Report for UKTram









UK Tram

An Investigation into the Economic Impacts on Cities of Investment in Light Rail Systems

Professor Richard Knowles
Dr Fiona Ferbrache

June 2014

CONTENTS

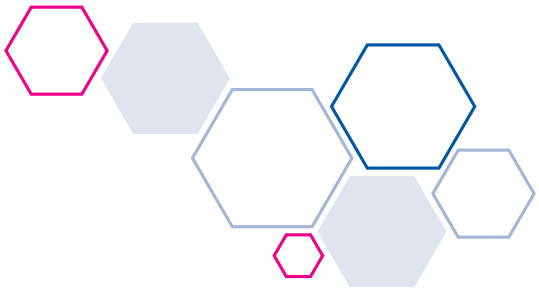
Figure captions and sources

Cover Images

Figures

Page

Table captions and sources



Abbreviations

BART Bay Area Rapid Transit
BBC British Broadcasting Corporation
BC British Columbia
BCR Benefit Cost Ratio
BID Business Improvement District
BRS Business Rate Supplement
CBA Cost Benefit Analysis
CBD Central Business District
CEA Cost Effectiveness Analysis
CfIT Commission for Integrated Transport
DART Dallas Area Rapid Transit
DECC Department of Energy and Climate Change
DETR Department for Environment, Transport and the Regions
DfT Department for Transport
DLR Docklands Light Railway
DR Danmarks Radio
EEA Economic Efficiency Analysis
EU European Union
GDP Gross domestic product
IT Information Technology
ITC Independent Transport Commission
ITV Independent Television Company
LDDC London Docklands Development Corporation
MAX Metropolitan Area Express
MCA Multi Criteria Analysis
NAO National Audit Office
NATA New Approach to Appraisal
NET Nottingham Express Transit
PATH Port Authority Trans-Hudson
PIA Private Investment Analysis
PTA Passenger Transport Authority
pteg Passenger Transport Executive Group
RICS Royal Institute of Chartered Surveyors
SACTRA Standing Advisory Committee on Trunk Road Assessment
SCBA Social Cost Benefit Analysis
SDG Steer Davies Gleave (Transport Consultants)
SYS South Yorkshire Supertram
TAG Transport Analysis Guidance
TCRP Transit Cooperative Research Program
TENs Trans European Networks
TEOR Transport Est-Ouest Rouennais
TGV Train à Grande Vitesse
TIF Tax Increment Finance
TOD Transit Oriented Development
TRRL Transport and Road Research Laboratory
UITP L'Union Internationale des Transports Publics (International Association of Public Transport)
UK United Kingdom
USA United States of America
VfM Value for Money
WTC World Trade Centre (Lille)

AN INVESTIGATION INTO THE ECONOMIC IMPACTS ON CITIES OF INVESTMENT IN LIGHT RAIL SYSTEMS

INTRODUCTION

Major cities in the United Kingdom (UK) have created effective post-industrial economies, which lead their regional economies. However, most of the UK's larger city regions remain less competitive than key comparator locations in Europe and beyond (Docherty et al. 2009). Transport plays a critical role in facilitating this competitiveness. High quality transport services and infrastructure improves labour market performance, helps attract inward investment and helps to create an improved quality of life.

Background

The most successful cities are able to deliver new light and/or heavy rail schemes as well as smaller schemes designed to eliminate road and rail bottlenecks. In recent decades, transport systems in the UK's major cities, apart from London, have fallen well behind those in major competitors in Europe and beyond. The UK has spent about 40 percent less in Gross Domestic Product (GDP) on transport since the 1960s compared with key competitor countries in Europe (Commission for Integrated Transport (CfIT) 2001) and this deficit continues particularly in the UK's provincial cities.

Improving the level and quality of internal and external connectivity is critical for improving city performance. There is substantial evidence that locations with poor quality transport are at a competitive disadvantage (Banister and Berechman 2001).

The Standing Advisory Committee on Trunk Road Appraisal (SACTRA 1999) similarly concluded that positive outcomes from transport investment in cities can include:

1. Extension of labour market catchment areas
2. Stimulation of inward investment
3. Unlocking previously hard to reach sites for development
4. Reorganisation or rationalisation of production, distribution and land use
5. Triggering fresh growth through elimination of significant transport constraints

Non-transport benefits from rail investment can