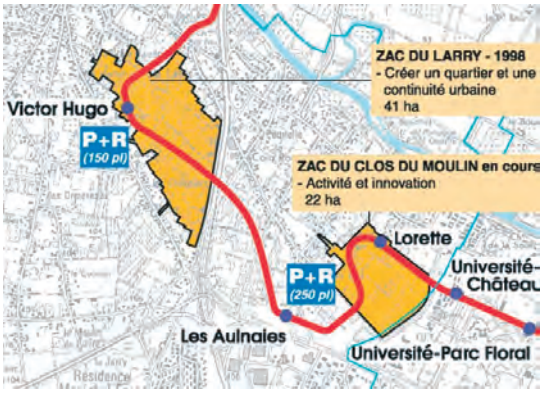
There is a plan to build a second line but this is not yet confirmed. The result of the 2001 local elections called into question a planned extension to the tram along an East-West axis when the new Mayor of Orléans announced that the future of the Tram was rather uncertain (van der Bijl, 2004). This has led to proposals for competing solutions in the form of high quality bus and guided bus solutions and so progress with the extension of the system has been delayed.

Orléans' new tramway boosted the quality of the historic centre. Small retailers in particular benefited from the improved urban quality and enhanced accessibility.

Planning policy framework

The Master Plan for Urban Development approved in 1994 covers the 20 municipalities that constitute the Orléans' conurbation (represented by SIVOM, the Syndicat Intercommunal a Vocation Multiple). This plan laid the foundation for sustainable development planning of the urban area through its three key objectives: limiting urban expansion, stimulating the growth of the city centre and structuring the sub-centres of the urban area around the tram network.

The Orléans Urban Mobility Master Plan (PDU), approved in 2000 is very closely linked to the urban development plan and together the two plans provide the framework for integrated transport and land use development (European Commission, 2003). The framework is based on six key policy principles:



Le Larry: ZACs

- Favouring urban development in the proximity of public transport nodes and secondary centres.
- Improving the attraction of the city centre by creating a pedestrian and cycle friendly environment.
- Improving city centre accessibility by promoting public transport and limiting car traffic
- Developing mixed use and neighbourhood services.
- Undertaking extensive housing construction programmes.
- Providing attractive amenities in the sub-centres

Core principles: land use planning to support public transport

An example of policy-led development is in the Le Larry urban development zone in Olivet, a rapidly expanding sub-centre in the Orléans conurbation. Originally a rural community with 6,000 inhabitants, Olivet has become a residential town of nearly 20,000 inhabitants. Growth originally followed an organic pattern around the village centre, in the valley and the along the main roads. During the last few years residential and commercial buildings have been constructed close to the tramway.

The site of "Le Larry" was entirely vacant when the tramway opened in November 2000. Nowadays it is a "natural" and living part of the city.

As part of the official land use plan an urban development zone was proposed at Le Larry before the tram system was conceived. Following the proposals for the tram the project has been refocused around the tram infrastructure and the stop at Victor Hugo. This was seen as a major step, and a move away from the previous approach based on volume house building towards a more balanced mix of development and a step towards supporting the high quality public transport infrastructure. The urban development zone is under construction and work for the whole project will be spread out over a 15 to 20 year period. The project includes blocks of flats, publicly owned town houses, amenities and a pedestrian zone. An immediate effect of the project has been to attract the private property market and as soon as the development plan was adopted, a private hospital was built on the periphery of the zoned area.

A similar example of transport infrastructure driving urban development can be found in Fleury-les-Aubrais, the second largest town in the département in terms of population and employment. Here the northern terminus of the tram has been used as a focus for urban development linked to the town hall, the central shopping area and other public amenities. The tram now provides the backbone for the development of the town and this development is in turn supporting the tramway. From the local neighbourhoods there is a network of feeder bus connections, cycle routes and pedestrian walkways and in the Fleury-lès-Aubrais urban development zone the parking standards have been reduced compared to other parts of the town. It is interesting to note that an original objective of this scheme was to increase urban density. It appears however that this has not been continued although the focus of supporting the tramway through patterns of development and complementary policies remains in place.

Regeneration

Redevelopment is taking place at îlot de la Râpe on a 3.5 ha site close to the administrative centre of Orléans. This is part of a specific regeneration project based around central area employment op-

Le Larry: September 2000

portunities and exploiting the possibilities for local access to the tram at Coligny. The aim of the project is to stimulate the central area and also to take the tramway into a previously disused and inaccessible site, improving its accessibility and local environment. This disused (brownfield) site was identified on an aerial photograph and has been converted into a pleasant square with a tram stop and a pedestrian path giving access to the administrative centre. The overall project plans to build houses (public and private schemes) to satisfy a local shortage and offices, as well as new road links where required.

In order to facilitate the development, land was assembled simultaneously for both the tram service and the urban development project. This meant purchasing from a large number of small landowners, pooling the land and subsequently redistributing to the owners / developers.

The tram is now in operation and stops at the administrative centre. The Urban Development Zone (Zac de la Râpe) was approved in early 2000.

Complementary policies

A number of complementary policies have been introduced to support the use of the tram.

These include:

- **Modal integration and access:** The bus network has been restructured in order to offer a better service by supporting the connections with the tram and the inter-district services. Feeder services are provided to Orléans and Fleury les Aubrais stations and Zenith Exhibition Park.
- **Slow modes:** Bicycles are allowed on trams provided they do not bother other travellers.
- **Park and Ride:** Line 1 is supported by six park and ride sites offering around 900 parking spaces.

Le Larry: Summer 2003

- **Landscaping:** The tram system is landscaped in order to increase its attractiveness to users and also to attempt to promote some community pride. Part of the tramway is grassed between the rails and thousands of trees have been planted.

Financial characteristics and funding opportunities

As with other French cities contributions from the Versement Transport have been used to support the introduction of the tram and its ongoing operation. The rate for the conurbation is set at 1.75% and the annual revenue (1999) has been estimated to be around 42 million Euros (Semaly & Faber Maunsell, 2003)

Innovation and fresh thinking

As part of the overall planning process associated with the PDU, regular monitoring is required to facilitate the ongoing evaluation of transport policy against targets. This includes monitoring the reduction of car traffic, enhancement of public transport services, support for non-motorized modes, structuring of the road network, effectiveness of parking policy and urban freight mobility management policies.

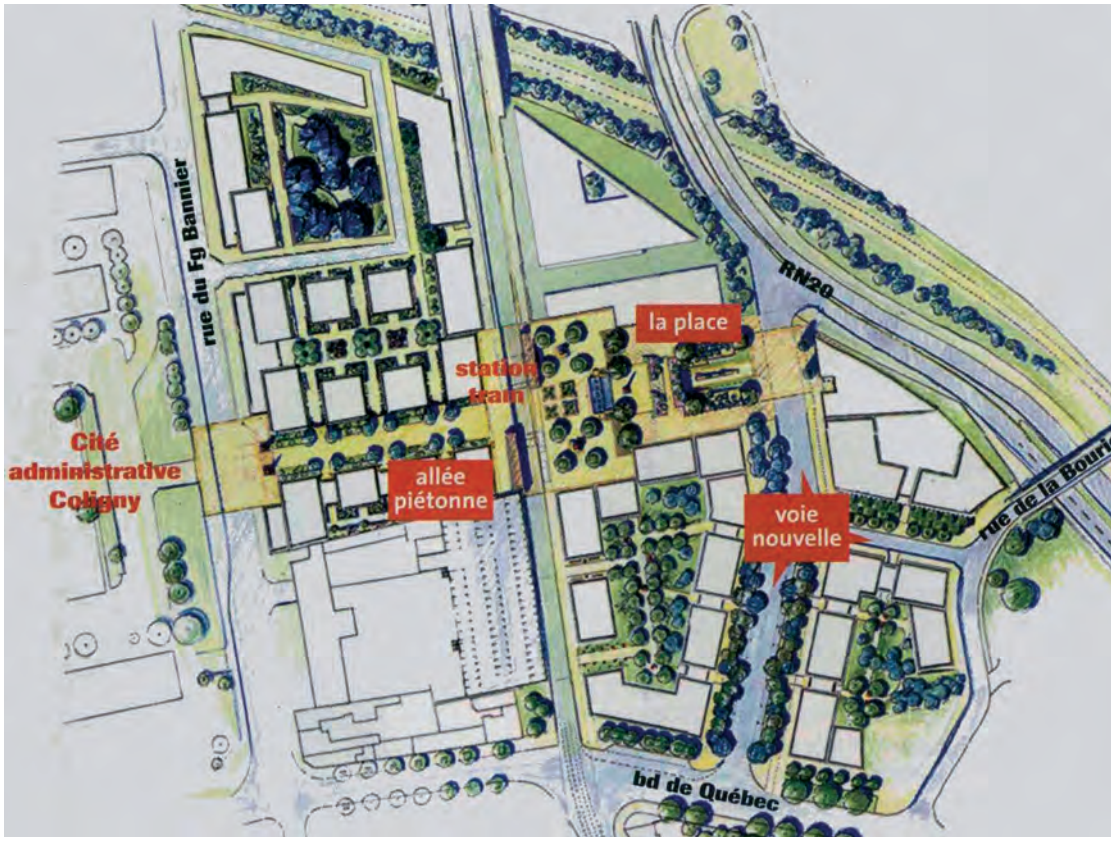
The Orléans observatory was among the first dedicated monitoring centres to be operational in France and has provided an example for others to follow. The monitoring structure consists of a steering committee, a technical committee and a mobility observatory. The steering committee consists of professionals involved in the PDU process (representatives of local authorities, regional authorities etc) and the technical committee usually consists of other partners including economic organisations, transport associations and transport specialists. Monitoring is the responsibility of a research team comprising a project leader and specialists with different professional backgrounds (community transport, urban planning, traffic management and environmental aspects).

The primary function of the observatory is to ensure the implementation of decisions, to measure their progress and their efficiency throughout the period covered by the Plan. A subsidiary function is to monitor land use, transport and socio-economic change and, where appropriate, to propose actions to modify them. Finally, the observatory is responsible for public communications.

The working of the French mobility observatories is usually co-financed by the State, the Region, the Department and the municipalities. In the case of Orléans the observatory is co-financed by the constituting local authorities (80%) and the State (20%). An important element for the working and success of the observatories is the motivation of the local authorities, which involves regular communication and feedback.

Performance

Monitoring data are only just becoming available for the tram but early ridership figures suggest that the service is carrying around 12.5 million passengers a year (Semaly & Faber Maunsell, 2003).



Cologny

Key Best Practice pointers

The Orléans tramway is still in its infancy but the approach to its introduction and operation demonstrates a number of best practice features as follows:

- The local authorities are pursuing a strategy of public transport-oriented development. This is based on a complex combination of corridor and node-based development, supported by mixed use development at strategic sub-centres and a policy of locating major attractors at key intermediate nodes on the high quality network.
- The tramway has been introduced into a dynamic area that offers potential for supporting patronage and also for providing a link with targeted redevelopment areas that offer the potential for node-based growth on brownfield sites.
- There is good coordination between transport and land use planning practices and common policy objectives have been established in local plans.
- Public housing schemes are being located to take advantage of proximity to tram stops in order to make the services accessible to those most likely to need them, a practice which in turn is likely to support public transport patronage.
- Orléans has taken a lead in establishing an observatory committed to monitoring the impacts of transport policy.

3.4 Strasbourg, France, tram

Reasons for selection

Strasbourg provides a best practice example of a successful approach to multi modal transport planning and urban development in a medium sized European city. As a case study it shows the way in which the two-way relationship between transport and land use can be exploited both to support public transport patronage and to encourage redevelopment. In particular it demonstrates the use of a high quality public transport system as a tool for urban structuring and illustrates the positive impacts of public transport on both the physical urban environment and the urban economy.

A sound institutional context has been complemented by strong leadership and political will. Combined with an inclusive approach to planning, these have created a strong public transport culture in Strasbourg that has also been an important factor in the success of tram.

Strasbourg redevelopment before and after.

Background

Strasbourg is a free-standing city located in the Rhine valley close to the Franco-German border in the eastern province of Alsace. The urban area covers 315 square km and is populated by some 430,000 people living in 27 municipalities, which together form the Communité Urbaine de Strasbourg (CUS). More than half of the population of the CUS is located in the City of Strasbourg (250,000 inhabitants), which combines the features of an historic city with its administrative function as the seat of the European Parliament and France's second largest financial centre. City employment is dominated by public sector jobs but there is also a strong manufacturing sector, with paper, electronics and food processing industries.

In the recent past Strasbourg has experienced strong, but spatially unbalanced economic growth. Between 1968 and 1990, the population of the CUS increased by 17%. During the same period, the number of jobs increased by 27%. Much of this growth took place at locations within the suburban fringe. Growth within the City was much slower, with parts experiencing a loss of both jobs and population.

Strasbourg's development history has given rise to the patterns of land use that characterise the urban area today. Despite difficulties of establishing offices in the historic core and the decentralization of major tertiary functions such as higher education and research laboratories to established zones such as techno parks, more than 70% of CUS service sector jobs are located in the central city area. The city centre is also the main shopping area with 25% of retail floorspace, the remainder being located in the surrounding urban area and at major shopping centres on the outskirts, adjacent to main roads. Industrial activities are mainly located in the north, the south and south west of the Strasbourg conurbation. The residential market is particularly strong in Strasbourg, with strong demand reflected in high land prices.

Intensive suburbanization combined with rapid growth in economic activity had led to publicly unacceptable levels of road traffic in Strasbourg by the 1980s. The river crossing points that provide access into and across the city centre had become seriously congested with cars and public transport road vehicles. The radial highway routes had also become congested with car traffic. Of particular importance were the principal axes of the City, including the Rue des Francs Bourgeois and Rue des Grandes Arcades. These had become so dominated by traffic that the fabric of the urban environment was deteriorating and along with this the image of the city centre.

A solution to the congestion and increasing environmental degradation was sought and the idea of reintroducing the tram was put forward as a sustainable transport alternative that could be used to revive the city centre and to steer the future growth of the wider urban area. Despite more than two decades of debate about the introduction of a high quality public transport solution however, little progress was made and successive proposals were rejected on political or economic grounds.

In 1989 the debate came to an end when the Mayor, Catherine Trautmann, took up the case for the tram. Through her political philosophy Ms Trautmann laid the foundations for a new planning policy framework based on improving the quality of urban living (la qualité de la vie) through improved integration of land use and public transport. In 1994 Strasbourg became the fourth French city to reintroduce the tram as an environmentally sustainable mode of transport. The tram has since become established as an integral part of life in the City. It has strong local support and its futuristic character has contributed to the image of the Strasbourg as a dynamic European centre, offering good quality of life underpinned by a leading edge public transport system.

Currently (2004) the Strasbourg tram network incorporates four lines (A to D) based on 26.4kms of track. Much of the network has been based on well established public transport corridors. It therefore draws its patronage from catchments previously served by the older trams and/or by buses that have since been released into service elsewhere in the city, enhancing the overall public transport offer. The tram was primarily conceived as a transport project promoted on grounds of access to opportunities and equity for local people. The introduction of the network was however planned on a façade to façade basis and every opportunity was taken to exploit economic development opportunities along the tramway.

Institutional framework and coordination

The CUS provides a framework for an integrated cooperative structure to manage area wide development strategy for the 27 municipalities incorporated within its boundaries. Within this structure there is a close working relationship between the different groups involved in developing and controlling the implementation of the transport and development planning frameworks. Of particular relevance in this respect is the process by which the development of the two key planning policy documents, the urban mobility plan (PDU) and the traffic plan (DVA), has been coordinated. This has involved establishing a technical pilot committee with wide representation from the City and the Region to discuss and formulate a common planning approach and to subscribe to the use of a common set of multi-modal policy assessment tools. This approach has meant that early in the planning process agreement has been reached, for example, on the population, employment and education projections that feed into the different plans and on the assessment of requirements through a multi modal transport simulation model.

Policy framework

The overall approach to planning land use and public transport is transport-led and has been founded on four guiding principles:

- Transport improvements will add to the quality of life by reducing traffic congestion, noise and pollution and maximising pedestrianisation opportunities

One of the many examples of a new (public) building close near a stop of the tramway ("Maison de la Région"; under construction, summer 2004)

- Travel will be refocused to promote public transport journeys, develop the use of two-wheeled vehicles and reflect local needs
- Public places will be revamped, notably the city's central and district squares, to provide a focus for social interaction
- Complementary parking policies will be employed to support the use of public transport use and reclaim public spaces.
- Implementation has been based on six key actions:
- Creation of the tramway system as the backbone for public transport and the basis for structuring/restructuring the urban area
- Integration of the tramway and bus networks
- Promotion of cycling and improvement of pedestrian environment
- Reduction of car use, including a ban on through traffic from the core area
- Re-planning urban spaces directly related to the backbone provided by the tram networks
- Participation and dissemination of information to local residents.
- Through these principles and actions the tram has become the cornerstone of ongoing development of the urban area.

Core principles: land use planning to support public transport

Land use policy has been carefully developed and integrated to support public transport objectives and the close physical integration of land uses with the tram network is an important feature of the Strasbourg system.

At the strategic level, urban planning policy aims to develop a well-defined, compact urban structure by controlling journey length and hence the long term pattern of urban growth and the prospects for public transport use. Development has been focused at key points or activity centres along the network and at the termini of the lines, which are linked either directly via the tram or via feeder buses and park and ride to the surrounding residential areas. Although the main focus for employment and shopping is on central locations, many of the tram stops are characterized by mixed use development with housing, public and private services including leisure activities and some local/convenience shopping. There are plans to further focus patterns of economic activity onto the public transport network by encouraging development at points where radial public transport services intersect and at points where radial and orbital routes cross.

Minimum development densities for areas associated with the high quality network have not been prescribed in planning documents. These are however under discussion for transport corridors and tram stops and it is expected that guidelines will be incorporated in revisions to current plans.

Working within the strategic planning framework, efforts have been made at the local level to encourage development into locations that will support the use of the tram and also cater for local need. For example:

- At the terminus of Line A at Hautepierre Maillon, a mixed use development incorporating high density (multi-storey) social housing has been created near to the tram stop. A range of local services in a district centre including shopping, leisure and healthcare facilities complements the housing. The area also has a school and enjoys good access to open space. The hospital serving this community is only two stops away and enjoys immediate access via a covered walkway from the tram. The pattern of development ensures that this socially disadvantaged community is not disadvantaged further or excluded by its dependence on public transport.
- Major trip attractors / generators have been located to take advantage of public transport access and where the CUS has more direct influence over the location/relocation of new public buildings or services this is used to maximize the public transport advantage. For example, the decision was taken to locate the new offices of Alsace Regional Council near to a tram stop and the head office of the County Public Works Directorate has been located close to La Rotonde tram stop on Line A.

Regeneration

Key target areas for reconstruction in Strasbourg included the main squares in the city centre, the Place Kléber and the Place de la Gare. However, it is Place de l'Homme de Fer that has become the main city centre tram stop/junction. It has undergone a major transformation as a result. The transformation of these squares has had a major impact on the image of Strasbourg and this is one of the most important positive externalities associated with the introduction of the tram.

The status of Place de l'Homme de Fer has been raised to that of an important and more vibrant square since it assumed the role of the dominant stop in the central area. The plaza is busy not only because of the coming and going of transit passengers using lines A and B, but also because of its distinct architecture, which offers important overhead protection from the elements, seating and meeting places.

Line A line also allowed for the pedestrianisation of the streets around Place Kléber. And this is now linked by pedestrianised streets to the Place de la Cathedrale and the Petite France quarter, which has benefited mainly through improved accessibility and the restoration of its old buildings and their facades.

The identity and sense of place of Place de l'Homme de Fer and the Place Kléber have also benefited from the frequent passage of tram passengers. Place Broglie and the Place de la Republique have benefited similarly from Line B.

Although the tram has resulted in the loss of some green space, environmental improvement measures along the new routes of the tram include the planting of 1,400 new trees and the transplanting of 300 existing trees.

Investment for the tram has come from a variety of sources. As with other French cities, Strasbourg has taken advantage of its ability to raise funding for investment and operation of its public transport systems through the Versement Transport tax, levying the maximum percentage charge (2.2% of payroll costs) on employers. This tax is understood to have contributed around one quarter of the costs of construction and rolling stock in the system.

Innovation and fresh thinking

The Strasbourg tram is one of the most distinctive and futuristic systems anywhere in the world. Despite this, the system has been unobtrusively introduced to the street scene of this historic city and used as the basis for re-planning the urban area and reviving the public places that interact with the tram.

By changing the use of the transport network in the city from cars to light-rail and by opening up the rights-of-way, the planning authorities have consolidated previously fragmented public spaces and created a more cohesive visual character throughout the metropolitan area.

Furthermore, by adopting high standards of design and incorporating easily identifiable design elements into the overall planning approach, the

Place de l'Homme de Fer

tram system has imparted a unique character to the city. This in turn has encouraged 'ownership' of the tram by local citizens, who constitute the potential market for its services. The tram is one of the most photographed features of the City of Strasbourg and has clearly won the hearts and minds of its residents.

Though the tramway network of Strasbourg basically serves the conurbation, indirectly the tramway also supports regional planning and development, as transfer nodes accommodate transfers from local transport (tramway, bus, bicycle) to regional transport (RER-train, bus, car), and vice versa. Hoenheim is a fine example of such a transfer node. Its meaning is enhanced architecturally.

Assessment criteria / performance indicators

Integration of both land uses and transport and modal transport networks is a fundamental component of the success of the tram system in Strasbourg. The results of efforts to integrate land use and transport policy are evidenced not only by the disposition of land uses in relation to the tram network at the strategic scale, but also by the close physical integration of land use, economic activity and transport that can be seen in the corridors and stops along the tramway system. Within the transport system itself feeder buses, park and ride and cycle facilities are all in evidence at tram stops and there is seamless integration with pedestrian areas, giving immediate access to travellers. A number of the impacts are described below.

Patronage: Hass Klau et al (2000) note that between 1992 (pre-tram) and 1998 the number of public transport passengers in Strasbourg increased by 50% from 40 million to 60 million per year. Semaly and Maunsell (2003) quote weekday ridership figures of 76,000 per line for Lines A/D and B/C equating to just over 6,000 per route kilometre. Pre-construction forecasts given by the CUS for Line A were around 50,000 passengers per month; against this the success of the system is evident.

Mode share: The impact of the tram on overall car mode share is unclear. The SESAME project indicates that the mode share of public transport increased from 5.8% to 6.8% between 1988 and 1997 (2% in the central city and 0.7% overall), but the increase, although largely due to the tram, was captured from slow modes and not from car. Within public modes CUS figures indicate that tram accounts for around 58% of evening peak journeys fairly evenly split between Lines A/D and B/C and bus accounts for 42%. CUS figures also indicate an overall increase in public transport patronage of 105% (up to 300% at some stops) and surveys show a decline in car traffic and congestion on the main routes into the City where traffic has been managed by bans and re-routing. In particular traffic flows into the town decreased from 240,000 cars per day in 1991 to 200,000 in 1995 against a previous average annual increase of 2 to 3% per year (SESAME, undated).

Impact on land uses / economic activity: A CETE study (European Commission, 2000) has shown that 29% of private buildings along Line A have been improved or have undergone a change of use since the introduction of the tram. In the city centre 40% of buildings have been improved (mostly due to restoration of the facades) and the use of one in four

Hoenheim interchange

buildings has changed. Major changes have occurred in the Rue des Grandes Arcades, the busy former shopping street that crosses the city from north to south, and there has been an increase in the number of clothing shops.

Impact on retailing: The impact of the tram on retail activity has attracted particular interest in the case of Strasbourg. A survey by CUS of 4,300 retail establishments attempted to clarify changes over a four year period but less than 3% respondents provided satisfactory information and the response was thought to be biased towards failing establishments. The analysis suggested that although retailers had complained about the negative impact of the tram on trade there was also a belief that establishments in the vicinity of a tram stop benefited from an increase or diversion in trade.

Further work analysed the situation against the reference case provided by national trends in France. For the country as a whole this indicated a reduction in central retailing and growth in the suburbs, together with a decline in sales of clothes and shoes. By comparison central city retailing has remained fairly stable in Strasbourg, and although there has been a decline in the inner suburbs the areas in the tram corridors are an exception to this. This work also highlighted the displacement effect of the tram in the central city, where some shops have been lost to finance and tourism sector activities as a result of an inability to compete in the rising rental market. The study concluded that the tram has effectively speeded up the natural cycle of failures and competition leading to displacement of lower value activities.

Property prices: According to Hass Klau et al the tram has impacted positively on property values and the impact can be seen in residential prices along the tramline, particularly close to stops, where increases of up to 10% can be found. The CETE study referred to above reviewed the annual survey of rents and found that outside the city centre in areas served by good public transport, rentals in private housing stock had increased much faster than in the city centre.

Key Best Practice pointers

Strasbourg demonstrates many best practice ingredients for a successful high quality public transport system:

- The tram is based on 'historic', radial transport corridors that take advantage of well-established commuting patterns. As a result it captures a large proportion of the resident population.
- Strong political leadership and a well-respected institutional structure have contributed to its success.
- There is a well-coordinated framework for land use and transport policy within the conurbation, and planning policies have been supportive of public transport patronage with respect to the siting of new development and major attractors at key nodes on the tram network.
- A comprehensive set of complementary policies has been introduced to support the use of the tram and discourage car use. These include Park and Ride, good modal integration and slow mode facilities, central area traffic restraint and parking restrictions.
- The tramway has contributed positively to regeneration by improving city image, remodelling and reviving the city centre and helping to arrest the trend to decentralisation of retailing activities.

3.5 Freiburg, Germany, tram

Reasons for selection

For more than 30 years Freiburg has pursued a strategy of sustainable development underpinned by innovative practices to support the use of public transport. Today the city is recognised as one of the most successful examples of integrated transport and land use planning in Europe and its tram network has been developed as a fundamental component of the city's overall development plan. Two new districts of Freiburg provide examples for case study.

Freiburg Rieselfeld, the first of these, provides an example of a development in which the public transport infrastructure, in this case the tramline supported by park and ride, has been built out before development has been completed. Three-quarters of this district has been designated as a conservation area that will be protected from development. The remainder is being developed with relatively high density dwellings and shops, the whole being guided by 'ecological' principles.

Freiburg Vauban, the second district, is a brown field site, previously used as a military base. It has been conceived as a 'car-free' settlement that will be connected into the tram network in stages as the development is completed.

The Rieselfeld, as well as the Vauban site are connected to the City Centre (Altstadt) by means of new tram lines.

In 1996 Freiburg Rieselfeld and Freiburg Vauban were presented as examples of Best Practice in sustainable development planning at the UN HABITAT II Conference.

Background

Freiburg is located on the edge of the Black Forest in the southern part of the Rhine Valley, in the state of Baden Wurttemberg. The city forms part of the urban area of Breisgau and covers an area of only 35 square kilometres. It has a population of around 201,000, a workforce of 88,000 and is an important regional centre for services and higher education. Since the 1960s Freiburg has experienced strong growth in both population (23%) and employment (almost 30%) and its university has expanded to accommodate in excess of 25,000 students.

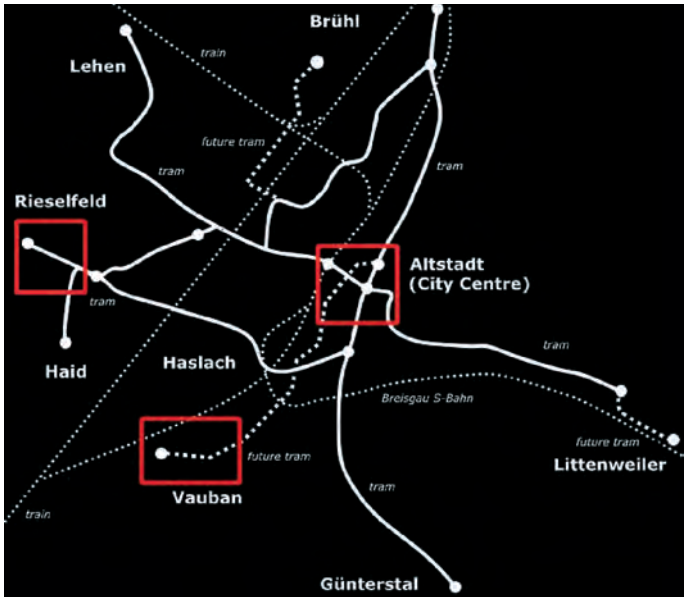
Unlike most German cities, Freiburg did not replace its original trams, although the old network was reduced from approximately 20 kilometres in its 1930s heyday to fewer than 15 kilometres by the mid 1960s. The first new extension occurred in the mid 1980s, heralding a new era for public transport in the city and a fundamental plank on which to build its strategy for sustainable development.

Since its decline in the sixties the tram network has almost doubled in size to 27.5 kilometres. The decision to retain the system was made in 1972 and one year later the city centre was pedestrianised, laying the foundations for traffic restraint prior to the expansion of the tramway.

Expansion has been based on a number of small extensions, resulting in three cross-city routes. The first and most substantial of these provided a new 7 kilometre link between the city centre and residential districts to the west. This line, which has forks to the north and the southwest, passes through a medium density corridor. It was opened between 1983 and 1985 and took the tram service into new areas, almost halving the 25 minute journey by bus. The other lines branch to the east, south and north and run through densities that are low by continental standards (Hass Klau and Crampton, 2002).

Planning policy framework

Freiburg has an established tradition of a coordinated approach to land use and transport planning. After World War Two the planning authorities opted to rebuild the war-damaged city along the lines of the traditional, compact model rather than to follow the trend to a car-oriented model based on lower development densities and sprawl (Newman and Kenworthy, 1996). More recently the growth of the city has been planned to exploit the availability of the tram system to move people around and new lines have been deliberately routed to serve areas of new settlement including Rohrgraben, Rieselfeld and most recently Vauban. The overall policy is



Schematic map of Freiburg


Altstadt

supported by strict regulations on the area of land released and zoned for development.

The major objective of transportation policy can be summed up as 'increased mobility with fewer car trips' and the whole approach to transport planning in the City is guided by 'ecological principles' aimed at improving the environment by reducing car use. Since the 1970s transport policy has been explicitly integrated with urban planning policies and reinforced by the use of a wide range of complementary measures.

Rieselfeld

The Rieselfeld district itself is situated on the west side of Freiburg, on part of a former sewage works of around 78 hectares. Construction commenced in 1994 on a large green field area and will continue for around 15 years. The local plan allows for 4,800 dwellings to be provided in the period to 2010. The final development will cater for around ten to twelve thousand inhabitants, giving a gross development density of around 6,000 dwellings and 15,000 persons per square kilometre. The settlement incorporates a range of district scale shopping facilities, as well as a large variety of public services, and will eventually provide 1,000 new jobs. The ratio of development to open space is 25:75 indicating very high net development densities.

The tramway (in red on the map) is complemented by a bus service (in blue). The main car infrastructure (depicted as black lines) is routed away from the central corridor. So, there is direct access for the tram, and indirect access only for the private car.

In the central corridor pedestrian and bicycle infrastructure accompany the tramway.

The tramway alignment follows a central axes within the Rieselfeld site. Density of the built environment is (and will be) intensified in the vicinity of the tramway. The two stops and the terminus stop are all within walking distance of this residential area.

The planning goal in Rieselfeld has not been to create a mixed-use suburban community, but rather to develop a highly compact settlement structure in order to save land, support public transport patron-

Rieselfeld development plan

A central tramline penetrates the Rieselfeld area

Areal view of Rieselfeld

age and discourage car use (Stadt Freiburg, 1993).

The key objectives are:

- To develop a sound ecological planning framework
- To solve the conflict between landscape protection and open space requirements
- To create a residential area suitable for families, women and elderly people
- To plan a high-density, compact residential area
- To develop a forward-looking transport concept with the priority on public transport and non-motorised modes
- To reduce car parking space
- To reduce energy consumption
- To create sufficiently attractive public transport that households no longer find it necessary to buy a second car.

The tramway has provided the public transport backbone for the development plan and the actual development process has been facilitated by the introduction of the tramline prior to completion of the new settlement.

Tramway alignment, Rieselfeld

The tramway was installed in an early phase (1997), when construction work was still going and no more than 1,000 people inhabited Rieselfeld. By 2004 the number of inhabitants had exceeded 5,000. Within 10 years' time the tram will serve 12,000 people.

The development plan has been based on a compact settlement structure reinforced by a perimeter development of 4-5 storey apartment houses and high density development borders the 300 m long main street of the new residential area. In the main street shops and community services are located on the ground floor of the buildings, with residential development above. Small business uses and services are allocated space in the southern part of the district and there are a number of new schools in the area. Half of all residential development in the area is subsidized / social housing.

Although development densities are high, the plan is designed to create a pleasant environment in which to live, avoiding high rise developments and using quality architecture with a focus on ecologically-oriented planning and buildings. Strong marketing has been used to help sell the development concept to locals and Rieselfeld district has been marketed under the banner of "Family friendly and Barrier-free living".

The tramline itself runs through the centre of the development. This feature has been designed to minimize access times for the majority of the population and to provide good access to the centre of Freiburg itself and the associated employment areas. Ultimately it is hoped to reduce the reliance on Freiburg by developing local employment opportunities.

The Rieselfeld tram has been running since 1997, when only about 1,100 people were living in the district. By the end of the project, the planned dwelling completions will mean that all 12,000 people in the settlement will have easy access to an efficient tramway. During peak times the tram is running every two or three minutes and after 7pm the interval is fifteen minutes.

An existing tramline (Line 5) was originally extended into the area at a cost of 7 million Euros. In addition, a new tramline (Line 6) runs along the main street to the terminus, Maria-von-Rudloff-Platz. There are three tram stops and the distance from each residential building to the nearest tram stop is no more than 400m, or five to seven minutes' walking. Trams between Rieselfeld and the city centre of Freiburg run every 10 or 15 minutes from early morning until midnight.

To support the use of the tram there are park-and-ride facilities on the outskirts of the area and there is limited parking on the main street. All other supporting infrastructure is designed to provide trams with optimal conditions. New routes replace bus routes, which nowadays are primarily used to feed the tramlines with passengers from suburban or remote areas. At key points there are transfer nodes to the German regional rail network, and short access distances are guaranteed to other means of transport, including park and ride and cycling facilities. The transfer stations are also focal points of the local bus system.

In order to prevent the parking of vehicles in residential areas secure parking is available for local residents. All distributor roads and residential streets have cycle crossings and the cycle routes are connected with the wider network of Freiburg. Each tram stop has cycle stands.

The policy of car restraint is supported by adopting the area-wide speed limits of 30 km/h imposed

elsewhere in new districts. This minimizes car disturbance in the area.

Freiburg Vauban

Freiburg Vauban is located on the site a former French military base on the southern edge of the city. It has a total surface area of 42 hectares and is expected to accommodate 5,000 people by the year 2006. The apportionment of developed and open space is very different to Rieselfeld, and gross densities are slightly lower at around 4750 dwellings and 12,000 residents per square kilometre. Like Rieselfeld, Vauban is essentially a residential development with supporting community services. It is also connected to the tram network. In the case of Vauban however the extension to Freiburg is taking place alongside the development. Work on the tramline commenced in 2003 and is expected to be completed by 2005.

Vauban district plan is divided into three phases:

- development of an environmental action plan to guide implementation
- public relations events aimed at information dissemination and designed to encourage community participation
- implementation and construction.

In 1997 the implementation phase began and is due to last until the year 2006. Strategic goals in urban development in the Vauban area include several ideals of sustainable city planning, with the emphasis on 'car-free living':

- the creation of a district with greatly reduced car ownership
- provision of affordable housing
- a vibrant social centre
- good standards of community and open space
- housing schemes based on innovative low-energy solutions.

The majority of the Vauban site was initially segregated into small scale and individual plots and individual property owners and building cooperatives have been encouraged to buy and develop these. This has led to variety in the built environment and architecture and a mix in the social structure, which is contributing to a well-balanced development.

The public transport connection to Vauban was improved in 2003 when work began on the installation of the new tramline. This project is taking place in two main phases. The first line under construction connects Vauban with the Merzhauser area and is expected to take around two years to complete. This will be followed in 2005 by work on the second section, linking Vauban to the new Haslach line and linking the new settlement area to the regional transport system. The whole system is intended to be operational by 2006.

A particular feature of planning in Freiburg Vauban has been the very pro-active approach to community involvement. A number of working groups have been set up and regular open meetings are convened for residents of the district through the 'Forum Vauban'. Raising public awareness has been a key component of the overall planning process and environmental awareness has been a fundamental cornerstone of PR and travel campaigns.

New residents are deliberately targeted through marketing campaigns in order to speed the process of integration into the local community and to help extend the positive public transport culture. An important element of this approach is the ongoing effort to educate local people in the benefits of high quality public transport in an attempt to encourage a positive response to policies designed to discourage car use and promote sustainable transport modes. Discussions with local professionals suggest that this marketing-driven approach has been successful, both in developing public awareness, in acceptance of the tram and also in further developing the positive public transport culture that already exists in Freiburg.

The participation of the community in Vauban has been much stronger than originally expected. Local residents identify with "their" district. This can be seen through thirty community housing groups, community building projects, a large number of people taking part in workshops and widespread commitment to local activities and facilities.

Innovation and fresh thinking

The city of Freiburg has many examples of innovation in the areas of transport, energy and conservation. Both the Rieselfeld and Vauban developments can be considered as innovative in terms of the methods employed to reduce the attractiveness of car.

The Vauban district remains a centre of attention for planners, architects and scientists. Furthermore, motivation to participate in local planning issues and community activities is high, with a good appreciation of what is best for the environment and human needs. This is assisted by innovations such as "Freiburg EXPO 2000", which promotes public awareness and involvement with these issues.

Besides general environmental and energy issues, the concept of car-free living is the guiding principle of the new Vauban district. Contrary to existing federal building regulations, households do not have to pay for or subsidise car parking, as they can choose to nominate themselves for car-free living and living without a car parking space. Both options are designed to keep cars out of residential areas and to reducing levels of car ownership. A car-free household has to make a one-off payment of around 3,500 Euros (plus an annual administration fee) to the Car-Free Living association. The association acquires land that may be used as car space if a household wishes to change its mobility pattern. While choice of mobility remains the same, the prescribed space (of 8 square metres) can be used to provide community spaces such as playgrounds, gardens and sports fields. The regulation is in force for cars and motorcycles with a cubic capacity above 50cc.

A household without a car parking space but which owns a car has to 'buy' car parking space from the municipal property owner. These spaces are located in a multi-storey car park on the outskirts of the district, hence keeping the actual residential area clear of vehicles. The purchase price for one car space is around 17,000 Euros, which is approximately one tenth of the cost of the housing units themselves. In case of a change of property these arrangements guarantee that new residents have an option to have a car if they want to have one. However, a household that decides to buy a car has to pay a significant penalty for a new car space.

As a result of the scheme around half of the households in Vauban choose to seek alternative modes to car in order to save money and local planners hope that towards the latter part of the decade this scheme will achieve the goal of 75% car-free households within the Vauban district. The scheme does of course tie in with the upgrading of public transport, including the extension of the tramline and new bus routes. Also, revenue accumulated through the scheme and traditional sources (i.e. taxes) may contribute towards non-motorised transport infrastructure.

Key Best Practice pointers

Freiburg and particularly its new districts demonstrate a number of best practice principles:

- The growth of the city has been based on sustainable development principles following a compact model and avoiding low density sprawl and car-oriented development patterns seen elsewhere in Europe.
- The high quality public transport network has been closely integrated with development and the network has been extended both to facilitate commuting from existing suburbs and to facilitate the development of new residential districts.
- High quality public transport is viewed as just on element of a balanced strategy for sustainable transport and in turn sustainable development. A wide range of complementary and policies have been used to encourage the use of non-motorised modes. These include advantageous public transport fares policies, and supporting feeder bus and park & ride schemes, together with policies of restraint on car traffic and parking.
- The sustainable development strategy is strongly promoted through PR and advertising campaigns. These are used to boost the brand image of public transport and to nurture customer trust and loyalty.

3.6 Oberhausen/CentrO, Germany, tram, bus and regional train

Reasons for selection

Oberhausen has been selected as an example of the potential role that high quality public transport can play in the redevelopment of a brownfield site. As with the Sheffield case study, it provides an example of the introduction of a high quality public transport system in an area characterised by problems associated with long term economic decline. In Oberhausen the case study is focused on a single site that has been developed for regional scale shopping and entertainment uses (CentrO).

Background

Oberhausen is Located in the North Rhine Region in the heart of the Ruhr, the industrial centre of the German economy. It is part of huge, urbanised super-region, called "Ruhrgebiet", a former heavily industrialised coal mining area. Although the cities in this area are independent and to a large extent self supporting, Oberhausen, Duisburg, Mülheim, Essen, Gelsenkirchen, Bochum, etc. are becoming nodes within an urban pattern containing some shared amenities. Some city centres are developing new facilities and evolving into regional centres. Others are declining and their role tends to be restricted locally only.

The new Oberhausen and traditionally strong cities like Essen and Dortmund represent an urban zone of which the development is both car and public transport oriented. The zone is served by a dense highway network, as well as an extensive network of regional trains, called S-Bahn. Main stations of the S-Bahn are also served by national trains (ICE).

The super-regional S-Bahn is complemented by local and regional light rail networks (including additional bus services). A large area of the "Ruhrgebiet" is served by a unique light rail patchwork (U-Bahn). The city has a population of 223,000 and an urbanised area that extends to 7,700 ha. The region has suffered following the decline of its traditional coal and steel industries and as a result of the associated economic restructuring, much of the former industrial area of Oberhausen has been left with large swathes of derelict land.

Against a background of general economic improvement, the scale of brownfield land in the area has been viewed as a development opportunity and plans for its redevelopment were hatched in the early 1990s. Originally the industrial centre separated Alt-Oberhausen to the south of the town from Sterkrade and Osterfeld townships in the north. The idea that evolved was to create a new centre which would link these three districts and would be known as 'Neue Mitte Oberhausen'.

The plans for the redevelopment of Oberhausen received a boost in 1996 when the CentrO shopping and leisure centre opened (SURBAN, 2000). At the northern end of the agglomeration, on a 98 hectare site of a former steel works, the Centre was hailed as the biggest of its kind in Europe. It was conceived as the anchor for a new service-based economy that would assist regeneration and attract visitors from across a wide regional catchment.

In this context Oberhausen really is a 'winner'. The new CentrO mall, locally called "Neue Mitte" ('New Centre'), has transformed the amenity structure of this super-region. The new centre of Oberhausen serves the whole region and even welcomes many visitors from other parts of Germany, as well as from The Netherlands.

CentrO incorporates a shopping mall with 70,000 sq metres of retail space, multi-storey car parks and an area of restaurants. It also includes an amusement park with various attractions, a new public transport station, an auditorium for musical and sports events, an area of housing and a small office and business park with accommodation for R&D type activities. The new development is strategically located near three important motorways and within a radius of 2.5 kilometres there are twelve motorway exits. In addition it offers 10,500 free parking spaces.

CentrO is a joint-venture between the two British firms, Stadium Group and P&O, which specialise in developing brownfield sites. One of the consortium's flagship projects is the Meadowhall shopping centre in Sheffield which, like CentrO, is on a former steel plant site. In 1991 Stadium signed a contract with the

Ruhrgebiet. CentrO is situated on a former industrial zone north of the old centre of Oberhausen.

Tram / busway network

City of Oberhausen and subsequently took responsibility for the implementation of the framework plan.

The new combinedtram/busway was introduced in 1996, connecting Oberhausen's main railway station to "Neuw Mitte", CentrO. In 2004 the tramway was extended to a northern suburb.

CentrO is situated on a former industrial zone north of the old centre of Oberhausen (see map/aerial view, top and bottom respectively).

An elevated tram/bus station (T) and huge car parks (P's) serve the shopping mall.

From a transport oriented development point of view, the new tram/busway of Oberhausen (OB) suites two purposes. Firstly, it provides access to the regeneration area of "Neue Mitte". Secondly the tram/busway connects both the new and old centres of Oberhausen to other regional and super-regional nodes. It does this in two ways: by offering transfers at "Hauptbahnhof" ('main station'), to S-Bahn and other train services (Sterkrade "Bahnhof" also offers transfer to some trains, but no S-Bahn); and by the running of new tram and bus services on the local/regional networks of the neighbouring cities Mulheim (MU) and Essen (E).

In the near future the tram will be enhanced by means of two new connections (in red on the map) from the existing OB's tram/busway (in blue) to the Essen tramways (also in blue).

Planning policy framework

The development of Oberhausen has been guided by an integrated development framework that incorporates policies on planning, economic development and transport. With the support of the federal government (needed to overcome legal obstacles), the Regional Development Plan was modified in 1992 to incorporate the permission to develop the CentrO shopping and leisure complex. The City of Oberhausen simultaneously modified both its provisional land-use plan and the legally binding land-use

The partly elevated tram/busway of Oberhausen. Next to the "Gazometer" (top) and all kind of facilities near the CentrO mall (below right). The tramway is integrated in the public realm of the old centre (below left).

plan for the development project. Neighbouring cities were consulted on the proposals but despite concerns voiced about the negative impacts on local traders the centre was built.

In parallel with the planning process, a transport study was commissioned and its results were incorporated into the existing Traffic Development Plan of Oberhausen to allow for the forecast impact of CentrO. The main aims of the updated plan were to restrict the spread of urban development and improve public transport. The plan also included schemes for improving infrastructure for cyclists, restrictions on urban car parking standards and increasing central parking tariffs.

Regeneration Impacts

As if to underline the difficulties associated with assessing the impacts of transport in a regeneration context, previous research presents conflicting views on the success of the introduction of the tram and its impact on CentrO (for contrasting views, see for example European Commission, 2000 and SURBAN, 2000).

Besides serving CentrO, the tram/busway also provides access to park and cultural amenities in the vicinity of the mall. For instance, Oberhausen's new public transport serves, an old gasometer is nowadays a container of culture. A tram/bus stop north of "Neue Mitte" also facilitates a park, offering a site for circus "Olga". These amenities are welcomed regionally and contribute to the urban and economic transformation of the "Ruhrgebiet".

The partly elevated tram/busway of Oberhausen. Next to the "Gazometer" (top) and all kind of facilities near the CentrO mall (below right). The tramway is integrated in the public realm of the old centre (below left).

According to Hoppe (SURBAN, 2000) shopping and leisure activities at the northern end of the Oberhausen agglomeration attracted around 75,000 customers per day in 1996. This study cites the following from a long list of results to demonstrate the growing support and success of the public transport system:

- Travelling time on city express routes has been reduced by up to 40%
- City express buses provide more than 70% of all bus trips
- Services have improved for more than 90% of customers
- In 1996 the operator, STO.AG, had approximately 30 million passengers, which was an increase of 5.5 million passengers compared with 1995.
- Season tickets are used more frequently and special offers have become increasingly popular. The monthly season ticket ('Ticket 2000') is used by 9,000 customers and another 6,000 customers take advantage of the 'job ticket', which can be purchased by employees in participating companies.

- In contrast to the national trend of a decrease in public transport use, STO.AG had an increase of 18.4% in 1997
- By 1996, 70 new tram or bus drivers had been employed.

Researchers at the Institute for Spatial Planning at the University of Dortmund (European Commission, 2000) have questioned the overall success of the re-development. They acknowledge that CentrO is well connected to the public transport network of the city and has an innovative new public transport line with modern low-floor vehicles and frequent service to the main railway and bus stations. They argue however that it does not form the basis of a model to be followed elsewhere, mainly as a result of its wider impacts, notably on the following grounds:

Within three years of opening CentrO had diverted trade from retailing and services in the city of Oberhausen and the two neighbouring townships. A survey revealed that 58% of all residents of Oberhausen prefer to shop at CentrO instead of the traditional centre. Losses of customers to CentrO are even observed in the neighbouring cities of Essen, Mülheim and Bottrop.

Most residents of Oberhausen regard CentrO as an improvement in the shopping opportunities of their city. 78% evaluate the project as good for the city despite its negative impacts in terms of car traffic growth and city centre decline.

CentrO is car-oriented, offers a vast amount of free parking (10,500 spaces) and this, together with its good motorway connection, stimulates more long-distance shopping trips by car.

In addition to the impacts reported by the researchers in Dortmund there have been other setbacks. Tempted by the most modern hockey rink in Germany, in 1997 one of the country's premier hockey clubs relocated to the site in the belief that they would attract substantial crowds. Despite success on the pitch and good accessibility, the crowds did not materialise and the club folded in the summer of 2002.

Key Best Practice pointers

The practices followed in Oberhausen have some features in common with the experience in Sheffield (not just the developer of the shopping centre), where the tram was also intended as a vehicle for regeneration and the retail development was in turn viewed as a means of supporting public transport patronage.

Firstly, although there is a more supportive and better integrated public transport planning framework in Oberhausen, there is an inevitable element of conflict between transport policy objectives that stems from siting CentrO within such a short distance of 12 motorway exits and providing such generous levels of car parking. This approach leads to modal competition between car and public transport and this may well have undermined the potential of public transport to contribute to the regeneration process.

Secondly, although the retail development sites in both Sheffield and Oberhausen were previously derelict, the choice of an out of town development location in each case has introduced economic competition, leading to a negative impact on city centre activities. In the case of Oberhausen the scale of the development and its regional role means that this impact has been felt beyond Oberhausen in other centres, including Essen, Mulheim and Bottrop.

In both cases the out of town location does not make best use of the central focus of public transport routes.

On the plus side, clearly CentrO and the new tramline have made an impact in the immediate vicinity of the development. The shopping centre has turned a derelict space into a lively centre of activity and the use of a brownfield site has avoided the potential loss of a greenfield site with the associated environmental impacts. There is also a strong underlying public transport philosophy in the region and, despite the car-orientation of the development, evidence of commitment to the tram can be seen in the form of a new connection to the town of Essen.

3.7 Stuttgart, Germany, light rail and regional train

Reasons for selection

Stuttgart is acknowledged as a best practice example of a medium sized city with a well-integrated high quality public transport system based on a variety of modes and supported by a powerful institutional structure. There is a history of joined-up policy thinking on land use and transport issues and the city has introduced an innovative regional think tank incorporating private sector participation to promote new ideas for the coordination of planning, transport and economic issues. Particular importance has been attached to supporting new developments with light rail links. Public transport patronage is growing, with evidence of positive impacts associated with the introduction of high quality public transport.

This case study focuses on light rail (the upgraded former tram) and regional rail (the suburban rail network called 'S-Bahn') in the context of their integration with wider public transport and urban planning policy.

Background

Stuttgart is the capital of the state of Baden Wurttemburg. The city has a population of 580,000 and covers an area 207 square kilometres, with an average population density of 2,800 per square kilometre. It lies at the heart of an urban region of 2.3 million people that displays a polycentric structure and a range of densities varying from an average of 2,900 per square kilometre in the city centre through to 1,100 in the outer ring (15 km from the centre), and 440 per square kilometre in the hinterland (EU Scatter, 2003).

Stuttgart is a wealthy city and its post war regeneration not only reflects the economic recovery of Germany in the last 50 years but also the success of its planning and transport policies in supporting its economic development.

As a state capital, the city performs an important economic and cultural and function and has earned recognition as a test bed for innovation in the transport industry. There has been strong growth in the residential population of peripheral districts in the last few decades. In addition, as with many of the HiTrans cities, there has been substantial growth in industrial and business activities on the periphery, reinforcing the overall pattern of decentralisation.

Stuttgart is a good example of post-war regeneration. Extensive World War 2 damage created post-war opportunities to extend the suburban rail network (S-Bahn) and for planning boulevard style roads. During the 1950s and sixties city centre tramlines were segregated from road traffic by routing through tunnels, and park & ride facilities were developed to support the rail system. In the late 1970s and eighties planning policy began to focus on improving the quality of life and this was achieved by careful integration of development with transport plans and projects. By-passes were built to reduce traffic nuisance in residential areas and 30 kph speed limits were implemented. At the same time public transport capacity was designed to accommodate peak demand in order to remove potential barriers to use and planned to link the main residential and employment areas.

Rail modes are now seen as the main form of public transport in Stuttgart and the light rail system has to be viewed as just one component of a successfully integrated transport system. There have been ongoing extensions to and upgrading of the S-Bahn commuter services and the conversion of the traditional tram system to provide a high quality light rail system is nearing completion. Typical rises in patronage of 20% have been reported following the upgrading of routes.

The conversion from tram to light rail capitalises on existing and established land-use transport interaction patterns thereby maximizing the potential from established travel patterns. Development in Stuttgart is also very rail-focused, creating a supportive environment for patronage.

Stuttgart traditionally had one of the most extensive and well used tram systems (strassenbahn) in Europe. As a result of an intensive modernisation programme commenced in 1976, the traditional tram system has evolved into a high quality light rail network (U-Bahn). This has brought major improvements in travel times, passenger comfort and overall

environment. The light rail lines are well integrated with the suburban rail lines (S-Bahn) that serve the main radial commuting axes into the city and the whole is integrated with the regional rail network, providing excellent accessibility at the regional and local levels. Feeder buses ensure a high level of accessibility to the rail network.

Institutional framework and coordination

The German approach to planning is generally characterised by a strong legal framework and decentralised decision-making structures. In the 1990s the Stuttgart Region (uniquely at that time) acquired its own political organisation comprising a directly elected regional assembly, the Verbrand Region of Stuttgart (VRS). The structure of the VRS is based on the 23 districts (covering a total of 179 communities) in the region and coordinates a wide range of policies including infrastructure, transport planning, economic development and landscape. This strong institutional planning structure has become a best practice model for other regions in Germany.

Regional planning of the greater Stuttgart area has created new focal points of urban growth, as well as reinforced existing ones. The regional maps illustrate this planning concept. All urban-regional nodes are located on an 'axis of development' ("Entwicklungsachse").

These axes are all served by rail-based public transport – on regional level by S-Bahn and on sub-regional level (conurbation of Stuttgart) by U-Bahn and S-Bahn.

The nodes have been set in a hierarchy. Firstly there is one 'upper centre' ("Oberzentrum"); this is of course the city of Stuttgart. 'Middle centres' represent the second level, containing area's regional centres, such as Bietigheim-Bissingen and Esslingen.

The third level contains smaller nodes/centres like Ostfildern and many others, some of which are not on an axis of development.

All centres/nodes host existing and, particularly, new residential areas ("Schwerpunkte des Wohnungsbaus"). Many of them also contain concentrations of employment ("Schwerpunkte für Industrie. Gewerbe und Dienstleistungseinrichtungen")

The third-level-regional node of Ostfildern (see maps) provides an example of new transport U-Bahn infrastructure being built to serve a huge development area. As in Freiburg-Rieselfeld, the public transport was at least partly established before the development took place.

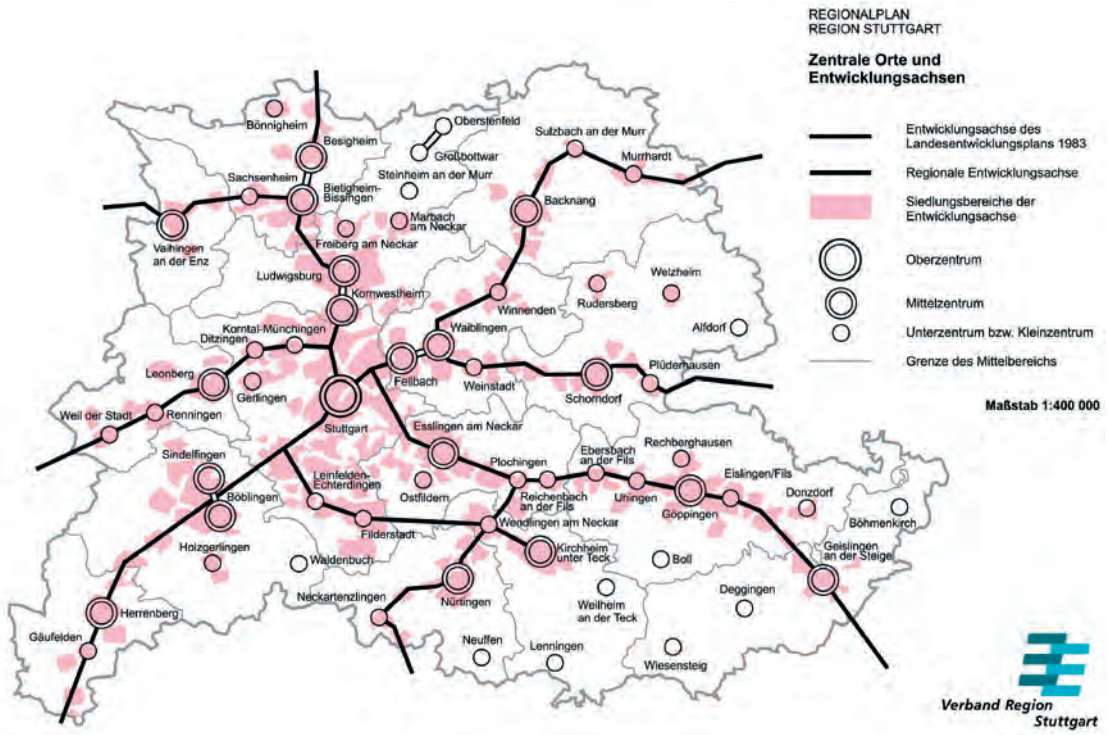
The Ostfildern site is connected to central Stuttgart by means of two light rail lines (in blue on the map), that bifurcate in central Stuttgart.

The VRS sits within the overall hierarchical approach to provision, regulation and integration of transport, which is structured as follows:

- State of Baden Wurttemberg (VVS) – responsible for regional heavy rail
- Verband Region of Stuttgart (VRS) - responsible for regional/commuter rail (S-Bahn)
- City of Stuttgart/Districts – responsible for local transport - trams and light rail (Stadtbahn), as well as buses.

The provision and regulation of transport within Germany have remained largely within the public sector. Following restructuring in 1995/6, the responsibility for railways transferred from the German federal government to the states. In response to the changes, Baden Wurttemburg formed a state company (NVBW) to plan, manage and finance heavy rail services. However the state authorities recognised the regional and local nature of many of the issues associated with the provision of regional rail and public transport services. In particular it was felt that in order to achieve a balance between the conflicting demands on land use / development, economic growth/regeneration, transport and the environment a locally focused level of guidance and control was required. The eventual outcome was to involve delegation of responsibility for the S-bahn commuter services to the regional planning body (VRS) and for local light rail/tram and bus services to the City of Stuttgart. The municipality operates the city trams / light rail and buses, with some private operation of feeder buses in the suburbs.

The decision to adopt this form of hierarchical ap-



Above Regional planning of the greater Stuttgart area has created new focal points of urban growth, as well as reinforced existing ones. The regional maps illustrate this planning concept. All urban-regional nodes are located on an 'axis of development' ("Entwicklungsachse"). These axes are all served by rail-based public transport – on regional level by S-Bahn and on sub-regional level (conurbation of Stuttgart) by U-Bahn and S-Bahn. The nodes have been set in a hierarchy. Firstly there is one 'upper centre' ("Oberzentrum"); this is of course the city of Stuttgart. 'Middle centres' represent the second level, containing area's regional centres, such as Bietigheim-Bissingen and Esslingen.

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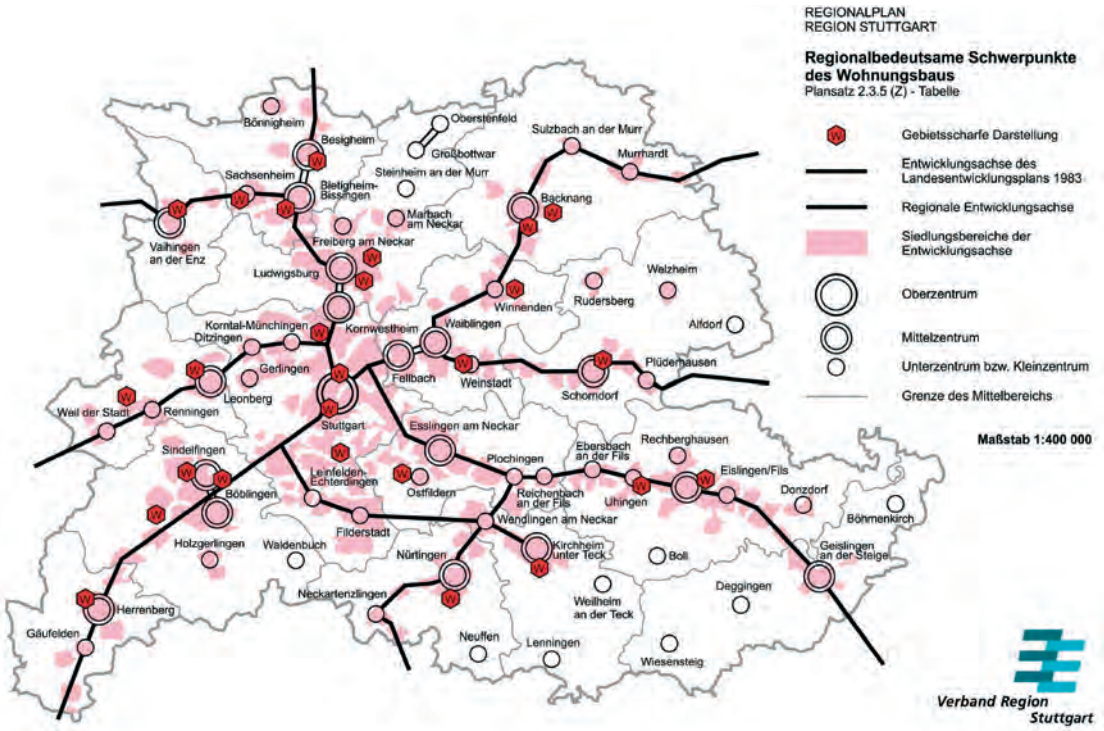
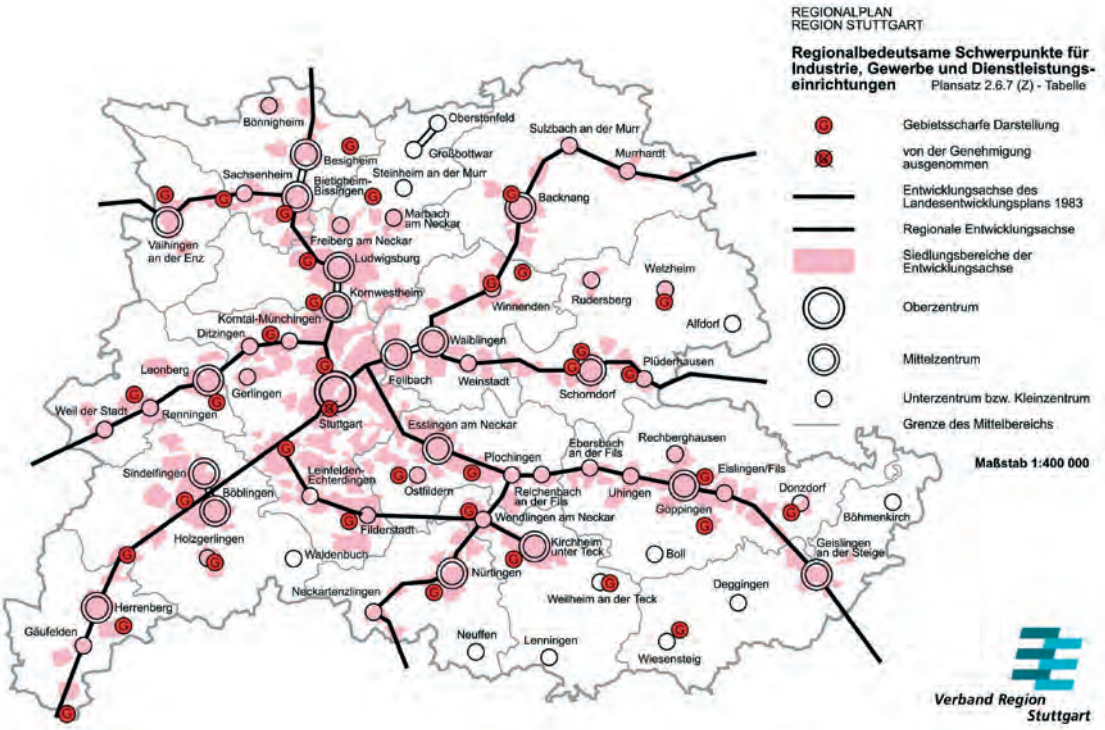
Top right All centres/nodes host existing and, particularly, new residential areas ("Schwerpunkte des Wohnungsbaus"). Many of them also contain concentrations of employment ("Schwerpunkte für Industrie. Gewerbe und Dienstleistungseinrichtungen")

Bottom right The third-level-regional node of Ostfildern (see maps) provides an example of new transport U-Bahn infrastructure being built to serve a huge development area. As in Freiburg-Rieselfeld, the public transport was at least partly established before the development took place.


REGIONALPLAN
REGION STUTTGART
Regionalbedeutsame Schwerpunkte des Wohnungsbaus
Plansatz 2.3.5 (Z) - Tabelle
Gebietsscharfe Darstellung
Entwicklungsachse des Landesentwicklungsplans 1983
Regionale Entwicklungsachse
Siedlungsbereiche der Entwicklungsachse
Oberzentrum
Mittelzentrum
Unterzentrum bzw. Kleinzentrum
Grenze des Mittelbereichs
Maßstab 1:400 000
Bönnigheim
Besigheim
Oberstenfeld
Großbottwar
Sulzbach an der Murr
Murrhardt
Steinheim an der Murr
Sachsenheim
Bietigheim-Bissingen
Marbach am Neckar
Backnang
Freiberg am Neckar
Vaihingen an der Enz
Ludwigsburg
Welzheim
Rudersberg
Winnenden
Kornwestheim
Waiblingen
Alfdorf
Korntal-Münchingen
Ditzingen
Gerlingen
Fellbach
Weinstadt
Plüderhausen
Schorndorf
Leonberg
Weil der Stadt
Renningen
Stuttgart
Esslingen am Neckar
Rechberghausen
Ebersbach an der Fils
Sindelfingen
Plochingen
Leinfelden-Echterdingen
Ostfildern
Eislingen/Fils
Donzdorf
Böblingen
Reichenbach an der Fils
Uhingen
Wendlingen am Neckar
Böhmenkirch
Filderstadt
Holzgerlingen
Waldenbuch
Nürtingen
Kirchheim unter Teck
Boll
Geislingen an der Steige
Deggingen
Neckartenzlingen
Weilheim an der Teck
Herrenberg
Gäufelden
Neuffen
Lenningen
Wiesensteig
Verband Region Stuttgart


REGIONALPLAN
REGION STUTTGART
Regionalbedeutsame Schwerpunkte für Industrie, Gewerbe und Dienstleistungseinrichtungen
Plansatz 2.6.7 (Z) - Tabelle
Gebietsscharfe Darstellung
von der Genehmigung ausgenommen
Entwicklungsachse des Landesentwicklungsplans 1983
Regionale Entwicklungsachse
Siedlungsbereiche der Entwicklungsachse
Oberzentrum
Mittelzentrum
Unterzentrum bzw. Kleinzentrum
Grenze des Mittelbereichs
Maßstab 1:400 000
Bönnigheim
Besigheim
Oberstenfeld
Großbottwar
Sulzbach an der Murr
Murrhardt
Steinheim an der Murr
Sachsenheim
Bietigheim-Bissingen
Marbach am Neckar
Backnang
Freiberg am Neckar
Vaihingen an der Enz
Ludwigsburg
Welzheim
Rudersberg
Winnenden
Kornwestheim
Alfdorf
Korntal-Münchingen
Ditzingen
Waiblingen
Leonberg
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Fellbach
Weinstadt
Plüderhausen
Schorndorf
Weil der Stadt
Renningen
Stuttgart
Esslingen am Neckar
Rechberghausen
Ebersbach an der Fils
Sindelfingen
Plochingen
Leinfelden-Echterdingen
Ostfildern
Eislingen/Fils
Donzdorf
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Uhingen
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Böhmenkirch
Filderstadt
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Kirchheim unter Teck
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Deggingen
Neckartenzlingen
Weilheim an der Teck
Herrenberg
Gäufelden
Neuffen
Lenningen
Wiesensteig
Verband Region Stuttgart

proach has been unique in Germany. It has facilitated integration of local transport services and has in particular allowed much greater coordination of land use and transport planning within the region.

Since 1978 all public transport modes have been coordinated by the Stuttgart Transport and Tariff Association (VVS), the management agency that is responsible for routing, timetabling and passenger information services throughout the Stuttgart Region. VVS has the support of the local authorities through its shareholding arrangement, which includes a mix of public and private sector interests including VRS, planning and operating organisations, as well as the investors. This arrangement means that the Districts can negotiate with VVS for services but they do not have financial responsibility for provision. VVS plans improvements in consultation with operators, estimates patronage and revenues.

Planning policy framework

The overall approach to planning and transport is characterised by good vertical and horizontal coordination of responsibilities, good modal integration and a public transport policy framework that both builds on existing development patterns and seeks to maximise access via public transport links by concentrating high density development and redevelopment schemes around public transport nodes and in corridors (transit oriented development).

The polycentric regional development pattern is served by radial commuter and regional rail services that link surrounding sub centres with the City of Stuttgart, providing an important link between central employment areas and the labour catchments of the outlying residential areas. Development of this network has been part of regional transport policy and has been integrated with land use and economic development policies aimed at reducing car travel and urban sprawl, and at maintaining the competitive position of Stuttgart.

Transport is established as a fundamental element of the regional land use plan. This provides an integrated framework for the sensitive and sustainable development of the area and is underpinned by multi-modal transport policies in which high quality public transport plays a central role. Priority is given to the development of brownfield / old industrial areas that have existing rail provision and to new sites that can be served by new rail links and stations.

The Regional Transportation Plan strategy is guided by the key objectives of improving transport efficiency and increasing the availability and acceptance of public transport. The development of a traffic management system and the promotion of mobility initiatives underpin this approach, which is taken forward in the more detailed district-level transport plans. Together these plans aim to extend and improve the public transport network, with the emphasis on light rail links and improved passenger services and information. In response to recent trends in the growth of travel to recreational activities, recent policy is encouraging a shift to public transport with a view to capturing the growth in the leisure market by planning new developments and public transport provision in tandem.

Core principles: land use planning to support public transport

In order to maximise potential public transport catchments, development is focused on existing public transport corridors and densities are increased to support patronage. As part of regional policy, new routes are designed to link employment centres with housing areas, supporting rail with park and ride and bus feeder services to facilitate use.

Spatial policy has also steered the direction of new development to take advantage of access to light rail and regional rail services (location efficient development). For example Stuttgart Airport, a cluster of leisure activities and the establishment of economic 'poles' in the Vaihingen and Wallgraben areas have encouraged new residential development in the southern part of the region. In Filderstadt, beyond the airport, the population grew by more than one-third in the 1980s. The area enjoys good accessibility to all the main transport networks as well as good accessibility to the airport and southern

Sillenbuch

employment areas, so that the quality of life and services is generally very high.

Policy also promotes the introduction of mixed use schemes. Housing is mixed with retail, employment and leisure uses in an effort to encourage the substitution of car trips by slow modes and to facilitate multi purpose trips.

Transport professionals have been involved in the design of development plans from an early stage in order to help achieve the local objectives of promoting public transport access and reducing road traffic.

Regeneration

Regeneration projects are a factor in the identification of new focal points for urban growth. Stuttgart's flagship project 'Stuttgart 21' is an example of this policy approach applied to the redevelopment of a difficult but major site within the city centre.

The Stuttgart 21 Plan aims at rebuilding the Stuttgart-Ulm-Augsburg rapid rail line. This will bring improvements in regional and long distance travel and good connections to the Filder area and the airport. It will also facilitate the development of new urban neighbourhoods in the city centre, the enlargement of green spaces and parks and the creation of jobs at the centre of a region that enjoys excellent and

improving public transport accessibility. The project has involved the reclamation of around 100 hectares of former railway land in the vicinity of the central station. Around half of the site has been redeveloped, leaving 20% for parks and open space and some 30% for streets and other green areas. Parking provision has been minimised in order to reduce road traffic in the area and to preserve land for open space uses.

For example the centre of Sillenbuch (Kirchheimerstrasse) was rejuvenated when the former tramway was upgraded to light rail standards and extended to the new residential area of Ostfildern (1999). Sillenbuch is not a regional, but a local node, being part of the city of Stuttgart. As part of the public transport upgrade the Kirchheimerstrasse has improved its architecture, public realm and adjacent amenities.

The physical scale of this project means that it has opened up considerable opportunities for new high quality development, coupled with high quality public transport at the heart of the city. The opportunities for efficient use of prime development land have been reinforced by re-routing of tracks through underground tunnels and the lowering of the station in order to reduce the land-take above ground.

The Kirchheimerstrasse in Sillenbuch is a fine example of retail improvement coinciding with improvement of public transport. This is symbolised by the official nickname of this local centre, 'The Mile' ("Die Meile"), which is promoted by retailers on a map displayed at many places. 'The Mile' is in fact the marketing term for the Kirchheimerstrasse and shops in the vicinity. 'The Mile' is depicted on the official map as a shopping strip of nearly two kilometres along the alignment of the new light rail connection. U-Bahn stations serve 'The Mile' and its retailers, as the map clearly indicates.

Innovation and fresh thinking

A feature of the integrated approach to land use – transport planning in Stuttgart, and one identified as important to the success of the system, has been the establishment of a Regional Think Tank. This body was set up by VRS with the purpose of bringing together public and private sector interests in order to promote an holistic approach to the planning of transport and to foster good practice.

The Think Tank comprises eight working groups charged with the task of supporting the coordination of transport with other policy areas, including the planning of new development, job creation, mobility and social inclusion, and the environment.

Implementation experience

Public opposition to many proposals has caused delays, changes and cancellation of schemes in the past. This included delays to the pedestrianisation of the central area, cancellation of a major subway system (U-Bahn) and cancellation of road schemes. Consultation is now a key component of the transport planning process.

According to the results of the SCATTER project, policies aimed at encouraging new developments along the transport infrastructure have not always been successful. In particular low density developments based on good quality individual housing have occurred on the periphery of the urban areas and there has been some development / infilling between the main transport axes. These areas have attracted higher income groups, leaving lower income households in the more densely developed areas that tend to be more congested and polluted, and where rents /property prices are generally lower.

The reform of local government in the 1970s left the municipal boundaries of Stuttgart unchanged. Since then many residential and commercial / industrial users have relocated beyond the boundaries, reducing the control of the City in terms of managing the spatial and functional evolution of development and the income of the City raised through taxes on income and production.

Key Best Practice pointers

Stuttgart is an excellent example of best practice in terms of the overall approach to planning and transport in a medium-sized city The approach is characterised by strong vertical and horizontal coordination of regional and local planning responsibili-

ties, good modal integration and a public transport policy framework that both builds on existing development patterns and seeks to maximise access via public transport links by concentrating high density development and redevelopment schemes around public transport nodes and in corridors.

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Stuttgart is also a best practice example of a sustainable approach to transport network development that mitigates the potential impact on land take through the use of underground construction solutions. The use of underground network increases the prospects for transit oriented and location efficient development. This practice is complemented by regeneration policies that give priority to the development of brownfield / old industrial areas that have existing rail provision. The Stuttgart 21 project is an example of this.

3.8 Graz, Austria, tram

Reasons for selection

Graz is the second City of Austria, with some 240,000 inhabitants. It is the regional capital of Austria's Styria province and by virtue of its well-preserved historic buildings and architecture it has become an important cultural centre. In 1999 it was designated a UNESCO World Cultural Heritage Site and in 2003 it was designated the Cultural Capital of Europe.

The City has been selected as a case study here because it is often quoted as a best practice example of public transport planning. It has a long-standing history of innovation in public transport implementation. Significant investment in its tram and bus systems was taking place as long ago as the 1970s, placing it at least fifteen years ahead of many comparable European cities, if not more. It has succeeded in introducing high quality public transport to its historic centre and for some years stood out as an excellent example of a well integrated, high quality public transport system. However, more recently, growth in car ownership coupled with a changed political situation appears to be threatening continued progress in discouraging car use. Despite this, the compact city centre is still well served by its tramway infrastructure and the associated urban design measures that promote a high quality urban environment to support it.

The city of Graz hosts a tramway network that reflects the historic-urban fabric. The overall catchment of the tram is limited however, as the tram lines never have been extended fully to new parts of the city, despite many impressive schemes and plans. The tram runs through the historic centre and the adjacent valleys that have been occupied for many years. The tramway network (in red on the map) is complemented by bus lines (in blue) that serve the outskirts of Graz.

Despite of the limited reach of the tramway, most of the sub-centres of the city are served (in red on the map – 'Z': "Bezirks- & Stadtteilzentren"). The core of the city and the tramway is the historic centre ('SZ" – "Stadtzentrum")

Background

The recent development of Graz appears to have been strongly influenced by its strategic location as a communications node between northwest and southeast Europe. This has created a situation where significant business development has had to be accommodated within an environment of great historical significance. The last decade has seen very little population growth within the city centre but considerable expansion of the suburbs as more and more people have elected to live out of town and take up commuting to work. Some 360,000 people now live in Greater Graz, which has an average population density of 2,000 per square kilometre. This contrasts with the city centre, where the density is almost double, at 3,800 per square kilometre. Some 70,000 people now commute into the city centre every day. Car ownership levels are very high – almost 50% higher than comparable cities in the UK, for example.

The quality of life in the city has always been high and transport policy has been primarily concerned with maintaining and improving environmental quality. The threats of congestion, atmospheric and noise pollution were realized very early on. As a consequence, there has been a long-standing tradition of pedestrianised areas and measures to discourage car use. The city probably has one of the oldest sustainable transport policies in Europe. Like many other cities with an important historic centre, Graz however, has faced the problem of accommodating growth without compromising its urban fabric. With already high central development density, the preferred solution has been to have a policy of suburban housing development. This has exacerbated the problems of commuting and transportation.

The policy of restricting car use in Graz in favour of public transport, walking and cycling began in the early 1970s. As is so often the case, there was a strong political champion for this policy in the person of one Councillor Edeggar, who was successful in gaining agreement to environmentally friendly policies. In 1973 53% of the population were in favour of restricting car traffic and 1975 a referendum saw the

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rejection of plans to build an autobahn through the city. Pressure groups have consistently contributed to making residents aware of the negative environmental impact caused by road vehicles.

Prior to the tendency towards decentralization, environmentally friendly transport policy appears to have been politically acceptable. This is witnessed by some quite strong anti-car legislation. Graz, for example, was the first European city to impose a 30 km/hr speed limit for the entire city area (barring major roads). With the increase in in-commuting however, the political climate seems to be changing and there is now serious concern that sustainable transport policy might be undermined by a shift in the political climate brought about by increasing demand for car use. The death of Councillor Edeggar some ten years ago has undoubtedly contributed to this change in culture and a referendum held in 1995 revealed that only a small majority were in favour of existing transport policy. Furthermore, the results of the referendum were undermined by a small turnout.

The tram system has seven distinct routes that radiate out to cover much of the city from the central area of Jakominiplatz and Hauptplatz. Consideration is being given to extending parts of the network further into the suburbs although with a less favourable climate for public transport, plans are moving very slowly.

All tramway lines pass through the historic centre and support the shops located there (though it will be hard to find full empirical evidence for this). The tramway certainly has contributed to the preservation of the historic urban fabric of the centre district.

All tramway lines pass through the historic centre and support the shops located there (though it will be hard to find full empirical evidence for this). The tramway certainly has contributed to the preservation of the historic urban fabric of the centre district.

Institutional framework and coordination

The national framework for transport policy in Austria is provided by a national infrastructure master plan published in 1997 and similar plans are also published at a regional level. The Federal Government is responsible for strategic national schemes as well as important regional infrastructure. Road transport is the responsibility of the Ministry of Public Economy whilst all other modes are the responsibility of the Ministry of Science, Transport and the Arts. It is interesting to note that land use policy is the responsibility of the provincial authorities (Bundeslander), which produce integrated plans dealing with environmental impacts, land provision for transport schemes and coordination between land use and transport policy. The Graz City Council also has a strong say in land use and transport issues.

Operation of public transport is the responsibility of several agencies within the City. A company called GBV, owned by the city council, operates the buses and trams. Private operators control other bus routes and these number over fifty in total. Local buses are supplemented by inter-urban services run by the Austrian Post Office.

Despite the large number of operators, integration of the entire system is the responsibility of MobilZentral, which coordinates services, publication of timetables and promotion of the network under the eye of its regulator organization Steirische

Ver-kehrsverbundgesellschaft (StVG). MobilZentral operates from offices in the centre of the city and oversees public transport throughout the province. Styria is divided into seventy zones and users can buy a single ticket for transport between zones valid for any mode of transport on any route. This arrangement reduced travel costs by up to 40% for some routes. The city's main railway station is the focus for service integration by virtue of extensive interchange facilities for rail, tram, bus, taxi, cycle and pedestrian modes. StVG is responsible for a turnover in excess of 100 million Euro per year within its constituent companies. 19% of this comes from government sources.

Despite the large number of operators and the complexity of the system, it appears that MobilZentral has succeeded in promoting very high levels of integration and the network runs very smoothly. Coordination of services and zone-based ticketing are important factors in this success.

Planning Policy framework

Although there has been a strong tradition of regional planning with emphasis on integrated land use transport and environmental policies, it is difficult to avoid forming the impression that the policy of housing decentralisation that been pursued in recent years has led to pressure on the transport network. Policy in the historic core has revolved around discouraging car use in the interests of sustainability and conservation whilst at the same time suburban housing development has been allowed to proceed independently. The longstanding network of trams follows well-established corridors within the city and in the past these provided a focus for compact urban growth. Without extension and harmonisation with the wider planning strategy however, these short corridors have little relevance to the growing problem of in-commuting.

At a regional scale, the Austrian government has concerns over the maintenance of rural economies and tax concessions that are available to long distance commuters. These were put in place to try and prevent rural depopulation. This policy clearly favours dispersed settlement patterns and conflicts with a policy of sustainable development based on public transport corridors and urban containment. There is a clear danger that past success of high quality public transport in servicing commuting patterns may be lost in the future as the journey to work area grows.

All of this suggests that the very positive and successful drive towards sustainable transport development that has been taking place within Graz will have reduced relevance in the context of the future growth of the urban area. If this is indeed the case, it lends strong motivation to the shift in political climate described above.

Core principles: land use planning to support public transport

It has already been noted that the basic structure of the transport network in Graz serves a well-established pattern of land use and movement in radiating corridors. Since 1970 very strong policies have been in place to maximise environmental quality by restricting the use of cars in the City centre. These policies have restrained car traffic by creating sizeable pedestrianised areas in the historic core, strong controls on central parking, implementation of cycleways and walkways and integrated promotional campaigns for public transport (see complementary policies below).

Since 1995 the City council has had a policy of 'gentle mobility' based on the concept of 'holistic integrated transport' or 'Grazer Integrierte Verkehrsentwicklung', which translates to the acronym 'GIVE'. It has to be noted that in relation to many other European Cities GIVE is starting from a fairly advanced development stage. Its general objective is 'to create a city for people and not for cars'. General objectives include achieving good accessibility to all destinations for city, regional, long-distance and goods traffic, together with providing a choice of public transport whilst reducing the amount of road space. Emphasis is also placed on local provision of goods and services to try and minimize trip lengths.

Particular emphasis is placed on increasing the use of cycling and halting the rise in car share.

Whilst GIVE has very clear targets its acceptance by the public has been marginal (see above). This might be put this down to a general shift in political climate but it is not unlikely that other factors may be at work. In particular, it is not clear what the specific policy instruments will be to achieve these objectives. Much of the current emphasis seems to be placed on what has been referred to elsewhere in this study as 'complementary policies' rather than developing a coordinated land use and transport management strategy.

Innovation and fresh thinking

The policy of promoting the use of high quality public transport to a young audience in schools and colleges is a particularly innovative aspect of transport management in Graz. It has the potential to secure patronage from generations to come as long as the service meets with expectations.

Many of the policies and supporting measures used in Graz have been emulated elsewhere and will be described in the other case studies examined in this document. However, whilst many of these measures are new to other comparable cities, it has to be remembered that they have been a fact of life in Graz for almost 25 years. Furthermore, the lukewarm public reception for Graz's GIVE policy package might well be an indication that the City has reached a threshold in progress of public transport provision, where significant new ideas and concepts are now very much needed. There must be a real concern that high quality public transport has lost political support and commitment and has therefore lost its way.

Implementation experience

The experience gained from some 30 years of policy based on restricting car use in Graz has to date been very positive. The tram has played a major role. There is widespread agreement that the historic fabric of the City has been preserved and an environment has been created where pedestrians take precedence. Low levels of noise, pollution and danger from fast moving traffic enable relaxed use of the Centre as a place for shopping, on-street social interaction and enjoyment of cultural assets. The environment is particularly conducive to parents with young children, the elderly and the disabled. (However conflict has been noted between these groups and the users of cycles in mixed pedestrian/ cycle areas.)

Hitherto, there can be little doubt that the measures taken to achieve these successes have been popular with the public who appreciate a high quality public transport service. Whether there is now a growing tendency to take these benefits for granted or whether a more deep seated reaction is being felt from people being excluded from these benefits due to failure to adequately service new urban growth remains to be seen. However, it has to be noted that recent developments have been small-scale extensions of existing policies. Major improvements planned since 1995 are effectively on hold. These include new tram routes; the extension of city pedestrian zones and creation of new pedestrian zones in the suburbs; the creation of freight distribution centres; and investment in new vehicles.

Key Best Practice pointers

- Initial transit development is best suited to established corridors of population and movement
- Development of transit must keep pace with land use developments based on transit supportive policies
- Strong political support for transit is essential and must be maintained even when systems appear to be established and successful. Planning and transport must be kept at the top of the political agenda
- Service integration is an important element of successful transit
- Educational programmes promoting transit are an important mechanism for attracting long term patronage

3.9 Manchester – Salford Quays, England, light rail

Reasons for selection

Salford Quays is the redeveloped area of Manchester's docklands and provides an example of the successful integration of public transport and land use planning to support the regeneration of an inner city. The case study demonstrates in particular how elements of regional and urban planning approaches can be combined in order to attract economic activity and support demand for public transport during the difficult, early years of a regeneration initiative. It also shows how the close physical integration of high quality public transport with a carefully balanced mix of land uses can attract patronage and help to reintroduce vitality and economic activity to local areas. Finally, Salford Quays provides an example of how such systems can succeed against a background of deregulation and how light rail systems can successfully provide new transport opportunities by integrating previously unconnected railway lines into the network.

Background

The City of Salford has a population of 216,000 and forms a part of the Greater Manchester conurbation, a polycentric metropolitan region incorporating 10 boroughs with a total population of 2.6 million (BISER, 2003). As a birthplace of the industrial revolution and the economic hub of the North West, Manchester has developed important strategic transport links for both road and rail. The area is linked to the sea via a ship canal, traditionally had a thriving port that was based on Salford and provided a distribution function for the surrounding heavy industrial areas.

After a difficult period of industrial restructuring the conurbation has developed a number of regional business and financial service functions. The legacy of restructuring however has been inner area decline. During the last quarter of a century central parts of the conurbation lost up to one fifth of their population and many former industrial areas were left vacant as businesses chose to locate in more accessible or peripheral boroughs. As a predominantly old industrial area in the canal basin, Salford Quays suffered particularly in this respect and by the 1960s the whole area was badly run down, with a preponderance of brownfield sites, including uncomfortable, empty urban spaces.

Although Manchester traditionally had developed an extensive network of commuter rail services, all of the city centre stations were located on the edge of the business district. In combination with the lack of a north-south, cross-city rail link, this restricted the use of rail. Proposed solutions in the form of a connecting light rail system came forward as early as 1914. It was not however until 1982 that a successful proposal to connect the three city centre railway stations was tabled and the foundations for Metrolink were laid.

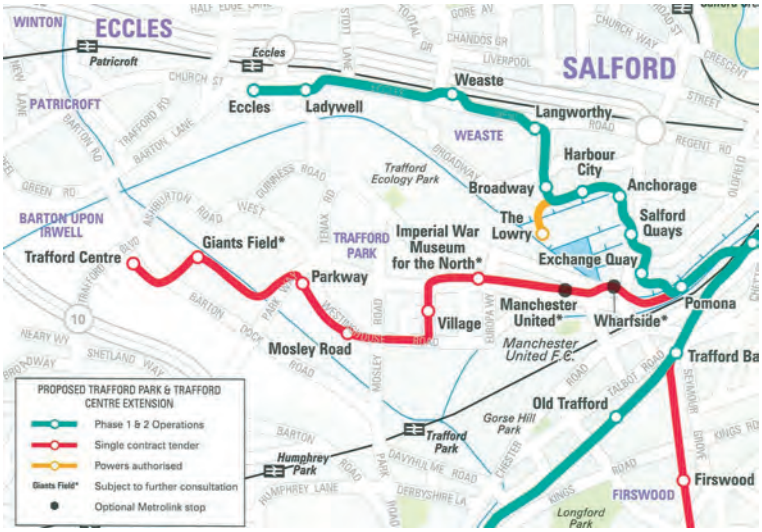
The 1982 proposals were delayed first by the complex funding requirements and then for more than two years in the aftermath of the deregulation and privatisation of local buses and the abolition of the Greater Manchester Council. The Manchester Metrolink finally received Royal Assent in 1988.

Phase 1 of Metrolink opened in 1992 and was designed to link the Central Business District (GMPTE, 2004) with Bury to the north and Altrincham to the southwest. It extended to 31 kilometres and involved taking over 16 kilometres of existing railway line between Bury and Victoria Station, and a further 11 kilometres of line to Altrincham. This first phase also introduced three kilometres of new street running track in central Manchester, providing a link to the G-Mex Exhibition Centre (see Black, 1998; European Commission, 2000).

The second phase announced in 1996 (the Eccles extension) was required to complete an important missing link in the network between Manchester Piccadilly Station and Eccles to the west. It was designed to incorporate Salford Quays and intended to support the ongoing regeneration initiative for Salford's flagship development scheme by improving accessibility and helping to create a high quality and positive image for the City of Salford.

In 1997 work began on Phase II and services on the new 8.1 kilometre route linking Eccles to Manchester Piccadilly started at the end of 1999. The new tram link via the Quays includes 6.5 kilometres

Phase 2 of Metrolink connected Eccles and Salford to Manchester (Piccadilly). This line generally is conceived as a true example of Transport Oriented Development. The stops 'Exchange Quay', 'Salford Quays', Anchorage', 'Harbour City' and 'Broadway' are situated near or very near to newly developed amenities, offices, and/or housing. Though the alignment of the Salford-portion of the Eccles-line is not optimal from an operational point of view, its stops are very well integrated in the new built environment indeed.



Our maps show that a substantial part of the Salford Quays redevelopment zone (grey area on map above) still isn't served properly by Metrolink. The Lowry Centre isn't actually situated within walking distance of the Broadway stop (but a branch is planned). And very important sites like the football stadium of Manchester United, as well as the new Imperial War Museum are not served at all. These destinations will be served, as a new Metrolink line will connect Trafford Centre (another important regional node) to Manchester City.

of track between the Cornbrook interchange and Eccles, and provides 9 new stops (plus the interchange), with an average overall spacing of 650 metres and less than 500 metres in the heart of Salford Quays redevelopment area. The first section of line threads through the docklands regeneration area. The second section is street-running along Eccles New Road and serves a residential population, a large Park and Ride site and the centre of Eccles.

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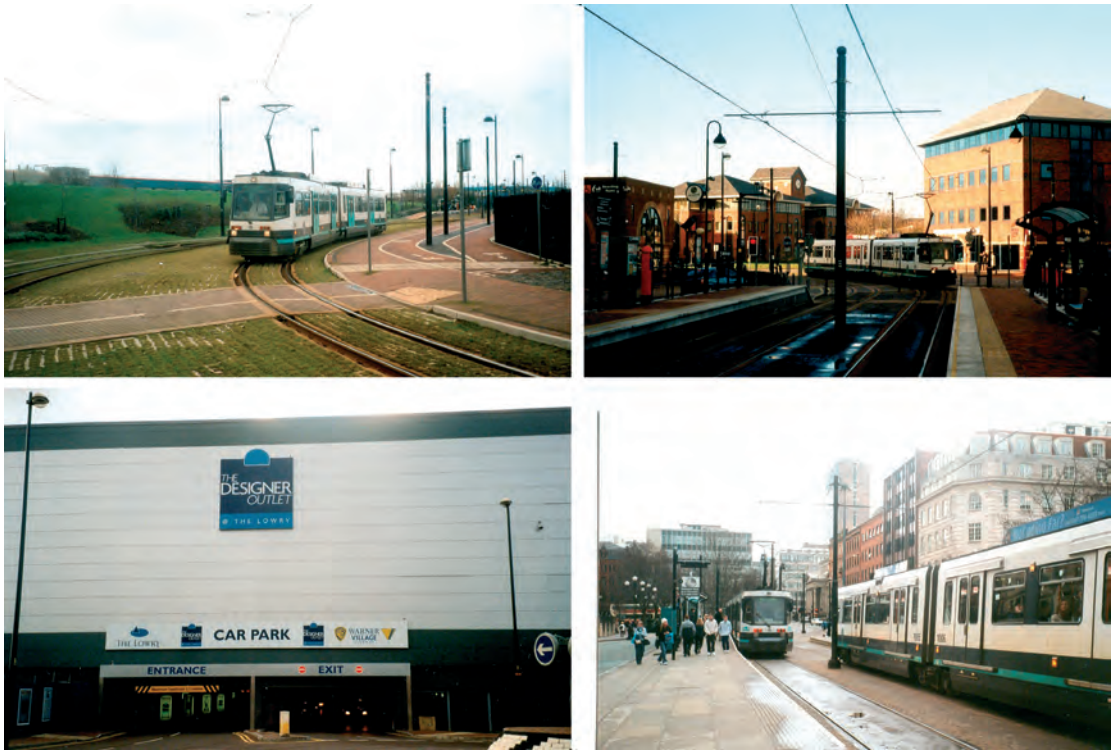
Institutional framework and coordination

Metrolink is owned by the Greater Manchester Public Transport Executive (GMPTE) and is operated by Altram. Responsibility for ensuring that the public transport needs of the City are met rests with the Greater Manchester Passenger Transport Authority (GMPTA), a joint board representing the 10 District Councils of Greater Manchester. The PTE has a strong vision for the development and promotion of public transport and its dynamic leadership has earned widespread respect in the UK planning and transport community.

Salford City Council is the local planning authority and seeks to influence and support the GMPTA in its policy making role in order to improve and integrate public transport services and planning within the City of Salford. In order to facilitate the planning and regeneration of the area the City Council purchased most of the Salford Quays site from its previous owners, the Manchester Ship Canal Company, in the 1980s.

Planning policy framework

The closure of the Port of Manchester docks in the 1970s led to the decline of a large part of Salford and in the early 1980s an Enterprise Zone was established



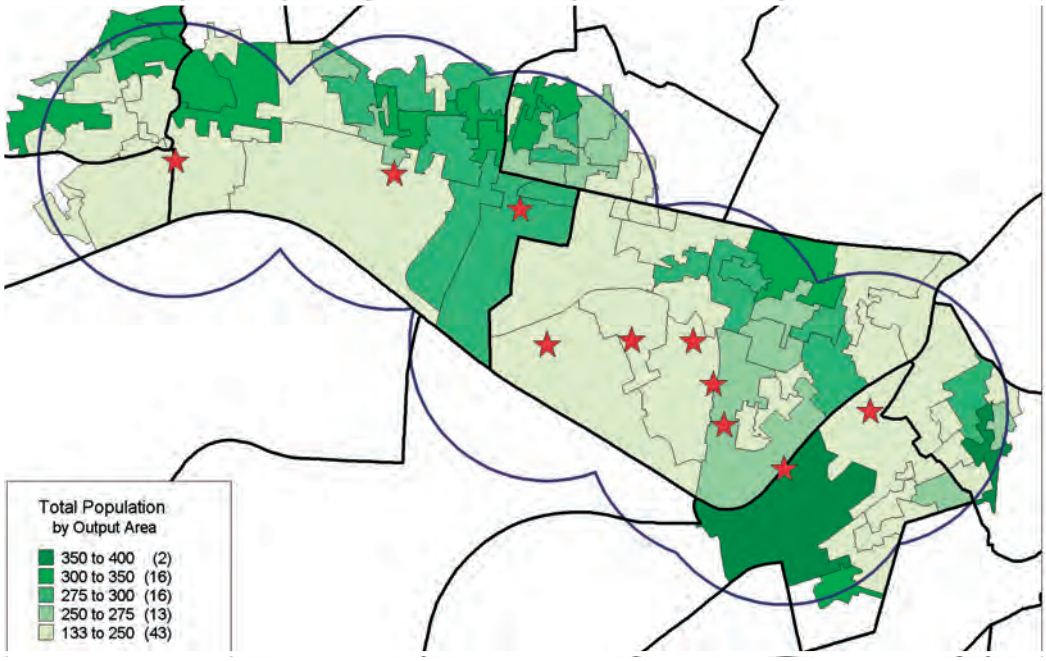
Metrolink is well integrated into Manchester's city centre (bottom right). In principle, the Metrolink network could be the regional backbone of new and existing land use in the conurbation of Greater Manchester. Well-integrated stop in the Salford Quays area (upper right). However some other parts of the Quays are mainly car-oriented; for example, The Lowre and the Designers Outlet (bottom left).

to the north and south of Salford Quays. This helped to attract businesses to both areas until its cessation in 1991. It was during the same period that Salford City Council purchased much of the docklands and in 1984 plans for their redevelopment were drawn up by the City Council and Urban Waterside Limited, a private developer. The plan was published in 1985 and approved by the UK Department of the Environment (Salford City Council, 1985). The docks were subsequently closed to commercial traffic, paving the way for redevelopment for private housing, commerce and recreation and the introduction of the tram.

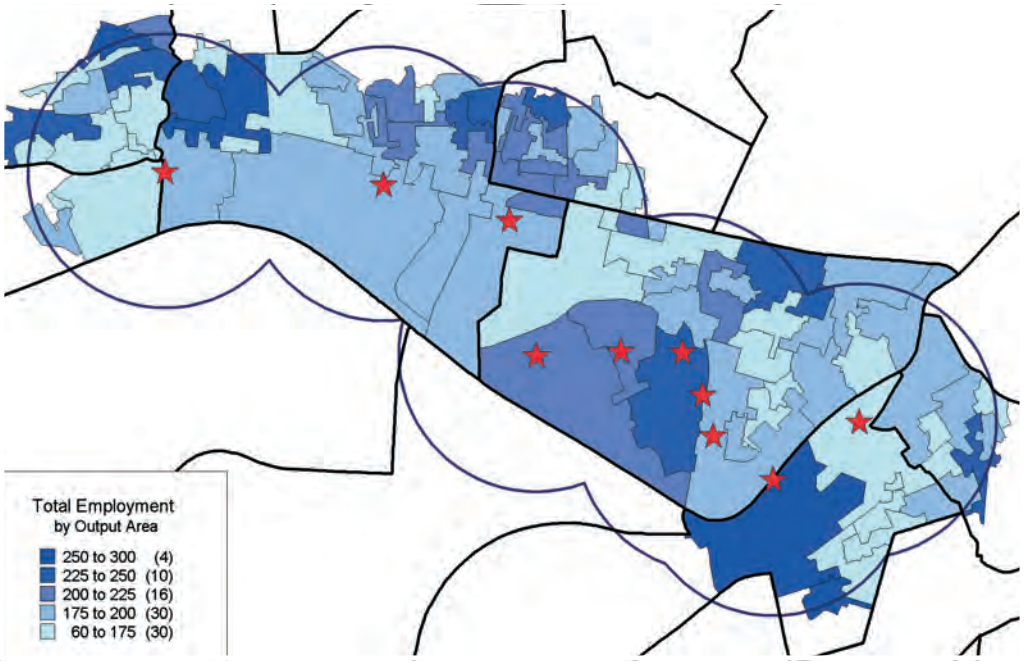
It was however to be some years before the tram became operational and during this period the area suffered from its relative inaccessibility. As the Quays area was being redeveloped, planners safeguarded land for the Metrolink line and developers negotiated to ensure the route would be directed through the most beneficial areas of the Salford Quays development.

Core principles: land use planning to support public transport

At the outset Manchester Metrolink was very much a transport-led initiative. The Eccles extension has been closely linked to economic development goals,



Population catchments for stops in the Quays (Census, 2001)



Employment catchments for stops in the Quays (Census, 2001)

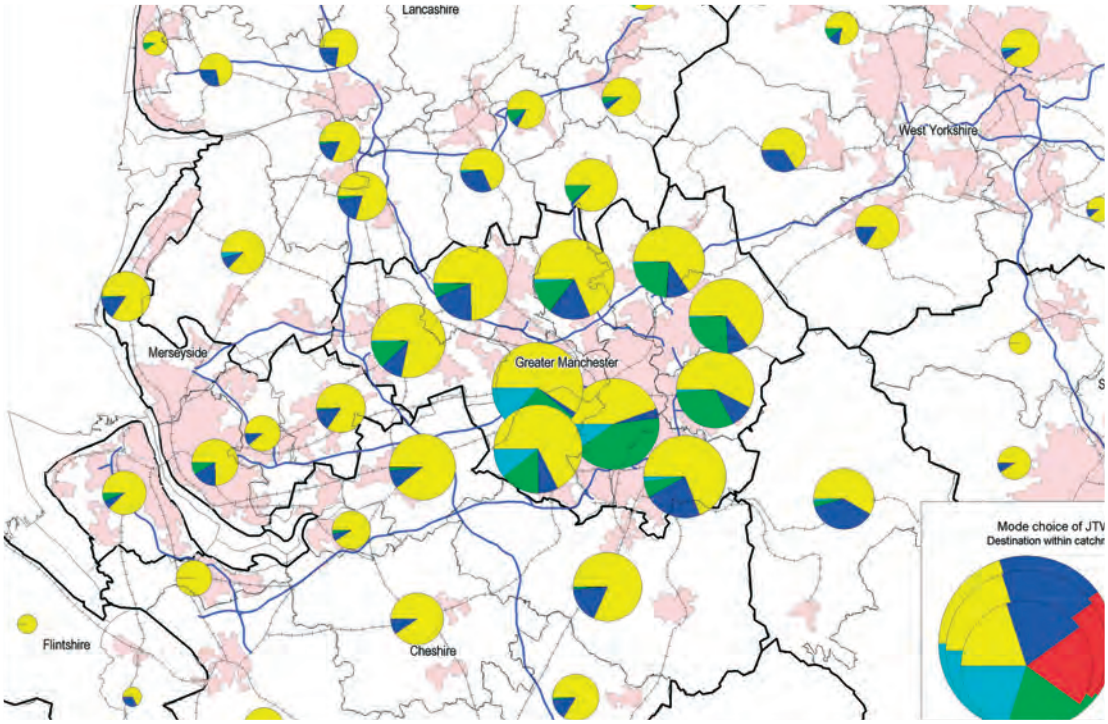
Four hundred metre stop catchments

Stop	Population	Density (persons/sq km)
Eccles/ Ladywell	980	150
Weaste	1,040	470
Langworthy	1,420	460
Broadway	200	50
Harbour City	310	210
Anchorage	280	350
Salford Quays	470	310
Exchange Quay	590	500
Pomona	360	310
Cornbrook	590	240
All Stops	6,220	250

however, and in turn the achievement of economic development objectives has been viewed as a fundamental means of adding support to the transport system. In practice, the way in which land use policy has been brought to support public transport in Salford Quays is particularly interesting because it demonstrates something of a hybrid approach with a distinctly international flavour.

At the more strategic level planning policy recognises that dense flows of people along the tram corridors are needed to support patronage levels. But corridors need not necessarily be short and compact in order to achieve this. As in many North American regions, the aim is for the tram to link a number of densely occupied key *nodes* with a mixture of land uses/economic activity, separated by low density development or open land. In practice this policy has been achieved by linking a number of mixed use local centres, such as Sale and Timperley, built around former suburban railway stations.

At the local level the approach has more in common with the urban design-led approach that is adopted to planning quality public transport *corridors* in European cities. At this level land use planning strategy recognises that LRT systems are most likely to realise their potential and play an effective role in densely occupied *urban corridors*, with fairly high residential densities along their length, coupled with a significant number of *key attractors* (demand generators). Local policy is aimed at delivering development of this nature whilst recognising that denser urban development also offers other benefits that are fundamental to the successful regeneration of the area, including better access to a wider range of facilities, more neighbourhood scale economies and better social cohesion. At the local level this urban planning policy is underpinned by a strong design philosophy that integrates transport with the built environment and exploits the contribution that high



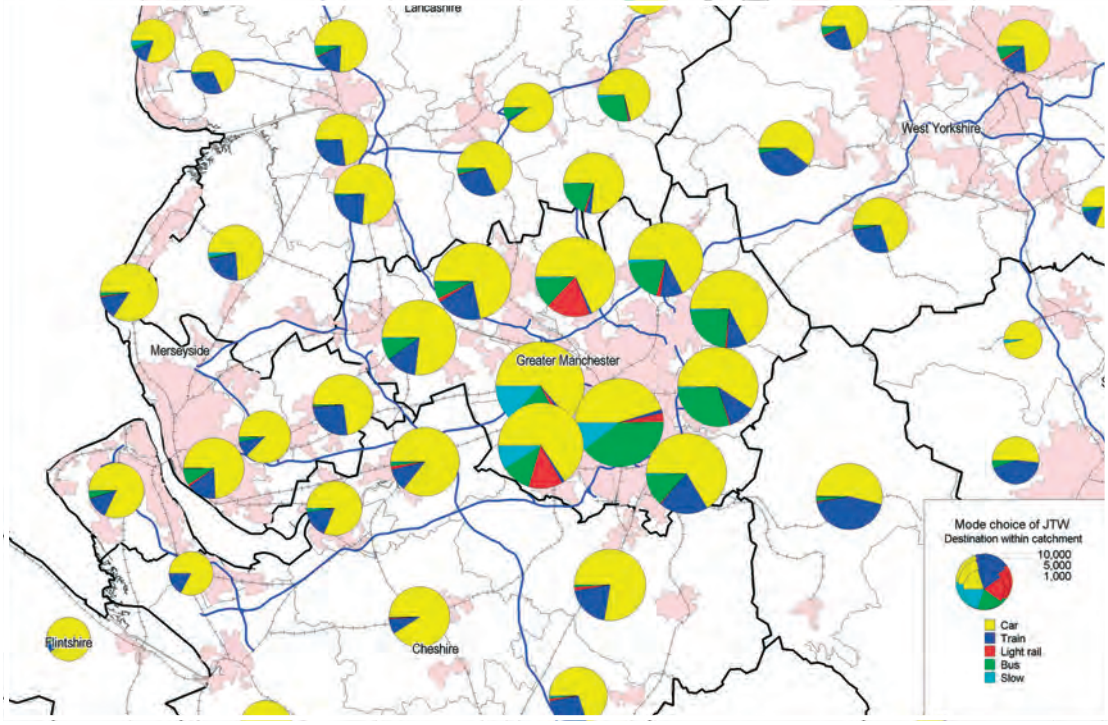
Journey to work by mode in 1991 (Census, 1991)

quality transport can make to the overall quality and identity of residential and business communities.

Currently the Salford Quays tram route runs for the most part through areas with very low gross housing densities that have suffered from decline and depopulation. The stops with the highest absolute population catchments are in established local areas, such as Eccles and Langworthy but overall population densities are less than 250 persons per square kilometre. As the development of residential land uses increases in line with objectives for the regeneration of the Quays, so will the general population catchment served by the tram route. However, a very major, current advantage for this part of the tram network is that Salford Quays is connected to the main Metrolink system and hence a large volume of travellers from a wide regional catchment may use the tram in order to access attractors at the Quays.

Metrolink is well integrated into Manchester's city centre (bottom right). In principle, the Metrolink network could be the regional backbone of new and existing land use in the conurbation of Greater Manchester. Well-integrated stop in the Salford Quays area (upper right). However some other parts of the Quays are mainly car-oriented; for example, The Lowre and the Designers Outlet (bottom left).

The nature of existing developments means that many trips in the area are likely to be journeys



Journey to work by mode in 2001 (Census, 2001)

to/from work, shop or leisure purposes but this balance is likely to change as the mix of uses in the area develops to include more residential. Using gross population figures extracted from the 2001 Census, a 400 metre catchment has been calculated for stops on the Eccles extension. The very small local catchments that emerge from the analysis demonstrate the importance of policies that encourage attractors and also provide integration with the regional rail network. These have been particularly valuable as a means of supporting patronage during the crucial early years of the development.

A similar though less extreme picture existed in 2001 with respect to local employment opportunities, although this picture is changing quickly, notably around the Harbour City stop. The gross employment density for the whole of the catchment of the Eccles extension line is approximately 1,430 jobs per square kilometre (2001).

Regeneration impacts

Considering first the *direct impacts*, analysis of UK Census data for Salford Quays catchment shows a small change in the overall pattern of mode choice for journeys to work in the Quays between 1991 and 2001 (only one year after opening). In 2001 the tram served around 0–5% of trip destinations to

each ward, with this share captured partly from slow modes and partly from bus.

At the origin end of the journey, for work trips with destinations inside the local catchment of the tramline, several differences can be seen in main mode of travel between 1991 and 2001. First, the overall number of trips has increased over this period. Second, the mode share of heavy rail has seen an increase, especially in areas further from the City of Manchester. Third, the impact of the tram can be seen in districts within Greater Manchester and especially central areas that are close to the tramway. In the main, the mode share at the origin end has been captured from heavy rail and partially from bus as well. Car use has remained largely the same in percentage terms. Note in particular the spatial extent of the regional Metrolink catchment for the Quays in 2001. This highlights the enhanced labour market opportunities delivered by the introduction of high quality transport.

The tramway has also had an impact on the image of Salford Quays, and the sometimes striking physical relationship between the alignment and the adjacent buildings has made an important contribution to the overall quality of design, helping to impart a unique identity to the development. Indeed, as with the tram in the French city of Strasbourg, Metrolink has become such a part of the image of the Quays that it is a favourite subject for picture postcards.

The tram has only been operational for three years and so although our survey of local professionals indicates that it has played a vital role in accelerating development there is only limited quantitative evidence of any secondary development impacts. A review of key stops along the route does however shows how policy has succeeded in achieving close physical integration of high quality public transport with a carefully balanced mix of land uses designed to attract patronage and to reintroduce vitality and economic activity to local areas.

Exchange Quay: This stop is on the doorstep of the Exchange Quay development and also serves a nearby residential area as well as a Museum, a hotel, offices, bars and restaurants. It has been planned at the entrance to the Quays as a focus for business and social activity.

Salford Quays: This stop is designed around leisure and tourism uses and is centrally located to attract water sports enthusiasts as well as residents of Merchants Quay and visitors to the new office developments. It provides a setting for high quality residential, commercial and leisure uses including Salford Water Sports Centre that offers courses in sailing, wind surfing and canoeing. Ontario Basin also provides berths for visiting historic ships, such as the replica Golden Hinde, and the Quays are host to major boat rallies and regattas. Housing estates have been developed at Merchants Quay, Grain Wharf and around Ontario Basin. There is a business park at Waterfront Quay.

Anchorage: The focus at this stop is on business and supporting uses. The Anchorage development comprises 275,000 square feet of office floor space, with a shopping mall and waterside food and drink outlet. The building is set at the end of Erie Basin, with long views towards the Ship Canal. A housing estate of 72 dwellings has recently been completed along the side of Erie Basin.

Harbour City: The Harbour City stop is again focused on business uses and the first phase includes an architecturally striking office building, the Victoria. The route and Harbour City stop were built on a reserved alignment that passes directly through the development between the Victoria and its car park.

Broadway: Broadway stop is at the north end of a landscaped open strip between The Quays and Broadway roads. It is in an area containing a mixture of factories, warehousing and offices and provides a necessary degree of separation from residential and service activities. This stop is positioned to serve existing businesses and is located to accommodate the ongoing developments in this area.

Langworthy: The first section of street running is from Broadway to Langworthy. Langworthy stop is located in a short corridor between Eccles New Road and industrial premises to the south. The stop has

been sited to serve the surrounding residential and commercial premises.

Weaste: Trams stop opposite the old Salford Corporation tram/bus depot at Weaste, from which the original trams operated. The stop is located to provide easy access for pedestrians and is designed to serve the surrounding residential and commercial properties, including the local school.

Ladywell: Metrolink's first purpose–built car park is located off Eccles New Road adjacent to the Ladywell stop and has 450 spaces.

Eccles: The terminal stop is in Eccles town centre and a new bus station has opened just to the west of the Metrolink platform, incorporating its own taxi rank. Eccles town centre provides the main shopping and employment opportunities within the area and functions as the district centre for the surrounding residential areas.

Given the extent of depopulation of the area, the revival and creation of a residential market in the Quays has been one of the most difficult regeneration objectives of the development and this was not helped by the mid-1990s property market crash. Despite this, house prices in Salford have approximately doubled in the meantime and high density properties in the Quays have provided an important step on the ladder for many first time buyers (Homesearch, 2004). The demand for housing in the area remains good and Salford City Council is continuing to promote high standards of development, with an emphasis on ambitious designs and mixing new housing with leisure facilities and business.

Key Best Practice pointers

As both a transport corridor and a regeneration area, Salford Quays demonstrates the benefits of an approach based on integration into a wider regional light rail-suburban rail network, particularly during the initial years of redevelopment when the process of building markets for transport and economic activity may be difficult. It also shows the way in which local planning policies, developed jointly through public-private sector collaboration, can successfully contribute to the process of redevelopment, which in turn strengthens the potential demand for public transport.

In particular the approach followed in Salford Quays shows how:

- The tram service has been able to capitalise and add value to existing patterns of light rail travel, which in turn have been built on well-established corridors of heavy rail patronage.
- The area has gained access to a much wider range of opportunities, including a wider labour catchment and an improved market for its services.
- A carefully balanced mix of land uses, designed to act as attractors and developed around key public transport nodes, can be introduced to help reinforce patronage and reintroduce vitality to local areas.

The track sharing implied by the Metrolink system requires technical and administrative barriers to be overcome but there are many local railway lines in and around cities that carry relatively low traffic levels, and may offer potential for this type of scheme.

3.10 Sheffield, England, tram

Reasons for selection

Supertram provides an example of the introduction of a high quality public transport system in an area characterized by problems associated with long term economic decline. The system has been much maligned and it has even been suggested that its principal benefit is in demonstrating how not to go about developing a light rail system in the UK (Swedish National Road and Transport Institute, 2002).

In judging the success of the tram it must however be remembered that, unlike many of the systems with which it was compared, it was, from the outset, intended to play an explicit role in delivering economic regeneration.

Furthermore, both as a transport and as an economic development initiative Supertram has had to make its way in an unwelcoming environment characterized by major investment in new road infrastructure, deregulation and sectoral competition for funding as well as patronage.

As a case study of transport impacts it is a rare example of an empirically well-researched scheme and provides insight into some of the lessons to be learned in planning the introduction of high quality transport in a regeneration context.

Background

Sheffield is a provincial city of 530,000 residents and 260,000 jobs, located in South Yorkshire, a polycentric conurbation of around 1.3 million people. The urban area covers 361 square kilometres and has an industrial heritage rooted in heavy engineering and steel industries that have suffered from international competition and decline.

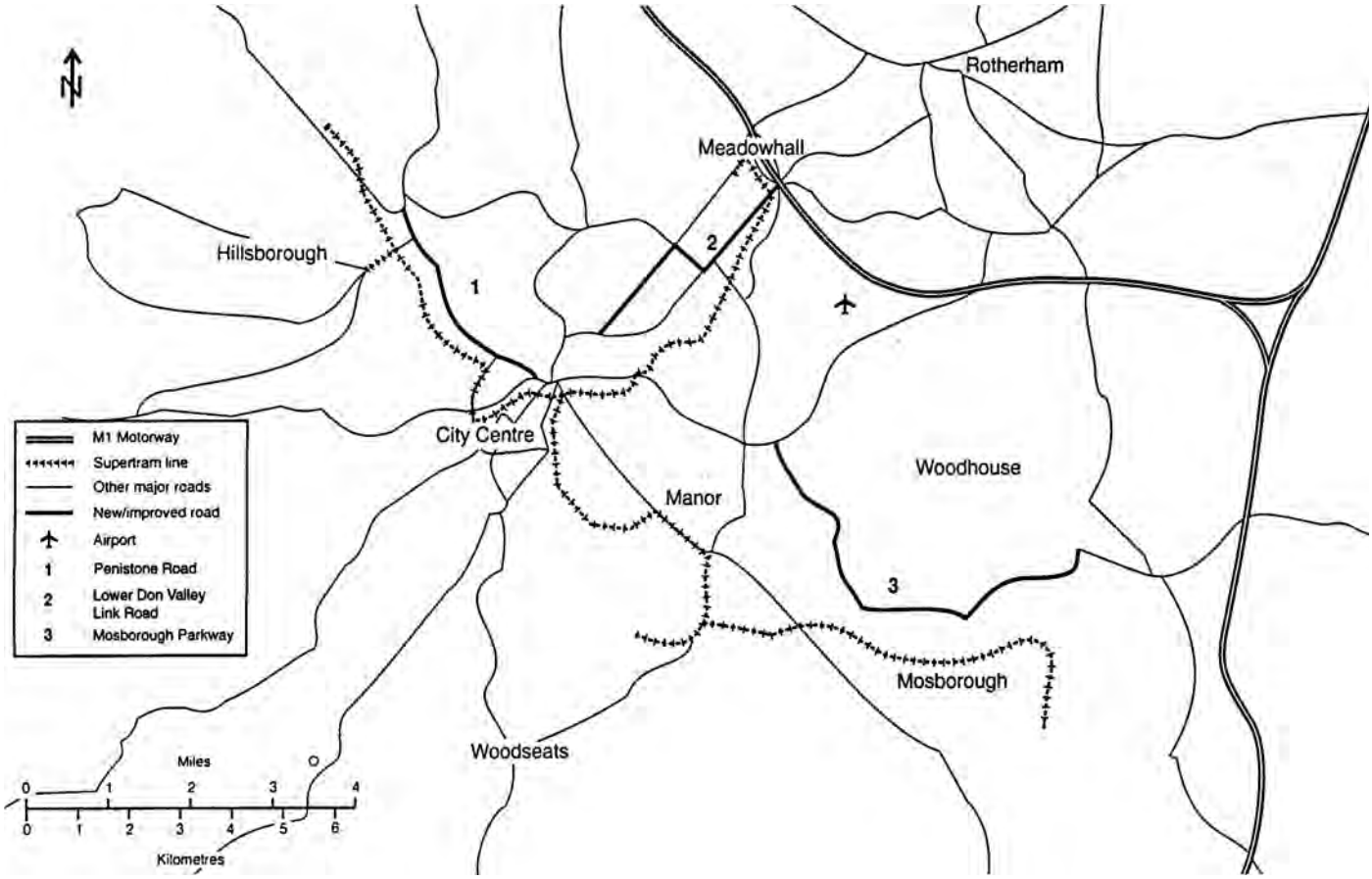
Given its size, Sheffield traditionally had a rather underdeveloped suburban rail system. This was partly due to topographic constraints imposed by the Pennines on its western edge but also because, unlike many similarly-sized cities, it had not developed as a regional service centre and therefore had not evolved a wide commuting, shopping or service catchment. Over the last 30 years there has been a slow but fairly substantial transition in the economic base of the area with light industry and services replacing steel and related industries.

Until the 1950s trams ran on-street in the City and the area was served by a widely respected municipal bus company. By the sixties the trams had been taken out of service to ease the way for more cars. By the seventies however, against a background of relatively limited investment in urban road improvements, growth in car ownership and use had begun to congest the roads in the city centre. As early as 1976 a joint land use – transportation study was completed and recommended a solution incorporating new suburban, mainly segregated tramlines. This was rejected on grounds of capital cost but by 1985 proposals for an urban light rail system incorporating a cross-city route had been evaluated, laying the foundations for the introduction of Supertram.

The Supertram system commenced operation in 1994–95 and comprises two lines configured as three branches extending to 29kms in length. Line 1 runs from Hillsborough in the northwest via the city centre from where the longest branch runs south east to the suburb of Mosborough. The remaining two branches are located within the Upper and Lower Don valleys. Line 1 is largely on-street running and originally was justified on grounds of its transport benefits in relation to existing patterns of urban form, most notably the link between the city centre and the major 'new' residential development area at Mosborough. The original proposal was extended to include Line 2, a largely segregated route from the city centre to a new shopping mall (Meadowhall) close to the M1 Motorway on the north east side of the city. This route was based on a disused freight rail alignment through what was to become the Lower Don Valley Urban Development Area.

Sheffield's Supertram potential for supporting existing and future land use should not be underestimated. The catchment area of the system is impressive.

The penetration of all Supertram-lines into Sheffield's centre implies a potential for supporting existing and future land use. The Lower Don Valley line is well connected to downtown Sheffield and its public



Sheffield's Supertram potential for supporting existing and future land use should not be underestimated. The catchment area of the system is impressive.

realm. The other side of the line the tram station (see picture bottom right) offers transfer to main line train services, while the Meadowhall mall is within walking distance.

In total there are 48 stops on the Sheffield Supertram network with an average spacing of 680 metres. Estimated average population catchments within 400m and 800m of a stop are 3,200 and 11,600 respectively with densities per line kilometre of 100 for a 400 metre corridor and 400 for an 800 metre corridor (2001). Gross employment density for the whole Supertram catchment is around 2,340 jobs per square kilometre.

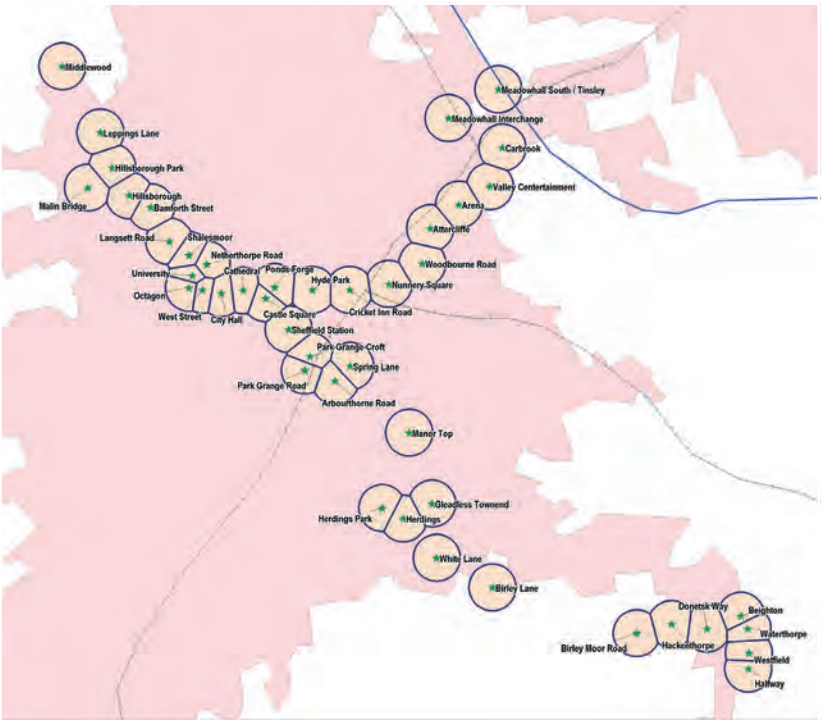
For analysis purposes, a catchment of 400 metres around stops on the route of the Sheffield Supertram has been taken and a 'nearest neighbour' analysis carried out to determine the population catchment of each stop (rounded gross densities in 2001).

Institutional framework and coordination

It is important to understand how changes in the planning system, particularly in the framework for organisation and coordination of economic develop-

Population at Supertram stops

	Population	Density (persons/km2)
Malin Bridge	2,590	5,860
Leppings Lane	3,880	8,200
Hillsborough Park	3,030	8,090
Hillsborough	2,220	6,200
Bamforth Street	1,900	4,860
Langsett Road	2,230	5,770
Octagon	1,170	4,970
Shalesmoor	840	3,660
University	780	6,200
West Street	1,330	8,290
Netherthorpe Road	460	1,740
City Hall	520	2,060
Cathedral	280	930
Castle Square	180	760
Ponds Forge	220	710
Sheffield Station	1,940	4,420
Park Grange Road	500	1,620
Park Grange Croft	1,520	5,250
Hyde Park	1,130	2,510
Arbourthorne Road	1,110	3,380
Spring Lane	2,360	6,150
Cricket Inn Road	450	980
Herdings Park	1,510	3,730
Nunnery Square	340	730
Herdings	1,800	5,060
Woodbourne Road	1,710	3,790
Attercliffe	420	950
Gleadless Townend	1,960	4,320
Arena	220	490
Valley Centertainment	100	220
Carbrook	150	310
Birley Moor Road	880	1,880
Hackenthorpe	630	1,440
Donetsk Way	2,870	6,600
Beighton	830	2,580
Halfway	360	1,020
Westfield	300	1,120
Waterthorpe	350	1,380
Meadowhall Interchange	690	1,370
Meadowhall South/ Tinsley	320	630
Manor Top	1,990	5,410
White Lane	2,810	5,600
Birley Lane	260	520
Middlewood	310	610



Stop catchment areas on the Supertram network (400m)

ment and transport, have combined to influence the impact of Supertram.

Following a change in government in 1979 British planning witnessed a change in direction underpinned by the philosophy that the market must be given enough room to facilitate economic development and growth. The role of planning and local authorities in urban regeneration was reduced by the introduction in 1980 of Urban Development Areas, where planning was taken out of the hands of elected local councils and replaced by Urban Development Corporations with a property development focus. In 1986 the metropolitan counties were abolished and although the Passenger Transport

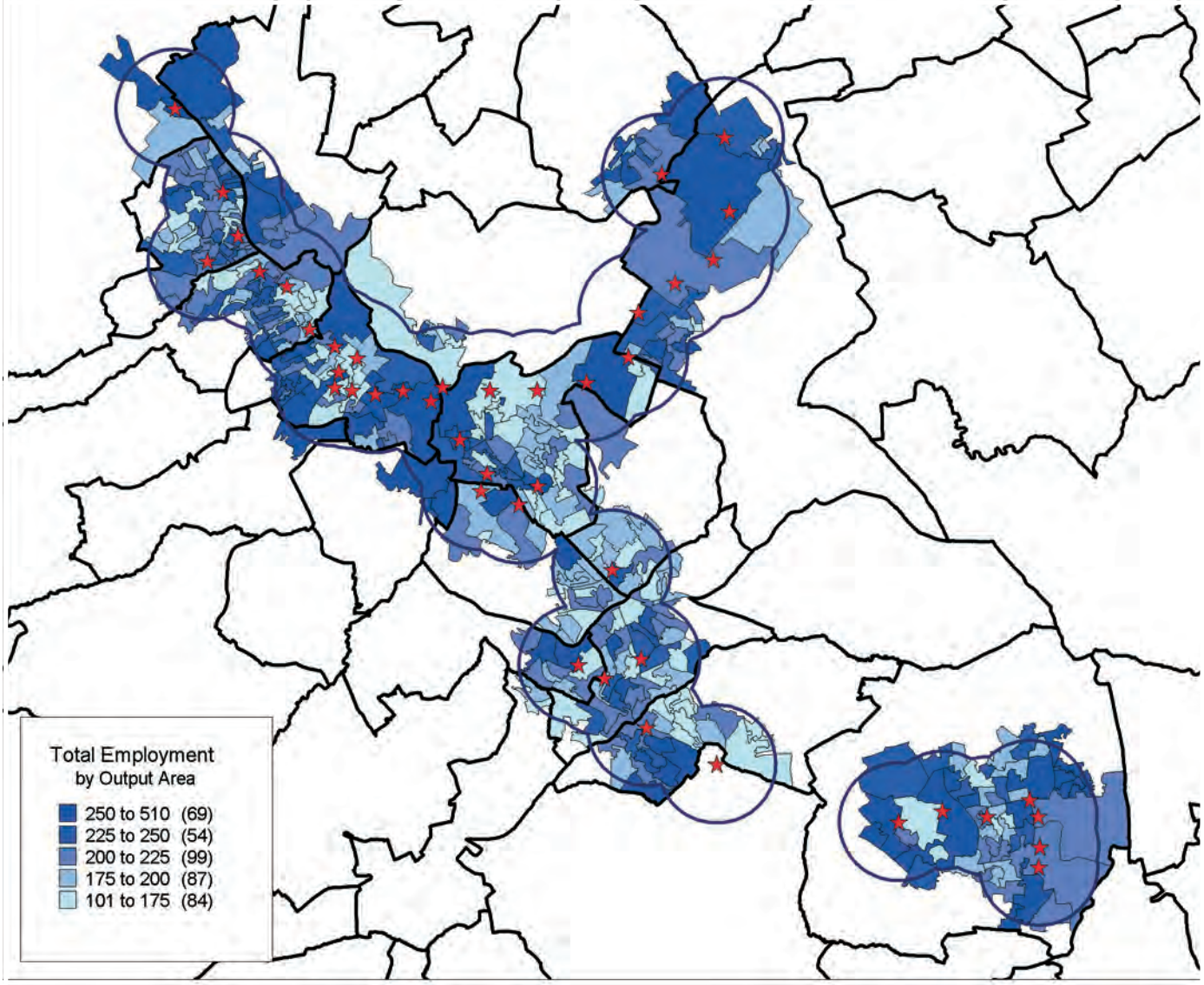
The penetration of all Supertram-lines into Sheffield's centre implies a potential for supporting existing and future land use. The Lower Don Valley line is well connected to downtown Sheffield and its public realm. The other side of the line the tram station (see picture bottom right) offers transfer to main line train services, while the Meadowhall mall is within walking distance.

Authorities remained, the simultaneous deregulation of local bus services under the 1985 Transport Act meant that they would compete with local rail services rather than complement them as might have been the case in a regulated operating environment.

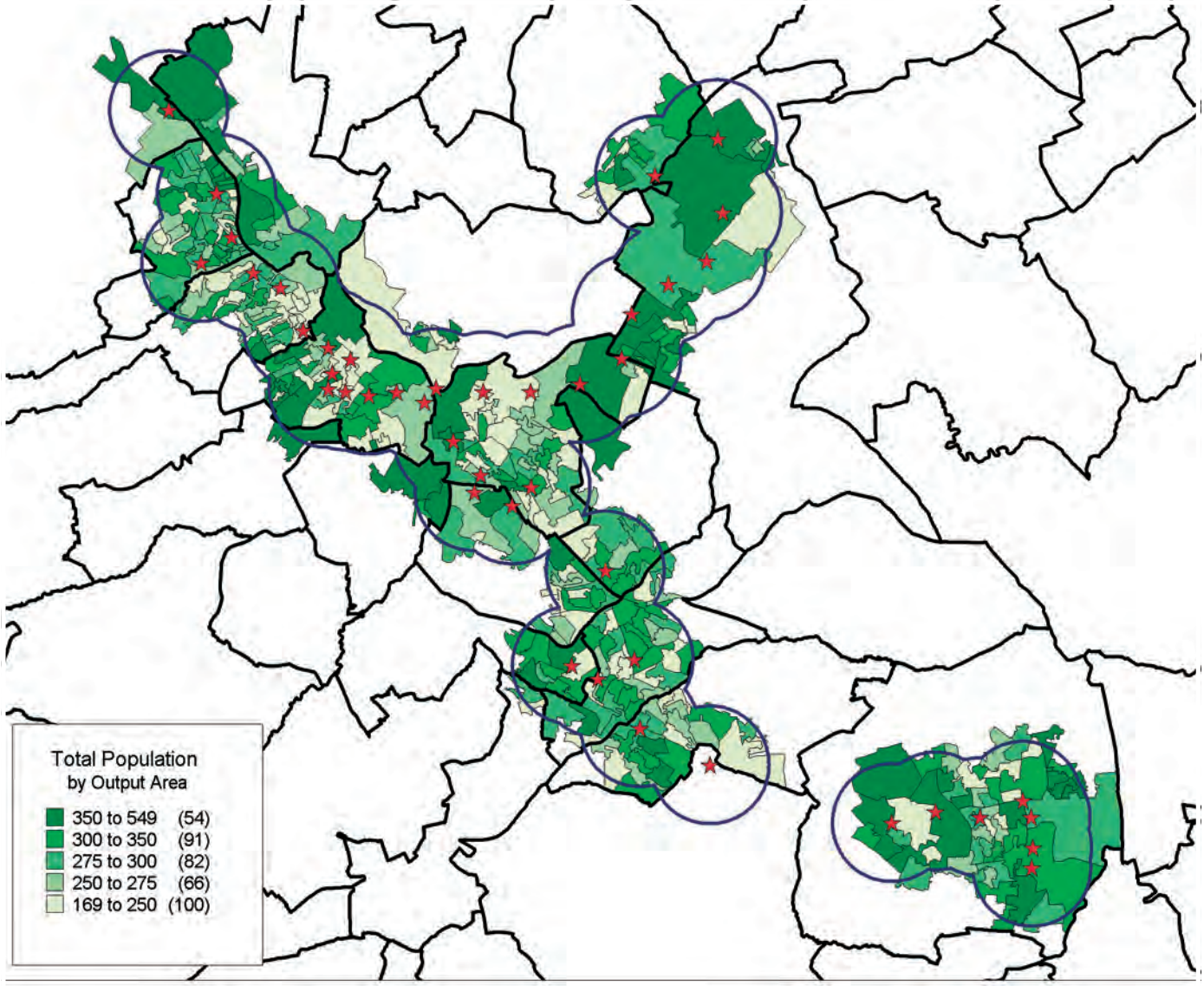
In the economic boom years that followed deregulation the loosening of planning controls contributed to major changes in patterns of land use including growth of out-of-town shopping and business parks. These land use changes in turn led to changes in travel demand creating new spatial patterns that were difficult to serve by public transport.

The original concept of light rail in Sheffield was encouraged by the South Yorkshire Public Transport Executive (PTE), when it was a part of South Yorkshire Metropolitan County Council. With the abolition of area-wide planning responsibilities however, the support of Sheffield City Council for the scheme became crucial as the route was largely restricted to the city. The council gave its support on condition that the proposal was expanded to include a route to the new Meadowhall shopping mall.

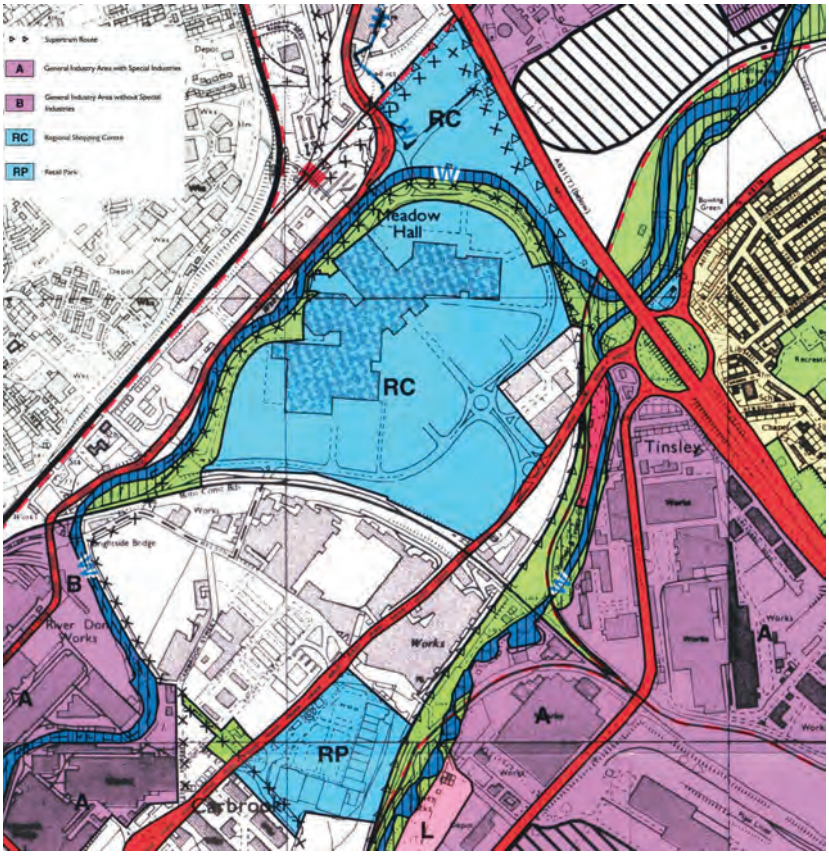
The tramway route is depicted on the map as a line of little triangles. The route curves around the Meadowhall site. The Lower Don Valley terminus of Supertram serves the Meadowhall mall quite well. This could be conceived as a form of public transport orientation of this important land use. Not all malls in



Employment in Supertram corridors (2001 Census)



Population in Supertram corridors (2001 Census)



The tramway route is depicted on the map as a line of little triangles. The route curves around the Meadowhall site. The Lower Don Valley terminus of Supertram serves the Meadowhall mall quite well. This could be conceived as a form of public transport orientation of this important land use. Not all malls in the UK are connected to quality public transport in this way. However Meadowhall mall is perfectly connected to the car-system as well. Parking amenities surround the building complex.

the UK are connected to quality public transport in this way. However Meadowhall mall is perfectly connected to the car-system as well. Parking amenities surround the building complex.

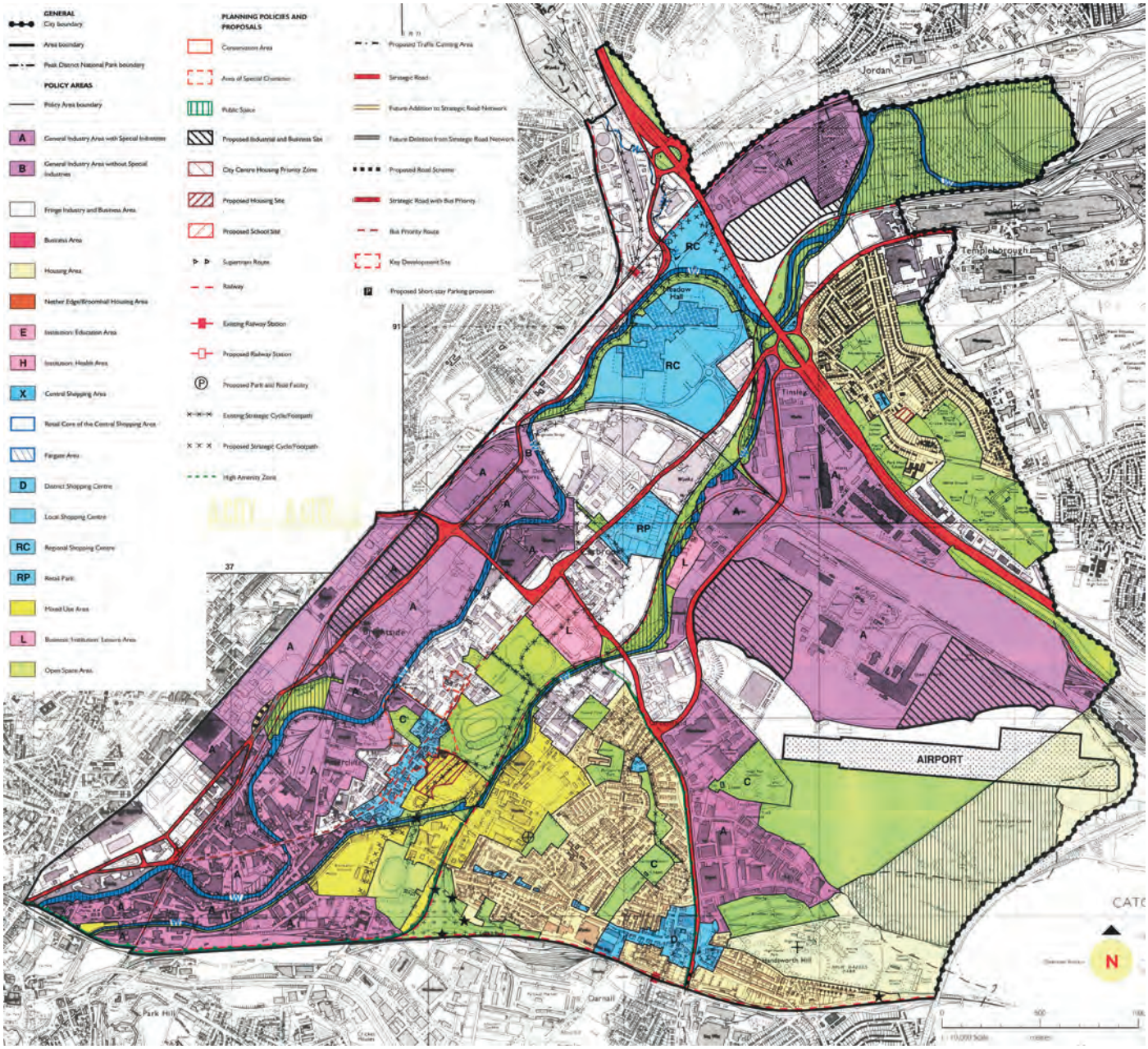
The government supported the public transport initiative but at this time the overall approach to transport infrastructure provision was market led, encouraging car-based mobility increases and responding to projections of significant growth in car traffic by accelerating the rate of road construction. The Supertram system was privatised in 1997 when a 26 year operating franchise was passed to Stagecoach.

It was expected that the major non-user benefits of Supertram would be delivered through reduced traffic congestion and impacts on land development and values – though these objectives must now be interpreted against the background of changes brought about by deregulation of both planning control and transport. The possible impact of diversion of trade from the city centre to Meadowhall did not influence the decision to develop a major out of town shopping facility. Furthermore, although the light rail was developed as part of a local commitment to encourage public transport in Sheffield, the timing of its introduction coincided with three major new road projects. The first, the Mosborough link road was completed in 1994 and provided new access to the residential and industrial areas to the south east of the city and ultimately to the M1 Motorway. The second (Penistone Road), upgraded the A61 major arterial route to the North West and provided a link to the trans-Pennine route to Manchester. The third, the Don Valley link road, was completed in 1996 and connected the city with the new Meadowhall shopping centre. Significantly this not only provided competition in the form of fast access to the new shopping facilities but also directly served a series of de-contaminated development sites. It was to become a main plank in Sheffield Development Corporation's strategy for regeneration of the Lower Don Valley and would establish major competition for Supertram.

Planning policy framework

In the crucial period during which Supertram was being introduced and established there were two relevant planning authorities that had the power to influence policies in support of the public transport system: Sheffield City Council and the Sheffield Development Corporation (Haywood, 1999).

The City was drafting its first Unitary Development Plan at the time and based on a very general



The corridor of Lower Don Valley contains different forms of land use that are supported by Supertram's alignment. The tramway serves areas of mixed land use, shopping, and industry, as well as recreational and residential areas. But again, all these areas are pretty well served by the car-system too. Moreover, Supertram's alignment in the Lower Don Valley corridor is mirrored by a new main road, running parallel to the tramway.

steer from the Regional Planning Guidance, this incorporated a number of policies that were broadly supportive of the tram. However, though mention was made of the intention to develop supportive park-and-ride sites there were no prescriptive land use policies or proposals to bring about the intensive development / redevelopment that had been envisaged along the route. The City Council did produce design guides for street works to accommodate the tram and these certainly produced some improvements in pedestrian facilities and physical quality of the built environment, notably in the environs of the city. There was however, little sign of a policy to support patronage.

Development proposals put forward by the Development Corporation however were closely tied to its remit to secure redevelopment within a limited timescale. The Corporation was invested with special interventionist powers and given resources (around £100 million, 1.4 million euros) to reclaim land, assemble development sites (using compulsory purchase if necessary) and to develop supporting infrastructure. Its strategy was however, strongly market-oriented and its proposals included extensive road building expressly to open up development sites, supported by extensive off-street car parking as a planning requirement.

Current Regional Planning Guidance recommends an extension of Supertram, specifically to serve the recently opened Sheffield City Airport. A short extension from the University to the Royal Hallamshire Hospital is also under consideration.

Regeneration Impacts

Various studies of the impact of Supertram have been carried out on behalf of government organizations and / or by researchers in Sheffield's universities (see for example, Dabinett, G. 1998; Dabinett, G et al 1999; Dabinett, G. & Lawless, P. 1995,1998; Grieco, M. 1994). These have been based on a mixture of surveys supported by analysis of planning registers, property data sources and labour market records. The research is mainly focused on transport corridors of up to 400 metres and includes some before/after and light rail versus road comparisons. The results generally carry two caveats; firstly that they are based on data from the 1990s (and may therefore be expected to change as the system matures) and secondly that impacts are the product of very complex interactions. Nevertheless they do provide a valuable and fairly unique source of information.

Impacts can be considered under the following broad headings:

- Planning activity
- Land use change
- Investment and investor confidence
- Local property prices
- Impact on businesses
- Labour market.

The findings of the research studies provide little evidence overall of the positive regeneration impacts of Supertram in terms of changes in planning activity. There was however a marked increase in major office and retail classes in the 400 metre corridor served by the tram, although the absolute numbers of applications in these categories was small. By comparison, the number of applications in the new/improved road corridors increased from 55% to 68%, being greatest in locations immediately adjacent to the road.

Extensive land-use change was identified by the studies, dominated by changes in the Lower Don Valley served by both the tram and the new road infrastructure. There was significant evidence of urban regeneration, with declines in both vacant land and vacant buildings and increases in industry, housing and most particularly in offices. Increases in the area of car parking were also identified but notwithstanding the fact that some of this was associated with park and ride these were attributed to support for road traffic growth. Despite the extent of change, detailed analysis showed that only 12 to 15% of net change was within 100m of a tram station and could therefore be regarded as *potentially* attributable to public transport impact. Moreover there was little evidence of Supertram having attracted major developments, but there was evidence that the Lower Don Valley Link Road had achieved this (Haywood, 1999).

Interviews with investment agents suggested that the ranking of Sheffield as a location for investment improved in the nineties. Moreover, following some negative press during the disruptive construction phase, by 1996 Supertram had emerged as a positive image factor.

Analysis of the impacts of the tram on the development industry revealed some complex and changing relationships. Six years before the services commenced house prices within the 400 metre corridor tended to increase with proximity to the route. By 1993, the year before opening (during the construction phase), this relationship had changed so that prices showed a tendency to increase with increasing distance from the route. Two years after opening no statistically significant impact was identifiable in the asking price for residential properties suggesting that confidence may have returned and demonstrating at least no negative impact on the residential market.

With respect to business relocation and operation only 5% of a sample of 150 businesses identified transport as a factor and 3% quoted traffic problems as influential in a decision to move. In contrast 70% highlighted property and site-related factors as important.

Local employment surveys revealed little to suggest that the introduction of the tram had attracted employees to live close to the route and amongst the unemployed less than three per cent said that they would use the service to travel to work if they could find a job. Perhaps significantly however, 11% of job seekers interviewed said that the tram had helped them look for employment opportunities over a wider area than before and this figure rose to 20% amongst the long term unemployed. Even more significant was the finding that those more familiar with the system were more likely to use it for work or for job search. In 1996, 12% of those resident in the tram corridor indicated that they would use the services to travel to work and 25% indicated that it had facilitated their search for work in other areas. These figures compare to three per cent and 11% for the sample as a whole, indicating the importance of traveller information and familiarity with services.

The corridor of Lower Don Valley contains different forms of land use that are supported by Supertram's alignment. The tramway serves areas of mixed land use, shopping, and industry, as well as recreational and residential areas. But again, all these areas are pretty well served by the car-system too. Moreover, Supertram's alignment in the Lower Don Valley corridor is mirrored by a new main road, running parallel to the tramway.

Key Best Practice pointers

With hindsight and the understanding provided by the academic research and case studies in this report, it is clear that in Sheffield a number of influential best practice factors were missing. In particular:

- The underlying philosophy needed to support public – transport oriented planning was absent.
- The degree of institutional coordination and cooperation between the various organisations in the planning and transport sectors was weak and no common policy objectives were in place.
- There was no effective planning policy to steer the location of major trip-generating land uses into the public transport network or to discourage development / redevelopment from locating / relocating to sites dependent on road access and / or distant from the city centre.
- Complementary / feeder bus services were not provided to support the system but rather were allowed to compete with it.
- There were no complementary transport policies to manage car travel demand or traffic routing.
- With the exception of concessionary fares support from the Public Transport Executive, there is no ongoing stream of funding to supplement the revenues from fares. In a French city of a similar size the Versement mechanism might be expected to generate more than £1million a year (1.4 m euros) to support the system (Semaly & Faber Maunsell, 2003).

3.11 Ottawa, Canada, bus

Reasons for selection

Ottawa-Carlton consists of 11 municipalities with a total population approaching three quarters of a million. 90% of this population lives in the urban area with 300,000 living in the Canadian capital of Ottawa. Covering some 370 square kilometres, Ottawa-Carlton has a strong tradition of dispersed population, which has given planners the problem of controlling urban sprawl and providing an effective transport strategy for servicing low density residential development.

A key part of the planning strategy of the last quarter of a century has been to establish a strict greenbelt policy whilst permitting some degree of development in the surrounding municipalities. This has resulted in a plan based on the vision of a hub, centred on Ottawa-Carlton where development will be focused. Spokes will radiate from the hub enabling growth to take place in satellite settlements with strong connectivity to the centre. The Municipality has followed a carefully designed land use and transport strategy to support this vision.

Ottawa is thus of interest in this case study because it represents an example of public transit being used to service a dispersed and relatively low density pattern of population across a large urban area. In order to achieve a successful system, Ottawa has opted to base development on a high quality bus system in the belief that it is only the transit approach that can provide the necessary flexibility to meet these transport requirements effectively. Certainly there is strong statistical evidence to support its success. In a sample of eleven light rail and bus systems drawn from North America the city had by far and away the highest levels of patronage in the Transitway's first year – 16,800 passengers per route mile. This made it four times more heavily patronised than Pittsburgh, the closest competitor. In 2000 the Transitway carried around 72 million passengers (Hass Klau and Crampton, 2002).

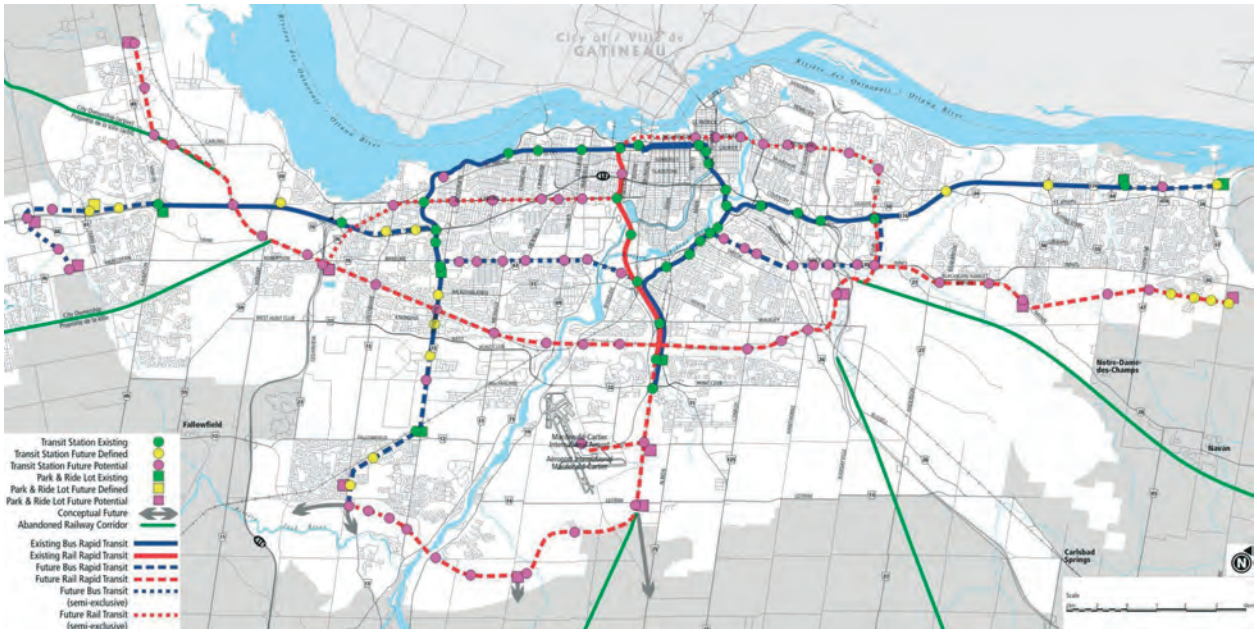
Background

Since 1980 the Regional Municipality of Ottawa-Carleton (RMOC) has grown faster than any other metropolitan area of Canada, with an annual rate of about 2%. It has a per capita income that is 33% above the national average and a strong economy, with near full employment. The City's affluence is built on its function as a major centre of government and this sector is the number one employer. However, substantial employment is also provided by high-technology companies, the health sector and a thriving business/financial sector. As a consequence of this affluence there has been a longstanding tendency for its working population to adopt a suburban lifestyle enjoying low density, single family residences. Even in the central business district the density of population is only 2000 per square kilometre. Like many North American cities, this has resulted in very large areas of uniform, suburban 'sprawl'. Efforts to control this growth pattern have revolved around a greenbelt policy implemented in 1959 that has shifted growth pressure to the satellite towns of Orleans to the East, Kanata to the west and out to Barrhaven and Stittsville to the south.

Although Central Ottawa still accounts for around 30% of employment in the region, the greenbelt policy has resulted in development of business parks and a decentralisation of more jobs to the satellite towns. In the 1980s and 1990s employment growth was fastest in these areas and their population almost doubled, giving rise to the need for a transport policy that could cope with both low density and relatively distant development patterns.

Although the ultimate solution to providing high quality public transport for the wider metropolitan area currently is viewed as the bus-based Transitway, Ottawa has also experimented with light rail. This takes the form of an 8 km north-south light rail system called the OTrain serving the central city. The OTrain shares standard gauge railway infrastructure and has a high frequency, fast service providing an overall journey time of around twelve minutes. It is designed to complement the Transitway in the central urban area.

The Transitway was approved in 1981 and consists of 31 kilometres of dedicated bus route with 30 stations. It follows an east-west axis parallel to



Since the installation of this bus system land use has been deliberately concentrated around the stations and the immediate environment. These stations (depicted as green bullets on the map) are located along one of Transitway's 2-line system (the bold green lines on the map).

the Ottawa River, with a spur to the south reaching South Keys. The route itself is grade separated from the surrounding streets by means of flyovers, tunnels and cuttings. It is a 13 metre wide, two line route with stations spaced at around half a kilometre in the centre and several kilometres apart elsewhere. The Transitway itself operates along the lines of a light rail system in that buses stop at all the stations.

Since the installation of this bus system land use has been deliberately concentrated around the stations and the immediate environment. These stations (depicted as green bullets on the map) are located along one of Transitway's 2-line system (the bold green lines on the map).

In the near future the bus system will be complemented by light rail (the first stage of this (bold red line on the map) is already in operation). Due to this, the future network public transport – land use integration could be enhanced.

Institutional framework and coordination

The institutional framework for the system is overseen by the RMOC, which was formed in 1969 to coordinate regional planning and major investments in infrastructure. The impetus for the creation of RMOC by the Government of Ontario was the problem of metropolitan sprawl referred to earlier. A tier below RMOC is the Regional Council, which includes elected members from RMOC and is responsible for the Ottawa-Carlton Regional Transit Commission – usually referred to as OC Transpo. The Regional Council also oversees the activities of the individual municipalities and is responsible for guidance on land use zoning, local plans and traffic laws. OC Transpo is

the system operator and is responsible for all direct service provision, coordination and integration.

Policy framework

Land use and transport policy is laid down in the regional plan which is coordinated by RMOC and produced jointly with the eleven municipalities. This plan embodies the development vision of a City-focused hub and radiating spokes to a hierarchy of primary and secondary development centres beyond the urban core. The Transitway is firmly placed at the core of this as and is required to provide an effective transport solution to servicing the resulting spatial structures.

The over-arching strategy for supporting transit-friendly development is based on a clear policy statement requiring substantial increases in the number of the region's jobs within walking distance (400 metres) of a Transitway station. In the mid-nineties this figure was around 32% and its increase to 40% was a target for the year 2000. In structural terms this meant that Ottawa was planned to remain as the primary employment centre. Below this Orleans and Kanata were designated as urban centres to have 10,000 jobs and nine further employment centres with 5,000 jobs were planned. All of these were to be within 400 metres of a Transitway station. Secondary centres with 2,000 – 5,000 jobs were planned to be located further from the Transitway but must have good access to its services. Furthermore, all regional shopping centres with more than 375,000 square feet of accommodation must also be located on the Transitway or planned extensions.

A second important policy that has affected transit provision is a very clear statement that transit development must take precedence over all forms of road construction and improvement. This 'Transit first' policy is a key feature of the overall transport planning framework. It is linked to patronage objectives that require that the transit captures 70% of trips to the City, 45% of trips to locations near central area Transitway stations and 35% of trips to locations near stations on the periphery of the system.

Core principles: land use planning to support public transport

Within the broad planning framework described above there have been major developments in the generation of policy at a local level to achieve these regional requirements. Most of these revolve around station area design and development. From 1988 onwards stations have become the focus for substantial investment in office infrastructure, retail facilities and residential provision. Indeed, one of the unintended consequences of the 400 metre station radius policy has been the introduction of high rise residential apartments in some areas.

The first key principle of station area planning is the identification of appropriate, transit supportive land use. 'Good' uses include offices, education, hotels, hospitals, retail, entertainment and institutional centres. Warehousing, retail stores and low density residential uses are deemed to be poor. Encouragement of higher net densities is recognised as being important and the creation of an appropriate mix of uses is deemed to be critical. Provision of good accessibility to surrounding residential areas is of prime concern especially where existing infrastructure (busy roads. physical features) might impose significant barriers to movement. The concept of land use zoning (specific designations) in the vicinity of Transitway stations is particularly important and numerous examples exist illustrating both specialist and mixed-use developments.

The bus lines of Transitway use public roads in the city centre. The 'light rail like' stations (outside the downtown area) are integrated with the urban environment of each station. This feature represents a basic condition for supporting new and existing land use. The visual and architectural integration however is open to debate. And walking distances between the stations and residential areas or public amenities tend to be long and complicated.

Riverside is a good example of a specialist institutional use development, where the Transitway has been routed through the grounds of Riverside hospital. In return for access to the necessary land associated with this, a station was built immediately

Transitway serves a huge hospital complex (photo left). Meanwhile this complex has been extended 'towards' the busway by means of a new building (not on the picture). Though American style malls are served very well by car, Transitway offers connection to this kind of amenity as well. In this second example (photo upper right) the bus station is integrated in the mall complex.

adjacent to the hospital buildings. In 1991 this enabled a new 4,200 square foot administrative wing for the hospital to be built immediately over the station, giving direct Transitway access for staff, patients and visitors. Subsequently, a new four storey medical building has also been built with enclosed access to the station.

Similar developments have taken place in the context of retail centres. At St Laurent construction of the station was associated with major expansion of the shopping Mall. This involved eighty new retail outlets linking the Mall to a three storey transit station. The top storey accommodates local bus route stops, the middle storey accommodates mezzanine corrected directly to the shopping centre and the lower storey accommodates the Transitway platforms. The resulting arrangement combines the staging between high performance Transitway and local distributor bus services with the possibility of shopping. It has excellent accessibility and was funded as a joint venture between the shopping centre developer and the Transit Authority. Further

incentive to the developer was provided by relaxing the requirement to provide parking places by 25 for each Transit bay included in the scheme.

A good example of mixed use zoning is provided at Baseline station. This is located in to the South East of the City at the extremity of the Transitway so it is an important staging point for local bus services. The mixed use designation enables residential, employment, retail and institutional uses. The map shows the location of the station and areas within 400 and 800 metre walking distance. To the west of the station is an area of open ground separating it from the City hall, office developments and a high school. To the south there is a commuter parking lot and further open space which provides potential for station area development. There is also a shopping mall with significant car parking space and it can be seen from the map that a number of residential areas are also within 800 metre walking distance.

On paper Baseline has all the ingredients for a classic, mixed use station area. However, like many sites of this type, problems need to be overcome to create the ideal. Most of these relate to integration. At present the highways, parking lots, open ground and the Transitway itself act as barriers to comfortable pedestrian movement. The relatively low development density means that remedying this problem requires substantial investment. The key question is whether the economic draw of high Transitway accessibility will generate the necessary funding for such investment to be forthcoming.

Transitway serves a huge hospital complex (photo to left). Meanwhile this complex has been extended 'towards' the busway by means of a new building (not on the picture).

Though American style malls are served very well by car, Transitway offers connection to this kind of amenity as well. In this second example (photo upper right) the bus station is integrated in the mall complex.

Many stations of Transitway serve residential areas, like in the third example (photo lower right). Notice however the long walking distance, difficult route between station and residential buildings.

Complementary policies

At a micro level the structure and quality of the pedestrian environment is known to be a key factor in the creation of stations with high transit patronage. It is recognised that provision of a high quality, safe and well-lit, pedestrianised walking environment is important for success and similarly, installation of cycle ways plays a vital role in promoting sustainability. Attention to detail in building configurations and appearance is also important in creating a sense of place and minimising walk distances from office to station.

A variety of transit friendly, complementary policies have emerged in Ottawa. These range from bans on car parking at government offices to provision of incentives for developers to reduce parking space at retail centres in favour of more friendly uses. Car parking is a major issue and on balance policy now favours the restriction of parking at transit stations including park and ride in the suburbs. The logic of this is that any car parking undermines the use of feeder buses to serve residential areas in the vicinity of stations.

Transit use has also been found to depend on the quality of station facilities and information provision on services. This issue has resulted in the construction of very high quality facilities despite the issues of cost referred to earlier. No information in this review has been found on the incidence of vandalism and maintenance of stations. In terms of service information a system has been implemented where every station has a number. The number can be dialled free of charge to find out the arrival time of the next two buses.

Innovation and fresh thinking

The innovative feature of Ottawa's Transitway is the exploitation of the flexibility offered by high quality buses by virtue of their ability to function like trains on dedicated routeways but to perform like conventional buses elsewhere. This enables them to reach a dispersed low density suburban population.

Furthermore, the system is financially very competitive – despite the cost escalation associated

with providing high quality, state of the art station infrastructure. In part this is due to the possibilities it offers for small scale but strategic extension on a relatively piecemeal basis. This allows significant returns on the back of affordable, incremental investments.

Another interesting mechanism for achieving financial efficiency is a policy of building from the 'outside in'. This means that transit development is started in suburban areas prior to development of other infrastructure and linked in to the existing backbone. This reduces construction costs by virtue of green field route development and also improves developer confidence in proceeding with investment projects.

Implementation experience

The overriding experience of Ottawa is that transit oriented planning over a long period of time (30 years) within the framework of clear and firm planning policy can be highly successful – even when attempting to serve a large area of sprawling residential growth. Furthermore, by avoiding draconian controls which seek to change people's residential preferences and making strenuous effort to provide high quality supporting public transport it is possible to create a transit culture with high levels of public patronage.

Key best practice pointers

- Plan high quality public transport provision to serve the needs and preferences of the community it is to serve to ensure political support and good patronage
- Supporting a low density of population covering a large metropolitan area demands high vehicle flexibility. Ottawa's bus-based transit provides this flexibility and meets the important requirements of high speed/high volume movement on dedicated city centre routeways, whilst preserving the ability to service residential neighbourhoods from existing roads in the suburbs
- Excellent transit supports door to door movement with no transfers – the flexibility of a high performance bus system removes the need for park and ride.
- For high volume transit, excellent design of vehicles, stations and routeways is essential. Transitway recognises that passengers will not wait around in sub zero winter temperatures
- High quality node-based development around stations is essential for success. There must be a mix of appropriate uses and strong supportive policies to create attractive pedestrian environments
- Policies supporting public/private node development are financially effective and reinforce patronage

3.12 Portland Max, United States, light rail

Reasons for selection

Portland MAX was selected for this study because it is acknowledged to be one of the most successful transit systems in America, exhibiting many characteristics of best practice. Attempts to recreate Portland's formula for successful, high quality public transport are numerous and no study of regional light rail would be complete without a discussion of the Portland experience. The particularly interesting features of Portland are the way in which the interaction between land use and transportation has been understood and handled.

The Gresham link provides an excellent example of a situation where high quality transit has been built in favour of a new highway through an existing area of metropolitan development. It demonstrates how land use-led transport infrastructure can be made successful using development focused on nodes around stations. It also illustrates how integration of regional transit infrastructure with high quality city centre tramway provision in the form of Portland Streetcar can contribute to both urban centre regeneration and focused, sustainable out of town development by making the centre more accessible to the regional hinterland. Portland Streetcar is described as a separate case study within this report.

By way of contrast, the extension of the Transit to Hillsboro in the west provides an example of transport-led development. With the exception of Orenco, where there was significant high technology employment, the stations are located in greenfield sites that will be the focus for node-based development of balanced communities. The creation of MAX has taken place against a background of careful land use planning aimed at enforcing strict containment of sprawl within the Metropolitan area. Focused development of nodes in the vicinity of Transit stops is an important element of both the land use and transport led elements of the system.

Continued development of MAX with extensions to the north and south is probably the strongest testimony to its success.

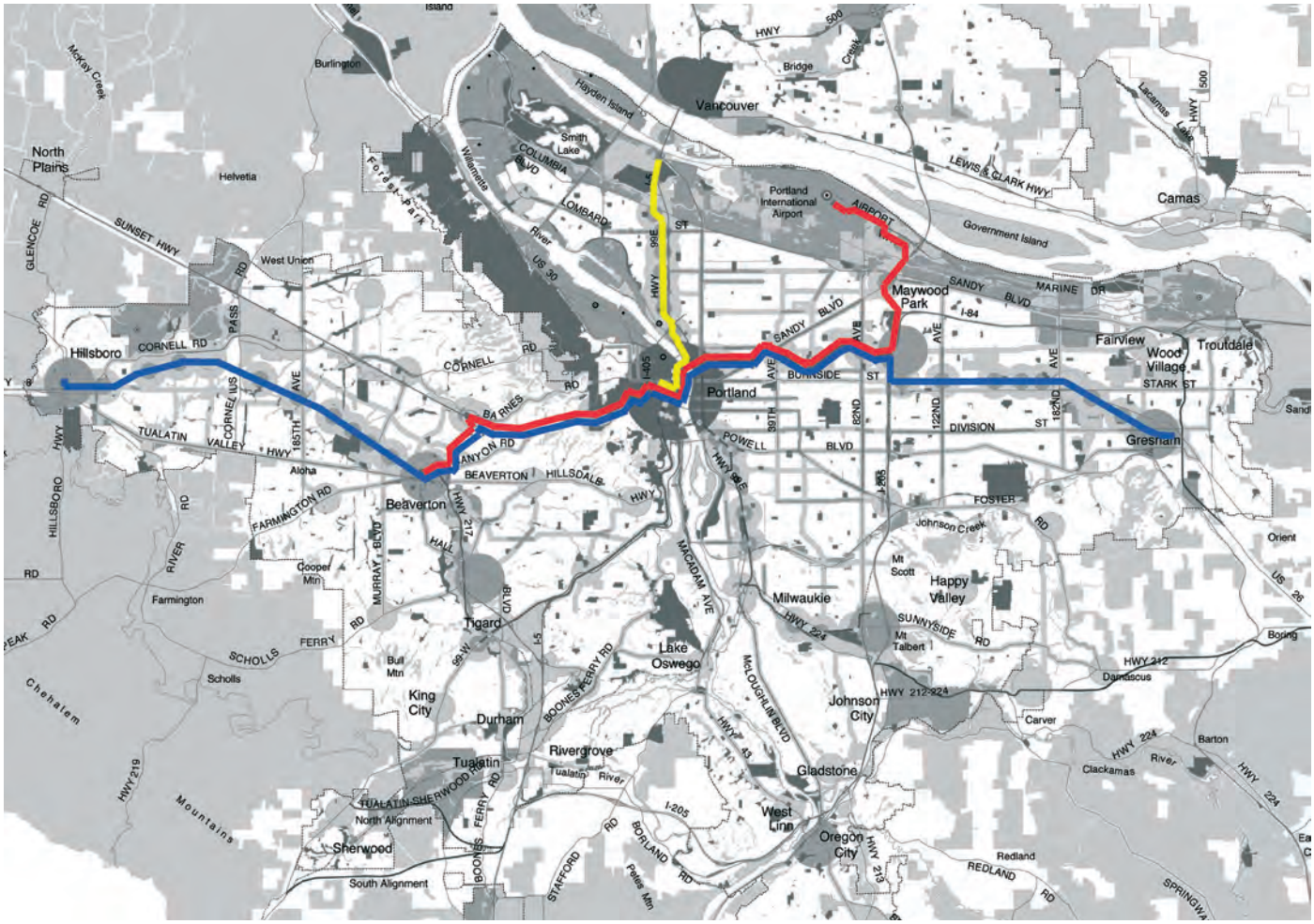
Background

Portland Metropolitan Area Xpress (MAX) is the regional light rail system serving the Portland conurbation on the US west coast. The Metropolitan area has a population of some 1.7 million people with about a million of these located in its 955 square kilometre urban core. The city of Portland itself has a population of some 500,000 with a density of 1,360 persons per square kilometre. For the broader urban area this drops to an average of 1,080 per square kilometre.

The area is the economic hub of Oregon and southwest Washington State, with Portland downtown the focus of economic activity. The area saw extensive growth at the turn of the century, with substantial increases in manufacturing, construction and mining activities. Portland attracted many of the functions associated with an important port by virtue of its location on the Willamette River. Associated with this economic success was the development of substantial areas of housing. Spread of this development in the form of urban 'sprawl' has long been recognised in the area as a threat to sustainable development and effective transportation policy.

With some 20% of the area's employment and 60% of leasable office space located in downtown Portland, the issue of car commuting and journey to work has been one of substantial significance for at least the last quarter of a century. By 1990 the average car use per person per day was 12.4 miles and 92% of all trips were by car. Furthermore, post 1970, there had been a rapid decline in the manufacturing base of the area (27% contraction) and in primary industries (20% contraction) matched by a 42% increase in service sector activity. With an ageing urban fabric in the traditional port areas and growing congestion/pollution from car use, positive steps were needed to achieve regeneration in downtown Portland and to stimulate new industry, especially high technology electronics, in the hinterland. This has been based on regional scale development of high quality public transport.

The need for economic regeneration, the fostering of new economic activities and a reduction of car use to reduce congestion and pollution provided the



The MAX network

springboard for the success of light rail in Portland. As early as 1970 it was evident that bus companies were fighting a losing battle in the metropolitan area and something needed to be done. The formation of a regional transport alliance involving the three counties of the metropolitan area (Clackamas, Multnomah and Washington) was central to the creation of administrative and political frameworks for achieving an integrated and sustainable light rail strategy serving the entire area.

The Tri-Met alliance was created by the state of Oregon and is responsible for bus and light rail in the region. It has a governor and seven board directors who oversee the work of the agency through a general manager. Tri-Met has a very clear mission statement aimed at increasing mobility in an expanding urban area via sustainable and environmentally friendly modes of transport.

MAX has been constructed in three main phases: firstly linking Portland City Centre ('Downtown') with

Portland downtown

Gresham to the east; secondly linking Downtown with Hillsboro to the west (the Blue line) and finally an extension to the north from Downtown in the direction of Vancouver to the Expo Centre (Yellow line). This section of the system is ultimately planned to form the north-south axis of a line linking Vancouver to Oregon City and Clackamas. The north axis of this link is now nearing completion. Also running north from downtown Portland is a link to Portland International Airport (the Red line), with major station development taking place at Cascades.

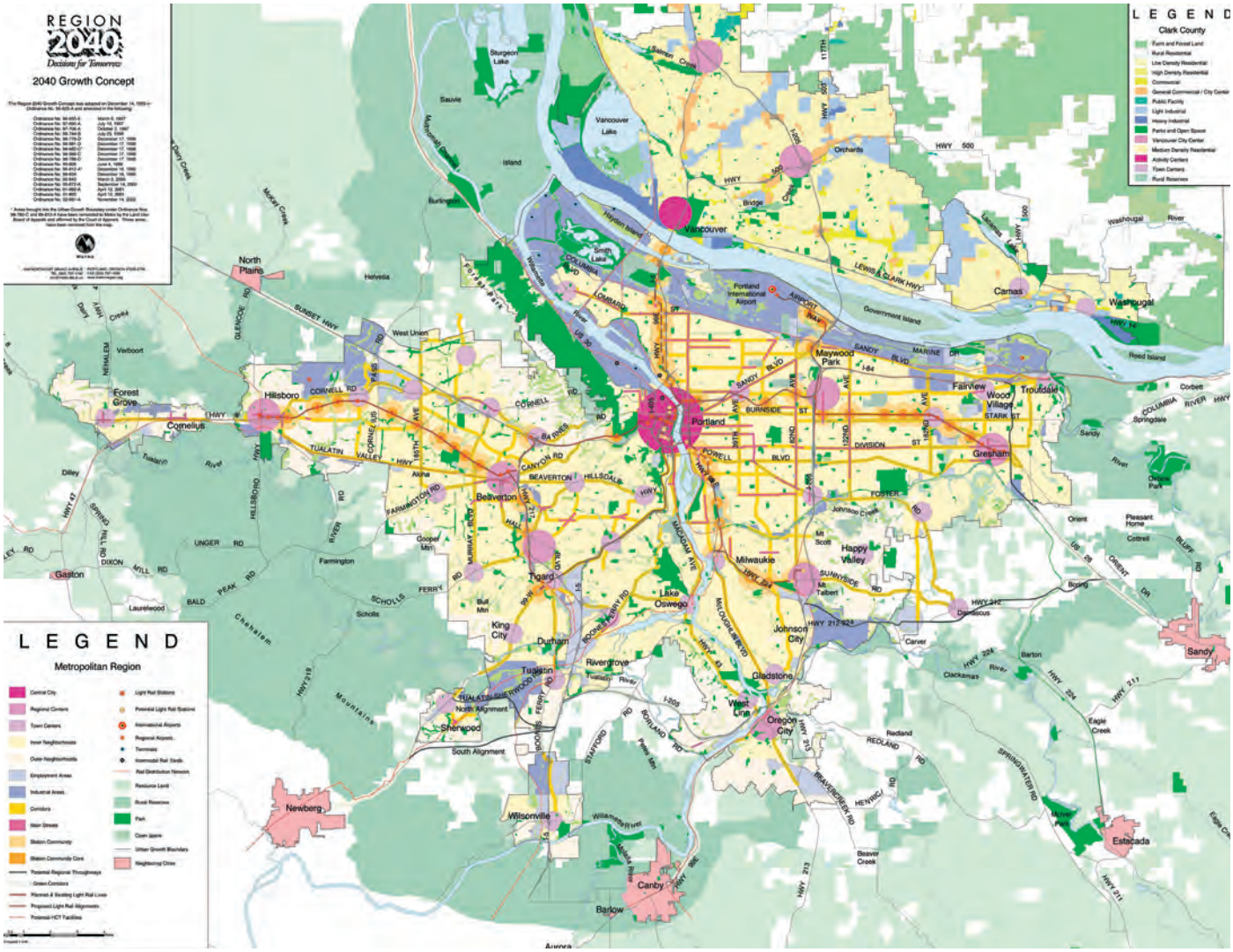
Portland hosts a 3-line regional light rail system. The Portland-Gresham link (1986) in the transit system is some 24 km long whilst the link to Hillsboro in the west (1998) is slightly longer at 29 km. Together these links are served as 'Blue Line'. The 'Red Line' (2001) connects Downtown to the airport. Recently (2004) the line is extended westwards to Beaverton. So far the northerly extension or 'Yellow Line' (2004) stretches just less than 10 km along a former state highway (but northern and southern extensions are on the drawing board).

Stations along the lines are grouped at 'growth centres' where land has been re-designated to promote transit related development. The system is focused on nodes, with each node containing one or more stations. In certain locations there are stations outside of designated nodes. A limited amount of park and ride has been created adjacent to some of the stations but perhaps more important, they have been sited to promote integration with the bus system. No regional heavy train services do exist yet.

Given the very large area of metropolitan development and the entrenched commitment to automobile use, it is remarkable that Portland's efforts to promote sustainable transit ever got off the ground. The key turning point was the withdrawal of a project to build the Mt. Hood freeway into Portland downtown and the release of funds for an alternative transport project. Against state opposition Tri-Met was successful in gaining support for a light rail link between the city centre and Gresham to the east at the expense of a high quality bus link. Considerable public and political debate lay behind this decision – but an important factor appears to have been the portrayal of light rail as an exciting and futuristic mode of transport. It also had the benefit of being quite distinct in requirements and infrastructure from bus – which might ultimately have contributed to freeway construction and yet more car traffic.

In part, the ongoing success of transit has been the result of the Gresham line's success in promoting economic development and change in a densely settled part of the metropolitan area. This success hinged on several key factors.

Firstly, the creation of a transit mall in the city centre within a framework of attractive, traffic-free pedestrianised areas with integration between light rail, bus, streetcar and slow modes of transport was fundamental. This scheme was championed by the mayor of the time – Neil Goldschmidt – who was instrumental in gaining the support of local business,



Regional planning in Portland aims to develop new nodes of urban growth, as well as improved existing ones, within the limits of regional 'growth boundary'. The map of 'Region 2040' depicts this advanced planning concept. In principle all nodes are served by light rail. However, light rail connections to the south side of the region are still in their planning phase.

Portland MAX

development agencies and the public for transit as an element of urban regeneration.

A significant part of Central Portland is known as Fareless Square. All journeys beginning and ending in Fareless Square are free of charge, to encourage public transport use. Fareless Square extends along a spur to the East across the Steel Bridge, via the Rose quarter and into the Lloyd district.

Secondly, the Gresham scheme was successful in stimulating integration of growth centres on the east side of the river. In particular it enabled massive investment in the Lloyd centre, an area immediately adjacent to the city centre but separated from it in accessibility terms. This investment was perceived as creating a more integrated central core with an expanded range of functions.

Finally, incremental development of transit-related improvements linked with strong publicity campaigns and close public involvement has maintained political and public support.

The strength of this public support appears to be based on widespread public understanding of the benefits of transit fostered by publicity, awareness and involvement campaigns. This is witnessed by the strong public support (73%) for bond-based fund raising to build the Hillsboro extension.

Institutional framework and coordination

The key institutional player in managing land use and transport policy in Portland is Metro, a directly elected regional government serving the 1.3 million plus inhabitants of Clackamas, Washington and Multnomah counties. Metro is also responsible for the 24 cities within the metropolitan area. It has a president who is elected region-wide and six councillors who are elected by the districts. Its responsibilities are extensive and cover issues ranging from fish and wildlife habitat protection through waste disposal to environment and recreation. All of these are embodied in its '2040 growth concept' plan, which provides a blueprint for development of the region. Transport oriented development is a very important part of this concept and the strong commitment of Metro in this area has been central to the success of the high quality public transport strategy. Metro's policy and plans for land use and transport are implemented in practical terms through Tri-Met.

The creation of Tri-Met was the key institutional breakthrough that has enabled the success of transit in Portland. It appears that Tri-Met is unique in the United States and its management has demonstrated remarkable powers of avoiding institutional boundaries to assemble the partner organisations and teams necessary for successful development. This is most amply demonstrated in the area of land use planning. Tri-Met has been a strong champion of integrated land use and transport planning. The policy of re-zoning to generate node-based growth around transit stations is the focus of this activity. Tri-Met has been successful in achieving transit supportive land use policies geared to creating a mix of employment, retail and residential infrastructure within high quality, often pedestrianised environments that are within walking distance of stations.

Regional planning in Portland aims to develop new nodes of urban growth, as well as improved existing ones, within the limits of regional 'growth boundary'. The map of 'Region 2040' depicts this advanced planning concept. In principle all nodes are served by light rail. However, light rail connec-

Orenco location

tions to the south side of the region are still in their planning phase.

The nodes have been set in a hierarchy. Together Downtown Portland and the Lloyd district (on the opposite side of the river) clearly represent the region's main node. Outside the city of Portland there are several larger nodes, such as Gresham, Beaverton, Hillsboro and Vancouver. The latter, at the northern side of the river, outside Oregon in the state of Washington, is not served by light rail yet.

Policy framework

The state of Oregon provides the main framework for land use and transport planning. Its longstanding policy of restricting urban sprawl within a clearly defined boundary has been fundamental to the success of transit via its tendency to promote compact, higher density settlement more amenable to being served by public transport. This 'urban growth boundary' was first established in the 1970s and is managed by Metro. Its function is to protect rural areas from urban development and to restrict sprawl.

The growth boundary has strict legal status and is reviewed every five years. State law requires that Metro has a 20 year supply of development land within the boundary. This means that although the boundary is very strictly protected it does change from time to time. The year 2002 saw one of the largest changes with the release of an additional 85 square kilometres for housing and employment use.

Within Oregon the individual counties each produce a land use plan that must comply with the growth boundary and that are revised and enforced by the Land Conservation and Development Commission (LCDC).

A key element of current planning policy stems from the introduction of the so-called 'Transportation Planning Rule' in 1991 by the LCDC. This demanded the reduction of per-capita vehicle miles travelled by 20% by the year 2020. This policy statement clearly recognises the importance of integrated land use and transport planning. Its effect has been to make local authorities change their development standards in favour of a more transit oriented style. In particular it stimulated the production of model development schemes for the development of areas within walking distance of transit stations.

Core principles: land use planning to support public transport

As described above, the planning strategy for the region has followed a policy of focused development at so-called nodes centred within walking distance of one or more transit stations. To qualify as a node an area must have clear market development potential. In the eastern parts of the metropolitan area this has inevitably involved introducing measures to enable land use change that allow a balance of office, retail and residential development. The mix of activities permitted has been designed specifically to ensure patronage for the transit. Inevitably this has involved infill development and renovation/reconstruction of buildings where regeneration was an issue. Great emphasis has been placed on environmental improvements to encourage pedestrian and cycle modes. Integration of transit and bus networks is a central feature of many nodes with specifically designed stations and malls.

In the areas to the west of the metropolitan area the concept of transit-oriented living has been central to the development of nodes. Whilst all nodes have been the subject of carefully thought through planning blueprints, those on the west side have taken on a particular significance by virtue of the possibilities for what might be described as socio-economic engineering. The blueprints act as an advert for high quality living in a sustainable, high quality environment. On the Westside there have been strong partnerships forged between planners, developers and local residents with a shared vision of these new, transit friendly structures.

The Lloyd District on the Eastside provides an excellent example of the nodal development strategy. Of the $1.3 billion (1 billion euros) investment around nodes, $767 million (590 million euros) has been spent at the Lloyd district, with the bulk devoted to the following large-scale initiatives:

- A 20,340 seat sports arena ($262 million)
- Renovation and expansion of the district shopping centre ($200 million)
- Oregon convention centre ($85 million)
- Federal government office building ($55 million)
- Red Lion Inn hotel ($38 million)
- Lloyd Centre Tower office development ($33 million)
- Pedestrian environment development schemes ($22 million)
- State office building ($11.5 million)
- Lloyd cinemas ($3 million)

Along the entire length of the Eastside transit these focused developments have had a significant impact on the housing market, both by stimulating redevelopment of better quality fabric and by encouraging influx of families seeking a better environment. This has substantially strengthened a declining housing market.

It is not insignificant that the first part of MAX to be constructed used a well established transport corridor through densely settled areas. The Gresham line is a classic example of land use-led develop-

Expo Centre

ment where the high levels of patronage required to ensure success of the Transit system were most likely to be forthcoming. The extension to Hillsboro on the Westside is quite the opposite where the line's twenty stations are predominantly surrounded by greenfield sites. There is almost three times the amount of development land in the west and just one of the Westside stations contains more development land than the entire set of Eastside stations put together (Arrington, 1996). This means that Westside is a classic example of 'transport led' planning where the transit is the catalyst and major policy instrument for bringing development.

Clearly, this type of development is high risk and could probably only be attempted on the back of the access to opportunities and markets resulting from integration with the successful Portland centre/Eastside line. Without this integration it is likely that there would be insufficient early patronage for the transit itself to maintain public support and furthermore, it is also likely that attracting developers to the area would be extremely difficult. Nevertheless, transit

development has some major benefits. In particular, it provides the opportunity to engineer new, sustainable communities that are high quality public transport oriented rather than dependent on the car. Orenco station on the Westside is an internationally famous example.

The original settlement at Orenco was established in 1906 as a company town by the Oregon Nursery Company. Its nine block grid layout made it the oldest planned settlement in Washington County. With the demise of the company, Orenco became a part of the very low density, sprawling Portland suburbs. However, the arrival of MAX has provided the opportunity to re-model Orenco as a flagship for sustainable, transit oriented development. The new community is within a 800 metres walking distance of the MAX station. When complete, it will boost Hillsboro's housing stock by over 10% and be a balanced community of housing, retail and employment opportunities. Inevitably, the project has its critics – in particular it has been suggested that the new community lacks social cohesion. However, early research (Podobnik, 2002) based on questionnaire surveys seems to suggest that this is far from the case. The same research suggested that new residents have a very positive view of the advantages offered by the transit system.

Though certainly car-based, Orenco Station has evolved into a community which is transport oriented indeed, at least by to American standards. The first phase of this 'residential node' was located at some distance (300–500 metres) from its light rail station. The next phases (which have been partly built) have been projected closer to the station. Orenco Station is widely conceived as a successful merger of transport oriented development and 'New Urbanism'.

It is probably premature to pass judgement on whether the nodal development policy on greenfield sites in the west will meet with the same levels of success as in the east. However all the indications are that it will. Portland has succeeded in building a 'transit culture' where people are willing to accept it as their main means of transport. Experience from the Eastside development has demonstrated that where people are committed to car travel it is extraordinarily difficult to get them to change. Development of nodes in these districts has usually failed. In new developments, linked to existing, successful transport – providing integrated access to life's requirements – this problem does not appear to arise.

The fact that MAX has continued to grow since the year 2000 demonstrates that it has passed a threshold critical to its ongoing success. The policy of using it to integrate the regional economy by linking key growth nodes clearly works and the latest example is the Red Line extension to Portland International Airport (Portland Development Commission, 2003). The project began in 1998 with the formation of a public/private partnership between Tri-Met, the Port of Portland, the Portland Development Commission and the Bechtel Corporation. Bechtel agreed to make a major contribution to funding the airport extension in return for the right to develop 55 hectares of mixed use land on the Portland International Centre Business Park. The Park is at Cascades station near to the airport.

The airport extension opened on September 10th 2001. The journey time from downtown Portland is 37 minutes and cost at opening was $1.55. The service has a frequency of every fifteen minutes between 5am and 11.30pm every day. The development of Cascade Station is expected to continue until almost 2015 and attract over 10,000 new jobs. Again, it is evident that the development will have excellent, sustainable, public transport links and will have good economic integration via the Transit with the wider Portland economy. Airport MAX is an excellent example of this type of planning strategy coupled to a public/private finance package that releases early funds for transport development.

The new Yellow Line connects the huge Expo Centre at the north side of Portland to Downtown and offers accessibility for a large and long existing residential area as well.

Innovation and fresh thinking

Portland MAX is a longstanding success story and many of the approaches to transit development described above are recognised as being internationally innovative. Many have been copied elsewhere. The key lessons from Portland stem from the way in which land use and transport interaction have been interpreted and exploited to support public transport. Initial establishment of the system involved building through an area of existing, relatively dense development. Regeneration and infill development schemes were built with due consideration for market forces to ensure that the transit had sufficient patronage. Once successful and fully operational, transit has been used as a development tool on the west side to create high quality communities and link them into the existing transit infrastructure. Again the philosophy has been to plan and build the necessary travel demand with a strong public finance lead to ensure success of the transport scheme.

Key Best Practice pointers

Portland offers many pointers to best practice, including the following:

- An effective supporting framework involving all of the relevant institutional players has been a key factor in successful regional transit in Oregon. Led by the Metro regional government, the creation of a dedicated land use and transport planning agency in the form of TRI-MET has been central to success. Tri-Met has the corporate vision and drive to engender cooperation and large scale development built on sustainable transport. It has been central to the success of MAX.
- Uncompromising commitment to high quality infrastructure, enabling door-to-door travel is the essence of high quality, competitive transit in Portland and has been a pre-requisite to ensure public support and patronage.
- Successful light rail is best initiated along established corridors of development. Stations should be sited in areas where there is existing patronage to support early development of the system. They must also have major development or regeneration potential to create a transit-oriented growth node. Appropriate local planning policies are essential to make such nodes possible
- Large scale development of either specialist functions or balanced communities should be a target at stations to provide sufficient patronage to sustain and maintain the transit. These communities should be built on sustainable principles with high quality pedestrian areas, minimal need for, and exclusion of cars according to a shared, public vision of an excellent environment. They should have a strong sense of community and place
- Innovative funding mechanisms are required to support node development. These are best led by public investment but may then be based on public-private partnership. Successful node development with high quality transit creates the necessary political climate for local taxation to support development. Uncompromising public commitment to node development programmes and high quality transit provision creates the climate of confidence needed for private investment to follow.
- A successful transit supported by thriving development and/or regenerated nodes can provide the basis for new development at greenfield sites. Linking such sites into an existing network of economic success creates an environment where successful investment can take place.
- New development of this type is the key for creating balanced, high-quality, public transport-oriented communities of the future, with strong sustainability credentials.
- Large scale development ambition is important to transit success – compromising on the relatively modest costs of transit infrastructure leads to a high risk of failure.
- Public subsidy of fares is justifiable in growth terms and is an important element of transit success.

3.13 Portland Streetcar, United States, tram

Study prepared by Martin Glastra van Loon, OTAK – Urban Design and Town Planning, Lake Oswego, Oregon.

Reasons for selection

Portland Streetcar provides an internationally renowned example of a successful local transport scheme based on tramway technology. The scheme forms part of a broader, integrated transport system involving Portland's MAX Transit system and a widespread network of bus provision. It forms a key element of an ambitious scheme to regenerate Portland's declining city centre with transport led development and it is now argued that substantial economic and environmental improvements in the downtown area of Portland have been brought about by the scheme.

Despite some harsh measures to support sustainable land use and transport strategies in Portland, the Streetcar scheme has widespread public support and strong local community participation. It has a strong package of complementary, supportive land use measures and has benefited from a vigorous marketing programme. Whilst the Streetcar has some critics who question its credentials, the fact that a new extension linking Portland State University and the Riverside district is at an advanced stage of implementation (October 2004) speaks for its success. The extension is scheduled to be opened in March 2005.

Portland Streetcar connects Pearl District to Downtown. This provides convenient linkages throughout the central city that facilitate movement for pedestrians to and from the river, and to adjacent neighborhoods, like Pearl District northwest, and to the University complex south of Downtown.

The illuminated sign "GO BY STREETCAR" on top of one of Pearl District's apartment buildings symbolises the role of the new tramway. The tram is an integral part of the urban development. Of course this tram is a form of public transport, but moreover, it is the backbone of new land use in Portland's Pearl District. 'Streetcar Lofts' and 'Streetcar Condominiums' are being snapped up during summer 2004.

Background

The central city or 'down town' area of Portland developed along the western bank of the Willamette River in Victorian times. Soon after the turn of the century it had a population of some 270,000 served extensively by a local network of public transport using electric streetcars. The network had some 300 kilometres of track and carried both passengers and freight. As in many other cities, the advent of the car and a more flexible bus system resulted in removal of the tracks. In the 1960s much of the fabric of the downtown area was becoming aged and the extensive development of suburban housing, retail and business infrastructure had resulted in economic decline. In addition to ageing fabric, the area also suffered from classic inner city environmental problems revolving around high levels of car use, notably congestion and atmospheric pollution.

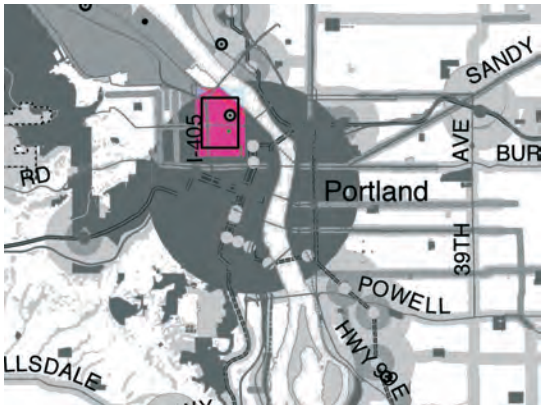
The last thirty years has seen a dramatic turnaround in the economic vitality and environmental quality of the area.

The River District is a major focus for activity by virtue of the fact that it has considerable redevelopment potential. Within the northern part of this renewal area, the Pearl District attracts much of the new development, and is becoming an import 'node' for the whole metropolitan region. On the 'Metro 2040' (detail in grey) it belongs to the Downtown area, located at the north western section (see map: in purple).

A key institutional player in this regeneration has been Tri-Met, a public, regional transit agency located in the central city. The formation and structure of Tri-Met has been described in the case study dealing with Portland MAX. Its policies have been central to the success of Streetcar, especially those which have prevented the development of new freeways into the city and discouraged commuting by car.

The Streetcar acts as a local circulator and follows a four and a half mile route through existing blocks in the city centre. Its purpose is to link key central area neighbourhoods (hospital, university, retail and new housing) with a fast, efficient and attractive transport system. Other locations served by stops in-

Portland Streetcar connects Pearl District to Downtown. The illuminated sign "GO BY STREETCAR" on top of one of Pearl District's apartment buildings symbolises the role of the new tramway.



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clude the Central Library, the Post Office and various cultural centres. Phase 1 of the system (July 2001) has 32 stops located approximately every three to four street blocks around the circuit.

With complementary supportive measures including parking limitations, creation of pedestrian and cycleways and limitations to vehicular access, the system aimed to overcome congestion, reduce air pollution and create an attractive environment conducive to pedestrians and suitable for construction of new housing with a strong market demand. Vital characteristics of the Streetcar include its frequency and reliability of service, plus its close integration with MAX and regional bus services. Specifically, it was designed to attract commuters by providing a rapid and attractive onward transfer to final destinations within the city centre.

Political will and public transport culture

Portland's fame as city succeeding on the back of its high quality public transport system was one of the reasons for its selection as a case study here. It has the image of a place where there is great public enthusiasm for and pride in the public transport

provision. Nevertheless, it has to be acknowledged that this culture was unlikely to have been spontaneous and many of the restrictive land use measures needed to support the system would have been deeply unpopular. It seems clear that a number of factors have contributed to initial acceptance of the Streetcar project and created an environment where it was politically acceptable.

Of great importance is the fact that the system is of undeniably high quality with total reliability of service and top quality transit vehicles. The frequent stops are appropriate for the inner city location.

The decision to choose trams appears to have stemmed from the successful introduction of four vehicles in the central area of the regional transit system as a tourist attraction. This experiment demonstrated a clear receptiveness on the part of the community to a tram-based mode of transport based, it would seem, on historic and somewhat sentimental reasoning.

Another important element of fostering and maintaining public support for the transit has been an ongoing, and highly successful publicity, marketing and promotional campaign. The key principle is to keep the community on-board by making sure that they have a voice in what is happening, how it is happening, when it is happening and why it is happening. This philosophy resulted in a fundamental adjustment to the proposed route of the system when three of the neighbourhood associations (Downtown, Pearl and North West district) argued successfully for changes. Clearly these sections of the community served by the system are now strongly in support of its structure. The Streetcar web site is a key instrument in this, alongside the Advisory Committee meetings. Other important aspects range from public consultation on development strategy to signing streetcar stops with electronic arrival time boards.

Institutional framework and coordination

Great care has been taken in Portland to establish the correct institutional framework. Project organisation was based on a partnership between the city council and Portland Streetcar Inc (PSI), a non-profit making organisation with the single aim of providing high quality transport to stimulate regeneration. The formation of a 'Central City Streetcar Citizens Advisory Committee' has been central to the success of this partnership. The Committee consists of local residents, business groups, neighbourhood associations and developers. It holds monthly, open meetings and provides an effective forum for consensus management.

It is clear that the institutional relationships between Portland City Council, Tri-Met and the Citizens Advisory Committee have been central to the success of the programme. Without this infrastructure in place it would have been extraordinarily difficult to arrive at a consensus on the design issues involved and the implementation programme. Furthermore, in the absence of service integration with the MAX Transit and the regional bus network, it is unlikely that the system would have achieved such patronage.

Policy framework

The institutional framework described above has enabled a land use and transport strategy to be tailored to meet the regeneration needs of the City. Of central importance to this strategy has been the principle of limiting urban sprawl at the metropolitan level by defining a clear metropolitan boundary and forcing all development to take place within its confines. The significance of this strategy probably has more to do with ensuring that the urban area to be served by public transport has an appropriate form than with increasing densification, although the latter is also significant.

The Tri-Met dimension to Streetcar ensures that City planning policy is in tune with the objectives of the wider metropolitan area. This area has one of the highest population densities in the Western USA, and as part of the regional growth strategy the City of Portland anticipates absorbing 20% of the Portland region's new jobs and households in the first part of the current century. This means the creation of 50,000 new households within the City, of which

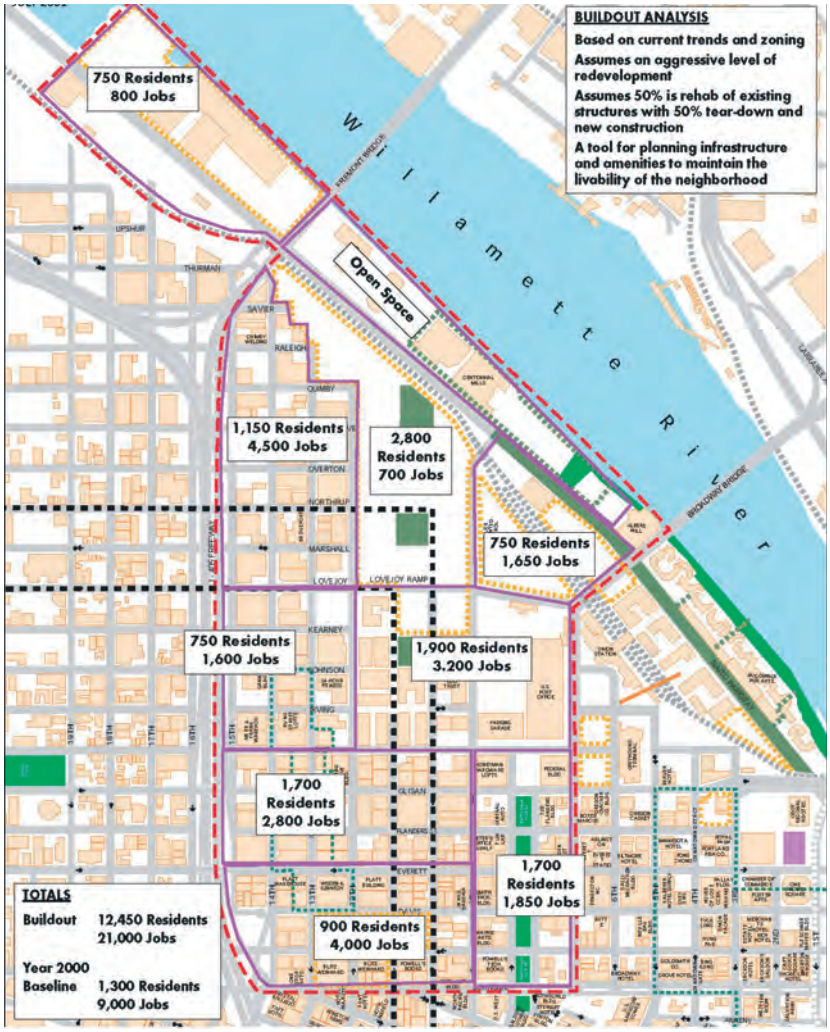
15,000 will be in the centre. The aim is for 75,000 new jobs in the city centre.

The Portland Development Commission coordinates the regeneration plans for the City. Designated urban renewal areas include the River District, North Macadam, Downtown Waterfront and Central Eastside. The River District in particular is a major focus for activity by virtue of the fact that it has considerable redevelopment potential. The northern part of the renewal area covers the City's Pearl District and Chinatown areas. Prior to the regeneration scheme the Pearl District was dominated by ageing warehouses and storage units related to the town's historic port functions. It had all of the classic signs of a depressed waterfront area. The existing Streetcar runs through the centre of the Pearl district following NW10th, NW Northrup, NW Lovejoy and NW11th street alignments.

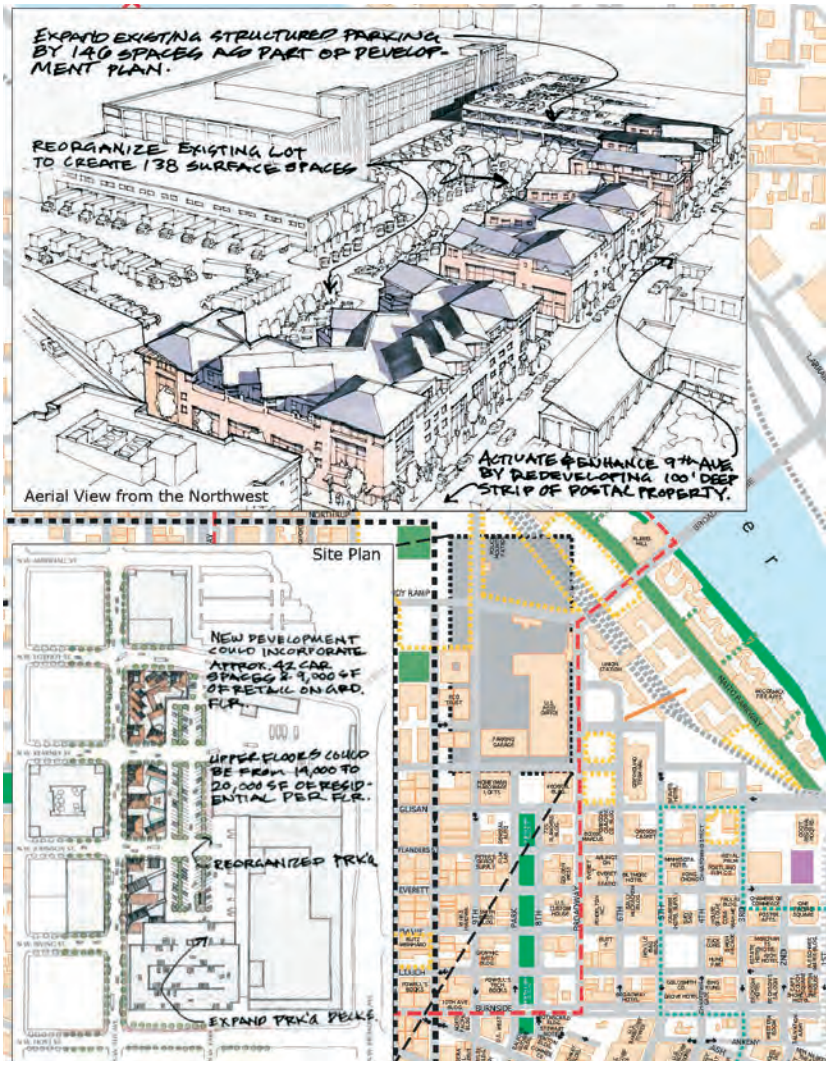
The Pearl District Development Plan (2001) provides a blueprint for regeneration of the area according to strict planning guidelines. These include:

- Linking the Willamette River to the community, thereby reinforcing the river's significance.
- Reinforcing the identity of the Pearl District neighbourhood.
- Orienting building entrances at pedestrian circulation points to conveniently and effectively connect pedestrians with transit.
- Providing convenient linkages throughout the River District that facilitate movement for pedestrians to and from the river, and to adjacent neighbourhoods.
- Encouraging the concentration of art galleries and studios with design features that contribute to the Pearl District's "arts" ambiance.
- Buffering and separate the sidewalks from vehicular traffic with street trees, plantings, and protective bollards.
- Enhancing the pedestrian environment through the use of arcades, awnings, and wider sidewalks.

Prior to the Pearl District Development Plan (July 2001) this old industrial part of the city was dominated by ageing warehouses and storage units related to the town's historic port functions. It had all of the



Pearl District Development Potential



Pearl District Development Plan

classic signs of a depressed waterfront area. Nowadays 'Pearl' is a new vibrant city developed within a surprisingly short period of time. The tramway – Portland Streetcar – runs through the centre of the Pearl district following NW10th, NW Northrup, NW Lovejoy and NW11th street alignments.

Implicit in these and indeed all of the remaining guidelines is a clear vision for regeneration of the area as a vibrant, waterside neighbourhood with a clear sense of history, proud of its (restored and rejuvenated) architecture, looking to the river as a key environmental resource. Support for the Streetcar is an important element of this vision. A detailed view of the River Districts development projects can be seen in the map. The extent of their success to date can be gauged by the numerous reports of the excellent restaurants, elegant condominiums and vibrant culture of the area (see for example *http://portlandor.about.com/cs/neighborhoods/a/pearl.htm*).

To the south of the River District is the Riverside regeneration project, focused on a 16 hectare site of disused railway marshalling yards. A private developer has acquired the site and is committed to constructing a substantial housing development. Whilst no information is available regarding the planning agreements involved, it is self-evident that the planning policy commitment to regeneration has made this decision possible.

Along, or very near to the new tramway a lot of new facilities have been erected during the last few years (2001–2004). The amount of new retail and new amenities is impressive (depicted on the drawing as many colourful, numbered bullets).

Central to the Riverside regeneration is the construction of an $18 million (€13.5 million) extension of the Streetcar network in the form of a 800 metre spur to Riverplace. This will involve the purchase of an additional two Streetcar vehicles and will be carried out in conjunction with a new highways project to build a strategic network link called the 'Harrison Connector'. Part of the new housing allocation required will be provided in the form of high rise apartment buildings. It is expected that the scheme will be completed in 2005. The new spur links the

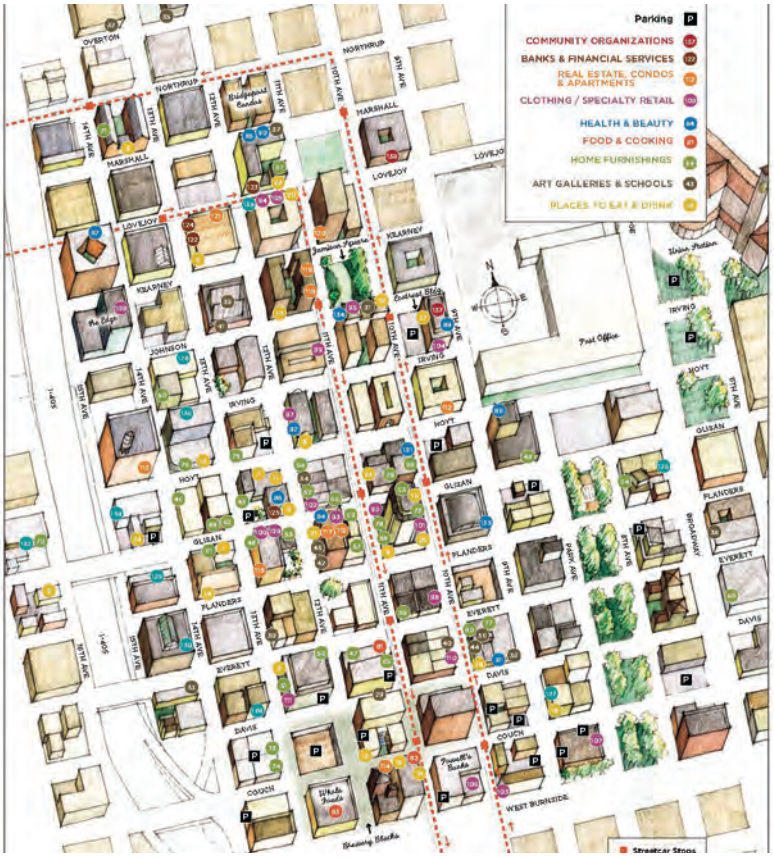
Riverside regeneration site to the existing Streetcar loop, close to the Portland State University area. This is significant for two reasons. Firstly, the university area has significant housing demand and retail potential and Riverside will be able to share in this potential. Secondly, it provides economic integration with the rest of the Streetcar and wider transit network, ensuring the excellent communications necessary for success.

Core principles: land use planning to support public transport

Within the wider metropolitan area a public bus and transit network has been developed (see the section of this report on Portland MAX) with the clear aim of identifying concentrated nodes for growth that could be linked together and to the City Centre by public transport, thereby stimulating regeneration. This principle of integrated regional development is crucial in providing impetus and patronage to the Streetcar initiative and its associated development objectives in Central Portland. The development node structure is an important element of the planning strategy and implies a clear recognition of the fact that trying to cater for the considerable, existing areas of residential sprawl in the metropolitan area by public transport is unlikely to be successful. This is not just because of its extensive spatial form but also because of an acceptance that people in these residential areas have a high resistance to adopting public transport in favour of the car.

Coupled to these wide area policies there has been a package of

- Restricting highway development that provides access to the City and taking measures to discourage automobile use. However, strategic links such as the Harrison Connector have still been permitted.
- Building the transport infrastructure to link with currently vacant sites, thereby providing a springboard for future, sustainable development.
- Building the transport infrastructure to replace and reinforce existing, well-established patterns of movement.



Planned redevelopment

Shop-top housing

Green spaces and sculptures enhance public realm.

Residential buildings located a long the tramway (NW Lovejoy)

- Establishing parking facilities outside of the Central Area and discouraging car use by means of significant parking costs
- Environmental improvements in the form of cycleways, pedestrian areas and building restoration to make Central Portland an attractive place where people can circulate easily without the need for cars and their associated congestion, pollution and accident risks.

The longer term strategy of development implies a shift from in-commuting, especially by road to a balanced City Centre community with residential, employment, retail and recreational uses in close proximity and served by an excellent, sustainable transport facility in the form of an expanding street-car network.

Financial characteristics and funding opportunities

Prior to the Riverplace extension the Streetcar project was estimated to have cost some $56 million (€42 million). Funding for the programme was drawn from a wide range of different sources. Interestingly however, the largest single contribution to this sum

came from City Parking Bonds – some $28 million or 50% of the total. Other significant elements came from Federal Transportation Funds via Tri-Met (10%), Local Business Improvement District Funding (17%) and Tax Increment Financing (13%).

The significance of using automobile-related revenues to support public transport becomes even more evident when recurrent costs are considered. The annual estimated operating cost for the Streetcar is just under $2.4 million (€1.8 million). Of this, two thirds is met by Tri-Met and the balance is from new parking facilities, fares and promotions. Given the importance attached to low fares and the fact that sponsorship is limited to one sponsor per vehicle, it is clear that parking revenues are of some significance.

The Riverside extension to the system follows a similar pattern, with significant elements of the $18 million (€13.5 million) investment coming from the Portland Development Commission and City Council funds. However, it is interesting to note that a further 20% is being generated from improvement district property owners and a slightly smaller proportion from land exchanges and sales.

Innovation and fresh thinking

The Streetcar project is widely recognised as a model of excellent practice and is frequently visited by delegations searching for the ingredients to enable successful emulation. Many of the measures involved in the programme, especially those concerned with environmental improvement, dis-incentives to car use and encouragement of slow modes have been incorporated elsewhere into schemes that have been considerably less successful. So what is it that sets Portland apart from other central city area regeneration schemes?

From the review above, the most striking features of Portland that have made it a success are the following:

- High levels of public transport integration across the entire metropolitan area, focused on nodes of demand for transport. Little attempt to address car use in vast areas of sprawl.
- High levels of institutional integration and sharing of financial responsibility, with a clear planning target agreed by consensus
- High levels of public involvement in the process
- Funding and support for fare box revenues from innovative property-related finance initiatives
- Cross-subsidisation of public transport using automobile generated revenues
- Recognition of a public willingness to accept and enjoy tram cars.

Key best practice pointers

- Early engagement and involvement with the local community to establish consensus on the project. Continued promotion and marketing of the scheme with excellent communication methods.
- Street-friendly system with low disruption levels associated with installation. Creation of pedestrian-friendly environment with freedom from cars, pollution and accident risks.
- Innovative funding practices and cross-subsidisation from parking charges.
- Integration with the wider metropolitan network to ensure high patronage from in-commuters.
- Establishing the system by linking key urban nodes capable of generating high levels of patronage (retail, university, hospital, cultural centres, metropolitan transit mall). Subsequent extension to brown field regeneration sites to tie them into the existing structures via 'transport-led' development.
- High levels of institutional integration with strong public involvement. Shared financial responsibilities to meet clear goals defined by consensus.

4 Lessons of the case studies

4.1 Introduction

The case studies that appear in this report provide a rich source of ideas and information about how to use urban land to promote high quality public transport, and how such public transport can itself be used to achieve urban planning objectives such as urban regeneration and more environmentally sustainable and inclusive communities. For the most part, the case studies provide inspiration for those looking for ideas about how it can be done. But the case studies also provide some salutary lessons about what to avoid.

This chapter will revisit the themes that were developed in the introductory chapter to highlight what we can learn from the case studies.

Most of the information in the case studies relates to the themes concerning the integration of land use and transport planning:

- selecting routes that consider land use in order to maximise both accessibility and patronage,
- focusing development along corridors and at public transport nodes, and ensuring that this development supports public transport use, and
- using public transport to revitalize the city, or parts of it.

This chapter will also highlight what the case studies can teach us in terms of providing complementary transport policies to support a high quality public transport service:

- urban design and traffic measures to promote pedestrian and cycling access to stations,
- parking policies that complement rather than undermine public transport, and
- management of public transport to make best use of high quality services.

However before turning to these themes, it is appropriate to draw attention to the lessons provided by the case studies about the best administrative structures to create and maintain high quality public transport.

4.2 The administrative and political context

Calls for the integration of transport and land use policies are not new. For example, the final report of the ECMT-OECD project on Implementing Sustainable Urban Travel Policies states:

"Sustainability requires that policy-making for urban travel be viewed in a holistic sense: that planning for transport, land-use and the environment no longer be undertaken in isolation one from the other […] Without adequate policy co-ordination, the effectiveness of the whole package of measures and their objectives is compromised." (ECMT, 2001)

Coordination is necessary to see that the various sectors each contribute to and not detract from overall objectives. The coordination may be needed to cross the boundaries of different governments, of different levels of government and of different departments. Sometimes it is a struggle to achieve coordination even within a single department.

Political leadership

Cities are fortunate indeed if they have political leadership with the imagination, drive and persuasive abilities to be able present a vision of how a high quality public transport system could be used to enhance the quality of life for a city's residents, protect what they regard as important, and promote the city's economic vitality. Individuals such as Strasbourg's Mayor Trautmann and Councillor Edaggar of Graz an have the ability to get their political colleagues and the community to think beyond the short-term decision making that all too often results in ever worsening traffic and accessibility problems. Mayor Goldschmidt played a similar role in Portland.

Even in France where the strong commitment to quality public transport is underpinned by the Versement Transport, changes in local political leadership can jeopardise the future of a system, as in Orléans where the planned extension of the tram system was called into questioned following the 2001 elections. In Graz too, changes in local leadership following the loss of a public transport champion have meant that land use and transport planning have slipped down the political agenda, carrying with it the development of the tram system.

Institutional structures

With individual political leadership being a fragile resource, more enduring are institutional structures that ensure that broad, long term objectives are pursued. These characterize the most successful cities.

Strong and well respected government agencies provide the foundations on which to develop a positive and supportive strategy and provide important continuity throughout the typically long development timescales. In order to be effective, the institutions must have the ability and also the authority to make policies work. Special powers may assist in fulfilling their role in regeneration areas where a comprehensive and spatially extensive approach to redevelopment is required.

A regional approach is a common feature of such structures. Nantes has a history of decentralized local government authorities cooperating together on matters of regional concern through bodies such as the Urban Community. Like elsewhere in France, the devolution of responsibility for public transport to the municipal level has encouraged the creation of regional bodies responsible to their constituent local councils, that are well placed to integrate land use and transport provision on a regional scale.

A strongly regional approach can also be seen in the Stuttgart case study, where the city provided a model for other German cities with its directly elected regional assembly to coordinate a wide range of policies in the 23 districts for which it is responsible. In a similar way to Orléan's Observatory, Stuttgart's regional Think Tank further promotes thinking and policies that leap over administrative boundaries.

Portland's Metro is another directly elected regional body that has been given an enormous role in managing land use and transport policy, as well as promoting a public transport environment in the three counties for which it is responsible. The creation of the Tri-Met alliance of metropolitan counties was an institutional breakthrough in the US. It is not only a champion of integrated land use-transport planning but also wields remarkable power by adopting an inclusive approach whilst at the same time leaping the many institutional boundaries

needed to tackle development planning and regeneration issues.

Ottowa-Carlton has achieved what is arguably the most impressive coordination of public transport policy and land use – at least in terms of controlling development – through its Regional Council and the regional Transit Commission.

It is interesting to note the way that such bodies have been able to deal with the multiple service providers that are often feature public transport provision today. While French cities will typically have a single undertaking that may range from full public ownership to a private company, other cities have achieved the benefits of both coordination and competition through the contracting process. Most notable is Graz, where the services of over 50 public transport operators are integrated through MobilZentral. (For further discussion of this issue see Guide 2, Public transport – network design.)

A clear strategic framework

Another characteristic of the most successful cities has been the articulation of a clear framework to guide decisions, whether they be in relation to public transport services, other transport matters, or land use planning. Graz has had its Gentle Mobility policy to encourage local access, public transport and non-motorized mobility on numerous fronts. Nantes' transport and urban planning decisions have been guided by a strong urban regeneration initiative and a clear idea of where they wanted the economy to go.

The Regional Municipality of Ottawa-Carleton has worked with its constituent municipalities to provide a clear spatial structure to guide decisions, including a clearly defined hierarchy of centres. The Transitway provides the obvious framework for this structure. The plan also guides the public transport providers to ensure that services are accessible and provides patronage targets.

Portland has both its 2040 growth concept plan as a blueprint to guide development, and the Transportation Planning Rule to force local councils to adopt development standards that support public transport. It also has had a clear mission to revive the downtown area by forsaking the previous approach of welcoming cars.

Strasbourg's ability to coordinate its two key transport plans and to ensure that these are both framed within agreed population, employment and educational projections is also an example worth adopting, as is Stuttgart's Regional Transportation Plan, for its capacity to guide the more detailed local level plans.

The hazards that a fragmented institutional structure pose for the provision of high quality public transport are demonstrated in the Sheffield case study. Policy fragmentation characterised the institutional structure at the time the Supertram was introduced. This fragmentation was at several levels:

- The formerly regional local authority was split into borough councils, with little in the way of regional coordination mechanisms.
- Land use planning was shared between the Sheffield City Council and the local Urban Development Corporation, which had a specific, narrow remit to promote economic development. It pursued this with the dominant paradigm of car-based accessibility, championing road and parking projects that undermined the viability of the Supertram.
- Public transport provision has been both fragmented and deregulated, with private bus companies providing parallel services that drew patronage from the Supertram, rather than work with it to maximise network accessibility and efficiency.

The ownership of the Supertram itself is now held by a private company on a long term (26 year) lease.

The specific role of a huge out of town shopping development is discussed below. The Sheffield case study suggests that while fragmentation might aid the performance of individual components in the delivery of their specific goals, what have been lost are the synergies demonstrated in other case studies, such as Strasbourg and Nantes.

The importance of marketing

Several of the case studies illustrate the important role that marketing can have in promoting public transport. Freiburg is an example, where intensive marketing campaigns have been used to support the use of public transport, including PR and consultation exercises, media advertising, educational seminars, community workshops and other promotional events.

But marketing can also have a political role in terms of building a culture that supports public transport initiatives. Nowhere is this more obvious than in Portland. What is particularly impressive is the way that public consultation and marketing have been used to overcome pro-car attitudes in what was a typical car-dominated community.

4.3 Designing routes with land use in mind

Clearly, the closer a public transport service is to people and the activities that they wish to undertake, they better it will be able to serve them. Accessibility will be maximized and so will be patronage.

Following this principle, transport planners should identify and link high density residential areas and traffic generating activities. Those areas and activities that have high proportions of people who are likely to be reliant on public transport, for example students and the elderly, will be particularly targeted.

Some land uses will clearly be likely to generate much higher levels of public transport use than others. Educational institutions will fall into this category. High density residential uses are also likely to.

A service that is designed as an urban regeneration measure may well be routed through areas with very low density and levels of activity. But there will be potential for densities to increase as regeneration occurs.

This may seem an obvious principle, but it is not always followed. Factors that will determine the final route include topography, where space for a route is available, the cost of land purchase and politics. Too often the route may be along the "path of least resistance", or worse, be determined by voting patterns.

The case studies provide a number of examples of sound route selection to maximize patronage, as well as examples of routes that serve very low densities.

Both Nantes and Orléans have achieved impressive coverage of potential patronage with their tram systems. Nantes' 27 kilometre of track covers a quarter of the residents within 400 metres and much higher proportions of jobs, students, shops and subsidised housing. It has also managed to serve all urban renewal projects. Orléans tramway captures an even higher percentage of its educational establishments.

Strasbourg, Nantes and Stuttgart have followed safe options, by running their high quality public transport along traditional well-established public transport corridors. Strasbourg and Nantes did this when they converted bus routes to modern tramways, and Stuttgart when it converted the tram to light rail. Using traditional routes in this way has several advantages:

- The corridors provide an existing development focus for population and employment.
- The networks tend to focus on the city centre, which may assist with regeneration initiatives.
- As historic development corridors, development densities are typically higher than those associated with later development periods. The catchments therefore cover – or have the potential to cover – a relatively large proportion of the population and provide a major source of demand.

Other case studies have examples of high quality public transport routes serving very low density areas. While these have had relatively low patronage in their early years, they have been justified as a tool for achieving urban regeneration. The Salford line in Manchester is a classic case. Sheffield's Meadowhall route had the advantage of using a disused freight right of way, but it has attracted few passengers because the route is largely through areas that had been battered by economic restructuring. However the potential for future high densities is there, and this could prove to be a highly worthwhile investment for the future. How this potential is being realized is, of course, another question.

Ottowa-Carlton offers an interesting model for cities with such low density that high capacity routes are difficult to identify. By using a system that has buses being able to use local streets before entering onto a busway, the city has combined the flexibility of low capacity vehicles with the high frequencies and capacities available on mainline routes.

Portland Max provides an interesting example of route selection at both extremes. The first line to Gresham in the east is described as "a classic example of land use-led development where the high levels of patronage required to ensure success of the Transit system were most likely to be forthcoming". Later lines to the west were, by contrast, through largely greenfield sites slated for development. While the Gresham line is land-use led, the Hillsboro line is an example of transport-led development.

The Riverland Spur of the Portland Streetcar will serve the Portland University, including the relatively dense housing and services related to that institution. Perhaps more important has been the way that the Streetcar route has been designed to link a number of strategic areas as part of the regeneration strategy.

4.4 Focusing development on corridors and centres easily served by public transport

Land use planners should maximize accessibility and patronage by encouraging higher density residential development and traffic generating activities to be located in areas that are easily served by high quality public transport. This means discouraging "out of town" traffic attractors that can only be accessed by car.

An areal view of a city should easily identify where the public transport routes are by the density of development and the location of activities; for example, medium density housing along the corridor, institutions and commercial activities clustered about stations and interchanges. The importance of existing public transport corridors as a focus for the introduction of new high quality networks and associated development has already been mentioned. In areas that are low density, or yet to be developed, node-based development may be more relevant than corridor-based development. It can allow the more distant spacing of stops to provide the speed to compete with the private automobile. (See report 2, dealing with network design.) It can be used to link existing suburban growth patterns into the public transport network.

Following Cervero's "3 D's" referred to in the introduction, centres should be marked by diversity that makes them attractive to visit and to live in. Diverse places are interesting and convenient, because walking distances are short. The combination of a mixed use development environment and a strategic location on the primary public transport network facilitates pedestrian access to local services and other opportunities, whilst also maximising the opportunities for access to work, school and other urban or regional scale attractors via the high quality public transport network.

Diversity of land use has been avoided in the past because of conflicts such as noise, smell and so on. Such conflicts should be prevented by measures such as building controls and the licensing of activities.

Looking at the case studies, the impressive coverage of the Nantes and Orléans tramways has not been achieved simply through careful route selection. That has been very important, but both cities have also followed a policy of channelling new development into areas around public transport nodes. Both have adopted a polycentric urban structure, paying special attention to areas such as Fleury-les-Aubrais to ensure they have the type of mixed-use, attractive development that will encourage people to locate near the stations and use the tramway for much of their everyday activities. In fact most of the case studies provide examples of policies to direct development along corridors or into mixed use nodes.

Ottawa-Carlton provides an example of node-based development based on bus technology. Growth has been constrained by a strict greenbelt policy. A hub and spoke-based strategy has focused growth on the central node of Ottawa, whilst allowing growth of satellite settlements with strong connectivity to the centre. The integration of the Bus Transitway with feeder bus services has then provided an effective node-based solution to serving the dispersed pattern of population throughout the region. Ottowa-Carlton provides particular lessons in the way that it has identified what sorts of development it wants in the hub and the "satellites" and what sorts should be further away, somewhat in the manner of the Dutch ABC policy.

Another city whose experience is worth examining is Strasbourg, with its mixed use public and private land use at many tram stops, as well as its plans to further focus economic activity at those points where the radial high quality public transport routes intersect with the orbital routes.

Freiburg provides a possible model for cities facing pressure for outward development: strictly delineated development boundaries, with new high density settlements (preferably on formerly developed sites) provided with the lure of high quality, high frequency public transport, have been used as a means of controlling outward expansion. Also notable is the proportion of subsidized/ social housing in the new developments.

The two new towns of Rieselfeld and Vauban are connected by tramlines that pass through open

High density housing and open space in Rieselfeld

fields. But the townships themselves are models in terms of transit oriented development: high density, mixed use, social mix, and with supportive community facilities. Structured around the public transport corridor, Rieselfeld provides a model of how pressure for fringe development can be accommodated. Vauban's innovative policies to create car-free communities through parking arrangements are particularly worth examining.

Although in a very different setting, Salford also has the tram route passing through very low density areas, but with nodes that have been carefully designed to take advantage of the high quality public transport, both in terms of urban design and in terms of the mix of land uses.

The case studies provide a number of examples of the use of high quality public transport to help market city or a part of it. "Der Mielle" ("The Mile") of Sillenbuch in Stuttgart is a good example of the way that public transport can be used to help transform and promote a retail district.

4.5 Using high quality public transport for urban regeneration

Urban regeneration is a common theme of the case studies. It is perhaps not surprising that high quality public transport is being used in this way. Good public transport can promote the accessibility of a location from the rest of the city, so promoting employment; and make living in a location more attractive because of the accessibility it provides to the rest of the city. State of the art public infrastructure can be a symbol of commitment to an area, as well as providing a futuristic image.

Also, areas in need of regeneration are typically:

- old docklands areas that have been by-passed by innovations in freight transport such as containerisation,
- old industrial areas adjacent to the city centre that have lost out to industrial competition in newly developing countries, and
- city centres that have lost retail and employment activities to suburban and fringe shopping and office locations.

These are areas that have typically been well served by public transport in the past, have often been shaped by public transport, and are areas that often have existing rights of way that can be utilized.

The case studies in which this theme is most evident are those of Nantes, Sheffield, Oberhausen, Manchester, Orléans, Portland Max, Portland Streetcar, and Stuttgart.

Nantes is the standout example of high quality public transport being used to revitalise an old docklands area. But this is only one of a number of areas whose image has been changed, with resultant new investment and economic renovation. Orléans' tramway has made the formerly disused site of Coligny far more accessible, helping to transform its economic prospects in the process. Stuttgart has also used the new public transport to provide access to near city centre areas in need of urban regeneration, as has Manchester and, to a lesser extent, Sheffield.

Practically every case study illustrates the use of high quality public transport to make the city centre more attractive. The most successful have done this by undertaking a series of complementary measures, which will be discussed further below. Worth highlighting at this point is the Fareless Square initiative of Portland, a city that has faced typical problems of central city decline as a result of car dominance.

As both the Portland case studies have revealed, the new public transport has played a vital role in urban regeneration of the downtown area and the Pearl District – a classic decayed wharf area that is now enjoying a post-modern revival, with a boom in "streetcar lofts" and "streetcar condominiums".

Also worth discussing are two other cities where the car also dominates: Sheffield and Oberhausen. Both had economies based on coal and steel that suffered during economic restructuring in the late 20th century. Both have seen their economies boosted by the creation of a huge shopping centre on former industrial land on the outskirts of the city. The boost has come at the expense of the economies of neighbouring towns as far away as 100 kilometres or more – and at the expense of the local city centre. The new centres were designed to be accessed by car, but both cities sought to promote their new shopping centre by the provision of a high quality public transport service that also served the traditional town centre. Sheffield's Meadowhall line also passed through areas ripe for redevelopment. While the case studies point to the benefits that Meadowhall and CentrO have brought to their respective cities as a whole, it is questionable whether the city centres will be net gainers as a result. (Sheffield's city centre has generally recovered from the Meadowhall-induced slump, but not without a huge injection of public funds.)

Portland River District development projects with the Pearl District to the north


PDC
PORTLAND DEVELOPMENT COMMISSION
Willamette River
RIVER DISTRICT URBAN RENEWAL AREA
DOWNTOWN WATERFRONT URBAN RENEWAL AREA
Street Car Lofts
Brewery Blocks
Jamison Square & Pearl Court Apartments
Chinese Classical Garden
MARQUAM BRIDGE
FREMONT BRIDGE
BROADWAY BRIDGE
STEEL BRIDGE
BURNSIDE BRIDGE
COMPLETED PROJECTS, YEAR
1 Pearl Lofts, 1994 27 condominiums
2 Hoyt Commons, 1995 48 condominiums
3 Chown Pella, 1996 68 condominiums
4 Irving Street Townhomes, 1996 14 townhouses
5 Pearl Court, 1997 198 rental units
6 Pearl Townhouses, 1997 10 townhouses
7 McKenzie Lofts, 1997 67 condominiums
8 Yards at Union Station, Phase A, 1998 158 rental units
9 Modern Confectioners' Building, 1998 8 condominiums
10 Riverstone, 1998 123 condominiums
11 Pacific Northwest College of Art, 1998 Full block facility
12 Food Innovation Center, 1999 40,000 square foot (sq.ft.) office/lab, for the Oregon Department of Agriculture
13 Port of Portland Headquarters, 1999 100,000 sf office
14 Fifth Avenue Commons, 1999 78 rental units
15 Fifth Avenue Court, 1999 96 rental units
COMPLETED PROJECTS, YEAR (cont.)
16 McDonald Center, 1999 54 elderly assisted living units
17 Powell's Book Expansion, 1999 50,000 sq.ft.
18 Yards at Union Station, Phase B, 1999 377 units
19 Weiden & Kennedy Headquarters, 1999 with adjoining parking facility
20 North Park Lofts, 2000 67 condominiums
21 Kearney Plaza, 2000 131 rental units
22 Johnson Townhouses, 2000 13 town houses
23 Park Northwest, 2000 18 condominiums
24 Tanner Place, 2000 121 condominiums
25 Brewery Blocks Redevelopment site. Mixed-use redevelopment of five blocks
26 Pedestrian Bridge, 2000 Across rail tracks at Union Station
27 Pearl Townhomes, 2000 10 townhouses
28 riverTec, 2000 75,000 sq.ft. of office space rehabilitation
29 Lovejoy/10th Avenue Ramps, 2001 Rebuild ramp to land at 9th, with at-grade street beginning at 9th
COMPLETED PROJECTS, YEAR (cont.)
30 Central City Streetcar, 2001 Streetcar route connecting NW with downtown and PSU
31 The Gregory, 2001 145 condominiums and 47,000 sq.ft. of retail/commercial space
32 Lovejoy Station, 2001 181 rental units, mixed-income
33 Jean Vollum Natural Capital Center, 2001 50,000 sq.ft. office/retail space
34 Old Town Lofts, 2001 60 mixed-income condo. units
35 Creative Services Center, 2001 80,000 sq.ft. office space
36 6th and Couch Apartments, 2001 13 rental units with retail
37 Police Mounted Horse Patrol Facility, 2001
38 Marshall Wells Lofts, 2002 164 condominiums
39 Streetcar Lofts, 2002 139 mixed-income condominiums
40 Bridgeport Condominiums, 2003 123 condominiums
41 Pacific Tower, 2003 156 sf. affordable rental units
42 Union Station Forecourt & 6th Ave. Extension, 2003
UNDER CONSTRUCTION / PERMITTED
1 Station Place 175-unit senior affordable apartments; 30,000 sq.ft. retail with 425-car garage
2 Burlington Tower 153 rental units, under construction
3 Park Place Condominiums 124 condominiums, under construction
4 The Edge 881 & 124 condominiums, under construction
5 10th at Hoyt Apartments 178 rental units, under construction
6 The Lexus 139 rental units, under construction
7 The Dunmoore 180 low-income units, under construction
8 The Avenue Lofts 170 condominiums, under construction
9 The Elizabeth 172 condominiums, under construction
10 Union Gospel Mission New facilities, under construction
11 McCormick Pier Conversion to 301 condominiums, under construction
12 The Pinnacle 176 condominiums, under construction
13 The Henry 123 condominiums, under construction
14 South Pearl 242 rental units, under construction
River District Boundary
OPEN SPACE/PEDESTRIAN PROJECTS
1 McCormick Pier Pedestrian Connection Proposed public walkway
2 Jamison Square, completed 2002
3 North Park Square, under design
4 Waterfront Park Phases a, b and c of proposed park
5 Neighborhood Park, planned
6 River District Boardwalk, planned
7 Classical Chinese Garden, 2001
PLANNED REDEVELOPMENT SITES
1 PDC Redevelopment Site Phases I & II. Approximately 2-acre site
2 Terminal One Approximately 12-acre site, mixed residential/commercial development
3 Undeveloped Hoyt Street Yards Property Remaining 10 acres of Hoyt Street Yards.
4 NW Broadway Properties Former "Trailways" site, comprised of two full blocks
5 One Waterfront Place Private office building and adjoining 700-car parking garage
6 Yards at Union Station, Phase IV Planned for approx. 40 units on 1-acre site
7 NW 3rd & Glisan Mixed-use redevelopment of block
8 "Fire Station", Redevelopment site.
RD PROJECTS FEB '04

4.6 Using urban design to enhance the role of public transport

Urban design is dealt with in HiTrans Guide to Best Practice no. 3; Public transport and urban design. That report provides many examples of best practice, some of which also feature in the case studies of this report. The specific interest here is in the way that complementary urban design measures have been used to promote public transport usage.

The most successful high quality public transport services will be easy and pleasant to access. Footpaths will be generous and easy to negotiate. Streets along the route may be pedestrianised in high activity areas. Parks and other public spaces will be incorporated into the overall urban design.

Public transport infrastructure that is difficult to cross forms a barrier to movement from one side of the line to the other. This can severely weaken the commercial attractiveness of locations next to heavy rail stations, because for half the potential customers that are nearby, the location is inaccessible. The barrier can be removed by providing good, easily used crossing points. Ideally they should be grade separated by having the station below or above surrounding ground level. This is not an issue for tramways, where on-street running can be used to avoid any severance effect.

Several of the case studies in this report highlight urban design measures that have enhanced both the public transport service and the localities they serve by improving the ambience and aesthetics of the surrounds.

Nantes has used the introduction of the tramway into its city centre to create attractive urban promenades and squares.

A consistent design pattern was applied to Salford's rail infrastructure and the adjacent buildings.

The Strasbourg case study reveals how the city has refurbished the central streets and squares served by the tramway using high standards of design. This extends to the refurbishment of facades along the route, as part of an effort to reinvent the city while protecting its historical heritage. Distinctive overhead architecture symbolises the refurbishment, while also providing protection from the weather. Careful attention has been paid to the design of suburban interchanges to ensure that these are both functional and aesthetically pleasing.

The Portland Streetcar case study also illustrates the way that aesthetic design, green spaces and public art can been used to promote a locality and the high quality public transport that services it. But far more common in case studies are transport-related urban design measures to promote walking an cycling access to stations and stops.

Pedestrianisation schemes are vital for the role that they play in improving the accessibility of public transport. Research demonstrates the important role that the supply of footpaths plays in influencing mode choice (Cervero, 2002) and the success of light rail systems (Hass Klau and Crampton, 2002). The pedestrianisation of city streets on which the tramway runs features in most of the case studies: Nantes, Strasbourg, Portland Max and Portland Streetcar, Graz, and Orléans. The tramways of Stuttgart and Sheffield also use pedestrian malls. The busway stations of Ottowa-Carlton also have high quality pedestrian and cycling access.

Freiburg is well-known for the large amount of the city centre that has been pedestrianised. The tramway routes in Rieselfeld and Vauban are also flanked by pedestrian and cycle facilities, from which cars are excluded.

4.7 Using complementary transport measures to reduce car use

As noted earlier, policy integration includes the integration of policies within a single portfolio. The impact of transport expenditure to promote public transport use can be negated by competing expenditure to promote transport by other modes, such as spending to expand traffic capacity. Another example of the latter is the private expenditure required to meet minimum car parking standards in centres that are already served by high quality public transport.

While policy integration within a single sector may seem relatively easy, in practice it may not be. There will be very real political pressures from commercial interests in centres to maximize accessibility by all modes, especially the car. Such interests fear that unless all forms of transport are welcomed they will not compete with other centres. This is why a strong land use policy to prevent competition from "out of town" commercial centres is so important.

Pedestrianisation schemes are vital for the role that they play in improving the accessibility of public transport. A complementary cycle network and secure cycle parks at key stops will serve to encourage those who live beyond reasonable walking distance to cycle and will help to discourage trips that might otherwise be made by car.

The case studies provide plenty of examples of complementary measures to reduce car use, through pedestrianisation (as we have noted above), or through traffic management devices; for example, Nantes' reduction of the number of traffic lanes in key areas. Also relevant here is the "city for people, not cars" policy adopted by Graz, which includes a range of measures, the most famous of which is probably the use of a 30kph speed limit on all non-arterial roads. (Similar speed regimes exist in Freiburg and Stuttgart, among others.)

These can be termed the "sticks" to discourage car use, as compared with the "carrot" of high quality public transport to promote the use of alternative forms of transport. Sticks as well as carrots feature prominently in the continental case studies, although it is interesting to observe that the French cities, possibly because of the funding provided by the Versement Transport, have placed an unusually high emphasis on the carrot as opposed to the stick. Perhaps this helps explain why the excellent tramway of Strasbourg appears to have had little effect on the car's mode share overall, even though it has succeeded in reducing traffic in the city centre.

Parking measures

Traffic management measures to discourage car use in particular parts of the city are common in many cities, especially in Europe. Perhaps a more interesting feature of the case studies has been the parking policies adopted.

Good park and ride facilities can be used as a "carrot" to support the use of public transport at key points along the high quality network. These are particularly important at termini and key collector points outside the city centre, including strategic locations on the highway network.

Park and ride facilities feature in a number of case studies: Freiburg-Rieselfeld, Orléans, Manchester, Sheffield, Nantes, Strasbourg and (to a lesser extent) Portland.

It could be expected that the lower the density of the city, the more that park and ride facilities will be used to provide access to the high quality public transport service. It is interesting, then, to note that low density Ottowa-Carlton has rejected the park and ride option, relying instead on the flexibility of the on-road + busway network to obviate the need for people to drive to transit stations. Portland has also generally preferred to encourage access to its light rail through feeder buses than the private car.

The "stick" of parking restrictions, particularly in central areas, features in Stuttgart's Stuttgart 21 policy of minimizing parking in the city centre to maximise and enhance the open space available.

The central city parking restrictions were also referred to in the Graz and Strasbourg studies.

Freiburg is also well-known for its very restrictive policies on parking in its historic centre. However the case study has focussed on the innovative parking measures that have been adopted in the new settlements of Rieselfeld and Vauban. The use of parking

policies to create a car-free community in Vauban is especially interesting. The recognition of the financial cost of "free" parking, the imposition of this cost on the householder through minimum parking standards – and the way that the residents of Auban can avoid this – are all worth careful study.

Portland Streetcar is supported by a parking strategy that pushes car parking to the edge of the downtown area, and imposes relatively high costs on parking in the downtown. The use of funds raised by car parking to support the Streetcar (along with taxes on property betterment) is an important source of revenue for the service. It is also a means of avoiding criticism of the parking charges, as people in general are less critical of government charges if they can see where they are being spent.

The relaxation of minimum parking standards feature in two or three other case studies. The urban development zone in mixed use node of Fleury-les-Aubrais (Orléans) has reduced parking standards compared to other parts of the town. Ottowa-Carlton's policy of relaxing car parking standards for shopping centre developers if they provide good accessibility via the Transitway can also provide a model for cities faced with developers who wish to cater only for the car.

Reorganization of bus services

The reorganisation of bus services to feed new high quality public transport is a common feature and has been referred to in the case studies of Portland, Freiburg, Graz, Orléans, and Stuttgart. Nantes uses orbital bus routes to feed its radial tram services.

Guidance on network design is provided in HiTrans Guide 2: Public transport – network design. Its principle of feeding a relatively simple, high quality network receives clear practical expression in Freiburg.

Sheffield is an interesting case in that the introduction of the Supertram occurred shortly after the privatisation and deregulation of public transport on the United Kingdom's provincial cities. The local government did not have the ability to control the activities of the private bus providers in order to provide a complementary network. Parallel and other competitive services have been blamed for the poor financial performance of the Supertram in its earlier years.

4.8 The applicability of these lessons to medium sized cities

The case studies have provided numerous illustrations of best practice, as well some interesting cases of the difficulties of working within frameworks shaped by competing interests and values.

The most impressive results have been achieved when a broadly-based institutional structure has been able to take an holistic approach to its planning – where the high quality public transport has not been introduced solely as a transport measure, but as tool in the effort to improve the economic vitality and quality of life in the city as a whole. It is one of a range of complementary measures that have been based on an understanding of the symbiotic relationship between transport and land use, and of the role that high quality public transport infrastructure can play in improving the image of a city. The most impressive high quality public transport systems, then, are not transport-led.

How applicable are the lessons of the case studies to cities in the North Sea region that have populations between 100,000 and 500,000? The population of a city should be borne in mind when contemplating its transportation system. Larger cities will have a larger population and financial base to support high quality public transport and – in Europe at least – will have the sorts of densities that need it.

Four of the cities – Freiburg, Graz, Oberhausen and Strasbourg – have populations between 100,000 and 500,000. So also does Salford, though this is part of a much larger conurbation. A further three – Sheffield, Nantes and Stuttgart – have populations only slightly above 500,000 and Ottowa-Carlton is larger again, with 750,000 people. Only Portland is significantly larger. Although Portland city has a population of 500,000, the three counties that the Tri-Met is responsible to have a combined population of 1.7 million. On the other hand, note also the low density of Ottowa-Carlton and Portland when compared with European cities, which would weaken the impulse for high *capacity* public transport – though not necessarily the impulse for high *quality* public transport. On size then, the case studies should be highly relevant.

The accompanying table is an attempt to assess the relevance of each case study in terms of specific factors: in terms of its relevance at a site specific, city-wide regional perspectives in terms of:

- the institutional framework,
- the access to new sites, or areas of regeneration,
- high density development along corridors,
- a focus on centres, and
- city centre revitalisation.

A black cell indicates that the matter is not relevant in the city that is the subject of the case study. A grey cell indicates that, while the case study reveals the matter is relevant at the geographical level concerned, it was not discussed in the case study. For example, the administration of the French cities is generally embedded in an institutional framework that covers the broader region, but this was not discussed. While the cities of Strasbourg and Nantes are both part of broader conurbations, Orléans is much more stand alone, with no significant urban settlement in its hinterland.

The final column provides an overall assessment. Note that this assessment is in terms of the extent to which the city can be regarded as a model to be emulated. Graz, for example is regarded as somewhat disappointing in that schemes developed to extend the role high quality public transport have not been proceeded with. On the other hand, while the patronage levels are low on Portland's trams by European standards, the case studies are valuable for the way they show that attitudes can be changed even in very pro-car oriented cultures.

Other factors that need to be borne in mind when assessing the relevance of a case study include the wealth of the city and the financial arrangements. Not every city even of Stuttgart's size could afford to underground its central lines and station. On the other hand, many small to medium sized cities have not had the industrial background that has created areas in need of regeneration. French public transport policies have clearly been shaped by access to the Versement Transport, which can generate the funding for high quality services that may not be available elsewhere.

However a large revenue stream is not necessary to coordinate transport and land use measures. Freiburg has demonstrated the way that a political consensus can be generated to pursue integrated policies that promote and sustain high quality public transport through complementary transport and land use measures. Its land use planning measures, including its regulations governing parking, are just as impressive as its public transport infrastructure – and equally as necessary in achieving the high quality outcome.

But no one city can provide a textbook lesson in how to coordinate transport and land use measures, because no two cities are exactly alike. There are clear principles that can guide best practice:

- design a public transport network to take best advantage of the way a city's land is used,
- design a public transport service that best fits a city's planned size, shape and density,
- shape land uses to promote and sustain the public transport network, and
- use complementary urban design as well as transport measures to promote travel by other means than by car.

But these are principles only. How these should be interpreted will vary from city to city.

Appendix 1

Accessibility and its measurement

The concept of accessibility and why it is important

A key aspect of the integration of public transport with land use is the provision of accessibility for people in the area concerned. As noted in the introduction to this report, we see questions of land use as both shaping and being shaped by the activities and interests of people for whom the transport service is designed to serve. Accessibility is an important concept for transport planners, for four reasons.

First, providing accessibility for a local population is usually a key objective of public transport services, and so meeting accessibility needs should be an important factor in designing public transport routes and in evaluating the service provided.

Second, accessibility can be the key factor in the use of public transport as a means of encouraging urban regeneration. Formerly depressed neighbourhoods can become revitalised by the introduction of a transport service that provides access for people to come into the area, or for people who live in the area to reach the rest of the city. (Social Exclusion Unit, 2002)

Third, if we know the levels of accessibility provided by different modes of transport in different areas, we can predict changes to travel behaviour that a new or altered service would produce. This is also important from a marketing point of view.

Finally, accessibility patterns are also important in the making of decisions about the location of major facilities, such as public hospitals. Such facilities need to be located in places that are accessible to the clientele.

Defining accessibility

However, although the importance of accessibility is clear, defining and measuring levels of accessibility are not straightforward. Location is of course a key factor, but it is not the only one. Just what determines a person's level of accessibility can be a complex matter.

Firstly, we cannot assume that all people are alike in terms of the things that they want or need to have access. Having a school nearby may be a thing of value for young parents, but an irritation for a retired couple. The accessibility of a location can only be defined in relation to the population with a demand to visit it.

People are also different in terms of the forms of transport available to them. Those who have ready access to a car will have different accessibility requirements to those who do not. Shopping centres on the edge of a city can be very convenient for people with cars, but unreachable for others. People who have some form of physical disability will have special accessibility needs.

For people who use public transport, physical distance needs to combined with a variety of other factors to determine their levels of access: the frequency of services to the desired location, the proximity of the service to both ends of the trip, possible barriers that may make walking to and from the service difficult, and so on.

Measuring accessibility

Measuring accessibility is undertaken in several stages.

The first stage identifies the locations of the people with whose accessibility the study is concerned, and the locations of activities to which they want or need to travel. Public transport planners and land use planners with a concern for social inclusion need to be particularly aware of people without access to a car. In fact, measures to make car access more convenient to a needed location may make people without a car worse off, for example if increased, faster traffic makes the streets more dangerous for pedestrians and cyclists.

Household or individual income is often used as a surrogate for the variety of factors that may make a person reliant on public transport. While the appeal of this approach is obvious, it may be hazardous because income does not determine where and how often people need to travel. Having said that, it is very common for people to suffer multiple levels of deprivation, and income will be one of these. In Europe indices defining the "Level of Multiple Deprivation" have been developed that attempt to

incorporate these variables into a single index. (See for example DETR, 2000) This however, may mask the very specific travel needs that some forms of deprivation require, for example, the need for person with a mental disability to attend a particular institution.

The next stage in measuring accessibility is to identify the gap between the locations of the people with whose accessibility the analysis is concerned, and the locations they wish to travel to.

Where people have a choice of possible locations for activities they need or want to undertake, the choice will depend in part on how easy it is to get to a particular location. Locations that may be quite close "as the crow flies" may be difficult to reach in practice.

The most well known model for both measuring accessibility and for determining likely travel patterns is the "gravity model", which uses the metaphor of gravitational attraction between bodies to predict where and how people will want to travel. It is assumed that the closer and "bigger" the attractor, the more likely it is that people will travel to it. But as noted above, the distance between a person and a potential destination may be affected by how circuitous the actual route is, whether there are barriers along the route, such as rivers or busy roads, the convenience of using the route by the particular mode available, etc.

These potential barriers are particularly important for public transport users. A large nearby shopping centre will not be used if there is no public transport to it. The identification of "public transport activity levels" (PTALs) is an attempt to come to terms with all the factors that will affect the public transport journey and so influence the choice of which service to use – or indeed, whether to use public transport at all. (For an example, see Wu and Hine, 2003.) Factors that are brought into the equation include: time taken, cost, reliability, quality of infrastructure, convenience (including the need for transfers), perceived security and so on. The factors themselves are identified by surveying users.

Software for analysing accessibility

The information about the accessibility of people to activities they wish or need to undertake can be used to identify gaps and to model the effect of alternative measures to improve accessibility. What follows is a discussion of the software that can be used to analyse and present the data for these purposes. (For further information, see the draft report on transport and land use on the HiTrans website.)

Spreadsheet programs such as Excel, which are available on most desktop computers, have the ability to produce measures of accessibility by statistical processes such as multiple regressions. The ability to produce results as graphs is another important feature. The variables involved in accessibility analysis (e.g. origin-destination matrices, distances and transport costs) lend themselves well to being handled in a spreadsheet format. For example, localities can be given a score in terms of various factors, which can then be weighted to produce an index of accessibility. (See for example, Greenwood, 2004.) The scores for each factor can be used in a multiple regression analysis to explain people's recorded movements, in turn enabling the modelling of new travel patterns if one or more of these factors were to be altered.

There are now a number of specialist computer programs with enhanced database capabilities that are specifically designed to model accessibility. While these offer the advantage of ease of use, there is a danger that, by removing the need for analysts to think about some of the assumptions that underlie the models, outdated assumptions will be allowed to remain. Updating 'hard wired' computer programs is a notoriously difficult and expensive process, and users of customised tools need to be careful that they avoid being locked into static technology that is expensive to develop or upgrade. However, as with most aspects of software engineering, this problem itself is becoming antiquated, as the opportunities for updating and customisation are combined with ease of use.

Because location is generally such an important factor in determining levels of accessibility, maps are a very attractive means of presenting the informa-

tion. Geographic Information System (GIS) programs are available that can transform spreadsheet and data base data into maps that can highlight the ability of particular categories of people to access particular services using various modes. A variety of factors can be separately identified or combined as "layers" that can highlight accessibility relationships. For example, concentrations of university students may be mapped, along with the university campuses and public transport services to these. Populations outside given standards, such as a ten minute walk to the nearest bus or train stop, can be easily identified through the presentation of 'buffer zones' around these stops. Socio-economic data for people who live beyond these buffers can also be presented.

Some of the specialised accessibility programs combine spreadsheet and sophisticated data base capabilities with the ability to produce information in a GIS format. TRANSCAD is an example of these, though it is more common to see generic GIS programs such as ArcGIS or MapInfo being used in conjunction with generic spreadsheet and database programs, such as Access and Dbase. Specialist programs may be needed if the sorts of barriers referred to earlier are to be incorporated into the analysis, although add-on extensions to overcome limitations of the generic software have been developed. The following figure is an example of the use of one of these, from Farrow and Nelson, 2001. It depicts a composite measure of accessibility in various parts of a city.

While GIS programs do not currently have the capacity to graphically present all of the complex circumstances that may be thrown up by a PTAL analysis, the situation is improving rapidly. Research into appropriate representations for accessibility analysis on networks is being carried out in Norway, for example. Here new data models take into account the properties of stations within the network and make their attributes (for example timetables) available for shortest path and gravity model type accessibility analyses. It remains however, that accessibility software, in common with all software designed to analyse transport and land use, is best at the strategic level. The more detailed and local the conditions with which we are concerned, the less use they will be.

The table provides a summary of the different types of software available for transport accessibility analysis.

Tyne and Wear public transport authority (Nexus) presents a good example of the integration of data from a variety of sources to produce information about the accessibility of those without access to a car. The council has a framework that embodies a wide range of large-scale data resources including the authority's Pajin public transport timetable database; the Ordnance Survey Oscar data; a Tyne and Wear property Gazetteer and some 7000 public transport stops. Software components include a range of products where significant investment has been made.

The approach taken by Tyne and Wear clearly makes good, shared use of a range of different resources and appears efficient in satisfying planning demands. The Arc GIS products provide the basis for visualisation of statistical information. Not all of the elements would be instantly recognisable as market leaders but the end product is high quality, focussed information that meets planning requirements. The key features that have produced this outcome are clarity in terms of the underlying objectives, approach, assumptions, measurement levels and data quality.

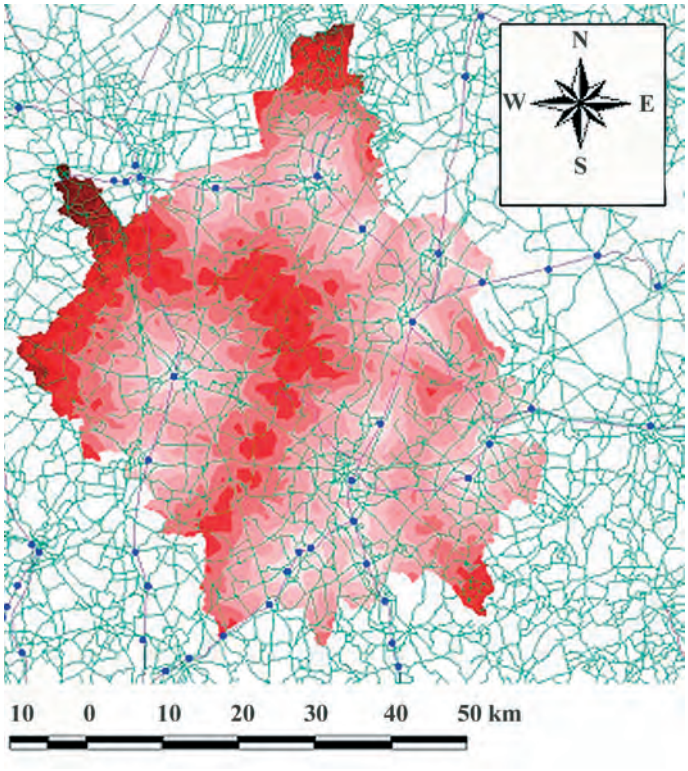
Fundamentals of measuring accessibility

With the rapid and exciting development of powerful software that produces visually attractive information for planners, it is easy to lose sight of the underlying principles that should guide accessibility analysis. However sophisticated the software, best practice rests heavily on the following fundamentals:

Careful definition of objectives and underlying assumptions. These might range from broad-brush calculations for scoping studies, to detailed accessibility modelling of a regional, light rail investment. The objectives will determine the required levels of accuracy and the types of data, indices and proce-

Type	Examples*	Capabilities	Comments
Generic spreadsheet	Excel	Statistical recording, analysis, graphing of results.	Cheap, widely available
Generic database	Access, Dbase	Querying, sorting data, storage and management of data.	Cheap, widely available
Generic GIS	ArcGIS, MapInfo	Data representation through maps, spatial functions, spatial data storage, linking data sets. Capabilities can be extended with extensions such as Network Analyst and Accessibility Analyst.	Good for translating a variety of formats
Specialist accessibility modelling	ACCMAP	Database construction, calculation of accessibility indices, spatial modelling of accessibility patterns, tabulation and mapping of results.	Can be reliant on assumptions of accessibility built into the software
Specialist transport GIS	TRANSCAD	Standard GIS capabilities tailored toward transport applications; for example graphically representing traffic on routes.	Used in conjunction with specialist transport and land use models
Specialist road and traffic modelling, network level	SATURN, EMME/2, TRIPS	Model impacts on traffic flows of changes in network at aggregate level.	EMME/2 multi-modal
Specialist road and traffic modelling, micro level	PARAMICS	Model impacts on local traffic flows of changes at disaggregate level, e.g. intersection design.	Large data requirements.
Specialist transport and l and use models	DELTA, TRANUS, MEPLAN	Handle interactions between transport and land use, including feedback features such as induced traffic.	Not widely available, although a CUBE version will soon be available.

* Disclaimer:
No suggestion is made that where an approach is identified as being particularly powerful or weak its merits or otherwise should be associated with the product used to implement it.



GIS-based modelling of accessibility using raster techniques

dures that should be used.

Careful definition of accessibility and socio-economic characteristics. Is the study concerned with accessibility by all modes and all groups to all opportunities? Or is it concerned with more narrowly defined forms of accessibility, for example of the unemployed to health facilities by public transport? It is important that the target group be clearly defined, because definitions of population or socio-economic group can substantially change the results of an accessibility analysis.

Appropriate use of high quality data. Care must be taken to understand the inaccuracies and assumptions underlying the data. It is well known, for example, that measurement of population densities can give quite different results if they are measured on different zoning systems. Similarly, the size and location of socio-economic groups can change dramatically if they are measured using different approaches.

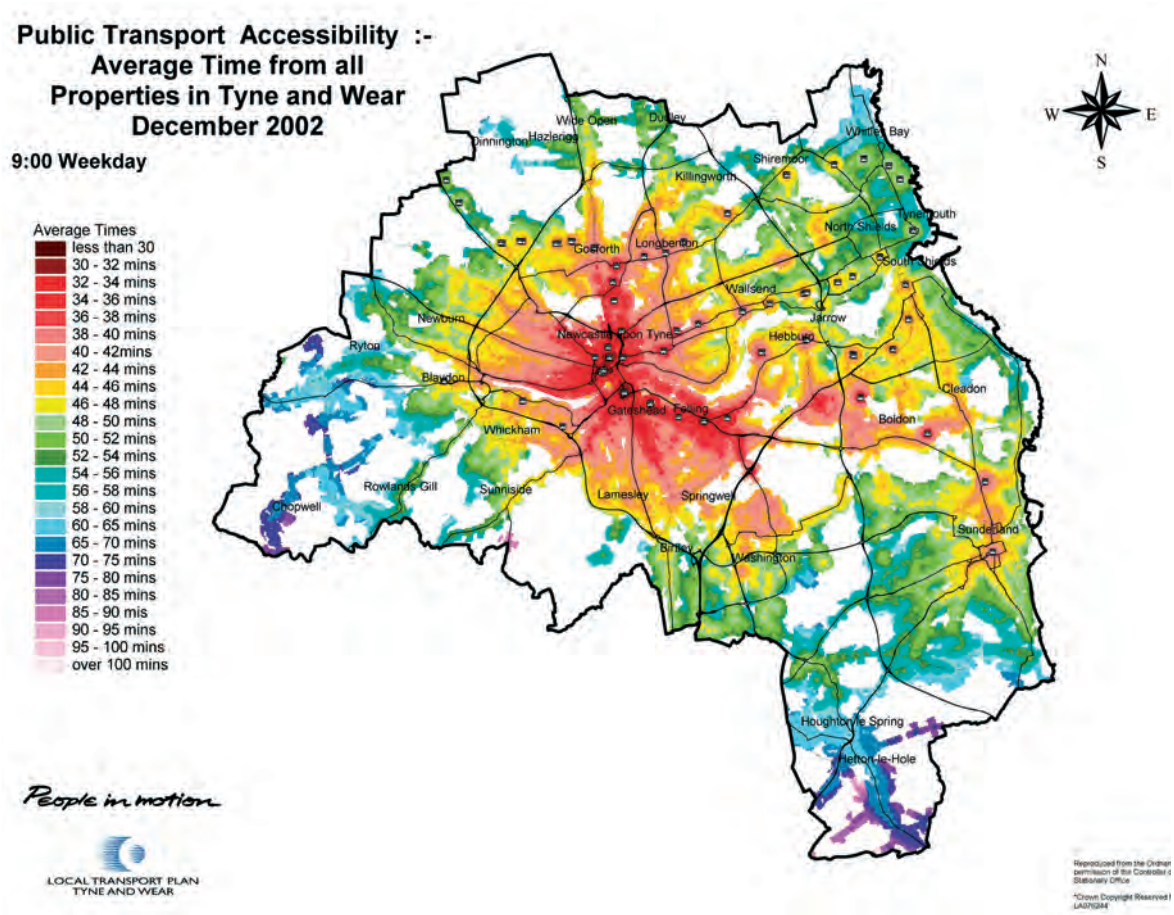
Appropriate use of accessibility indices. For the high levels of accuracy required by detailed studies accessibility indices must reflect all journey properties from door to door with due regard for utility, quality of service and user preferences. Historically, public transport planning has frequently fallen down in this area, for example by failing to consider all journey costs, especially those associated with transfers and utility. For general scoping studies the detail of measurement might be reduced, but the assumptions need to be clearly stated with the results.

Appropriate analytical procedures. What is the appropriate approach to take will vary. For example, spreadsheet analysis may be most appropriate for snapshots of local public accessibility to a new bus stop or shopping centre. However, understanding the impact of the facility at a regional scale over a long period of time will require land use and transport models capable of handling the feedback effects between the land use and transport systems.

Excellent visual presentation. Most accessibility studies communicate their results as maps. High quality mapping is important for understanding and analysis, especially to non-specialists in public inquiries and other decision-making situations. However, where statistical precision is necessary (for example in showing correlations), it may be preferable to replace or supplement maps with statistical tables.

Effective validation of results. The GIS and modelling systems used for many accessibility analyses carry out complex sequences of operations. The effects of erroneous assumptions and inaccuracies in data are often magnified and propagated in these sequences. It is important therefore to conduct independent checks on the accuracy of results.

Clear evaluation criteria. Accessibility is usually a relative concept and should be evaluated as such.



Hybrid system analysis of public transport accessibility in Tyne and Wear

For example, when modelling the improvements in accessibility from new public transport schemes they should be evaluated against alternative schemes using the same mode. For exercises determining likely use, it is also important to evaluate them against different modes; for example, bus against car.

Appendix 2

Capturing revenue from changes in land use

Public transport was historically a commercial enterprise, conducted either by government or private companies. Only relatively recently has fare revenue had to be supplemented with government revenue, either from general taxation or from some earmarked form of public revenue, such as the Versement Transport, which is a payroll tax that features in a number of the case studies.

Early railway entrepreneurs looked to capture the increasing land value that their enterprise created as a means of financing construction. This approach is being looked at again and there are numerous examples of local and regional governments using actual or projected increases in land value to help fund public transport. A summary of existing funding measures that take advantage of increase property values is presented here as a table.

Property related taxes

Funding mechanism	Revenue type	Explanation	Advantages	Disadvantages	Example
Business Rate Levy	Ongoing revenue stream from project start	Additional charge on top of existing business rates that is earmarked specifically for funding public transport improvements.	Easy to collect as it would be an add on to existing rates; transparent.	Difficult to measure benefit for individual businesses. If drawn too narrowly, it may push investment out of locality, before PT service is operational.	Los Angeles, for commercial property close to new metro stations.
Residential Rate Levy	Ongoing revenue stream from project start	Additional charge on top of existing residential rates that is earmarked specifically for funding public transport improvements.	Easy to collect as it would be an add on to existing rates; transparent.	Funds for a scheme may need to be collected by several different authorities.	No extant examples. Considered for the Hillier Parker study of the London Cross Rail route (Hillier Parker, 2002).
Tax Increment Financing (TIF)	One-off capital sum at project start	Bonds with guaranteed repayment, based on higher taxes from expected increase in property values.	Payments are deferred until the schemes are operational.	Risk – expected increase in property values may not materialise.	Widespread in the United States.
Business Improvement Districts (BIDs)	Ongoing revenue stream from project start.	Agreement with local businesses to levy property rate for improvements within the BID area.	Easy to administer; encourages public/private cooperation.	Negotiations can be complex, including appropriate boundaries.	Over 1,500 in North America. First used in Toronto (Barker, 2002).
Land Value Taxation (LVT)	Ongoing revenue stream, once scheme is operational.	Tax on the annual rental value of land, or on changes in land values.	Shares gains in land values due to infrastructure spending; occupiers whose situation deteriorates because of a transport scheme can be compensated.	Valuations need to be established and kept up to date.	Widespread. Denmark's first mass transit scheme is being funded by LVT.

Development Levies

Funding mechanism	Revenue type	Explanation	Advantages	Disadvantages	Example
Planning Gain	One-off charge at project start.	Conditions attached to planning permissions requiring developers to fund or to implement measures to offset the impacts of developments.	Flexible; easy to enforce; can be used to discourage urban sprawl.	Limited scope; cannot be easily tied just to public transport.	Edinburgh's new Suburban Rail loop. US 'Transit Impact Fees" are similar: Lancaster (California), Toronto, Portland.
Joint Development	Ongoing revenue stream or one-off capital sum.	Purchase of land adjacent to transport development, with later sale to recoup construction costs. Assumes it is undertaken in partnership with private sector.	Public sector benefits directly from investment in transport infrastructure; encourages partnership with the private sector.	Higher amount of initial capital investment; risk.	Copenhagen's Ørestadsbanen light rail
Density Bonusing	One-off charge at project start and ongoing revenue stream once scheme is operational.	Allowing higher densities near transport nodes, with extra revenue from charges on additional building units.	Early and easy form of revenue; higher density makes transit more viable.	Requires sufficient demand for development.	Popular in North America, e.g. Calgary in San Jose in California.

Other development charges

Access Rights	charged to telecommunications providers and other utilities for use of track and other transport assets for routing cables and pipes, as either a one-off charge or an annual fee.
Air Rights	to allow building on top of transport infrastructure assets (e.g Santiago, Chile, and Hong Kong).
Rights of Way	charged to developers to use pedestrian or vehicular access that crosses land owned by transport authorities.
Development Buy-in Charges	for the right to take advantage of new infrastructure, such as a "connection charge" on a developer to build a physical connection into a transport node, such as a walkway .

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HiTrans Best practice guide 1
Public transport & land use planning

ISBN 82-990111-2-4

HiTrans 2005
www.hitrans.org

Layout and cover design
Truls Lange Civitas

Printed by Hestholms Trykkeri AS, Skytta, Norway
Bound by Lundeby Bokbinderi AS, Hærland, Norway

HiTrans

HiTrans is an EU sponsored Interreg IIIB (North Sea Region) project seeking to improve public transport in medium sized cities with 100,000–500,000 inhabitants. The full official project title is *Development of principles and strategies for introducing High Quality Public Transport in medium sized cities and regions*. "High Quality" refers to modes that are perceived as offering higher quality than ordinary bus-solutions. However HiTrans also recognises the important role buses will have to play in any medium sized city.

HiTrans is a partnership between

- Rogaland County Council, Norway (lead partner),
- Edinburgh City Council, Scotland,
- Helsingborg City Council, Sweden,
- Jernbaneverket (The Norwegian National Rail Administration),
- NEXUS (PTE of Tyne and Wear), England,
- NSB (Norwegian National Rail Operator),
- AS Oslo Sporveier (Oslo public Transport Ltd), Norway,
- Statens vegvesen (Norwegian public Roads Administration),
- Stavanger and Sandnes City Councils, Norway,
- Sunderland City Council, England,
- Aarhus County Council, Denmark.

For more information on HiTrans, visit www.hitrans.org

HiTrans best practice guides

As part of its activities, the HiTrans partnership has produced five best practice guides:

1 Public transport & land use planning
2 Public transport – Planning the networks
3 Public transport & urban design
4 Public transport – Mode options and technical solutions
5 Public transport – Citizens' requirements.

1

Best practice guide 1
Public transport & land use planning

How can we reshape our cities to facilitate the use of public transport? A series of case studies provides some inspirational illustrations of what can be done – as well as some salutary lessons of what to avoid. There are examples of cities regenerating run-down areas, curtailing urban sprawl, building successful public transport oriented communities, ridding themselves of traffic-chocked city streets, as well as examples of cities reinventing themselves as attractive places in which to invest and to live.

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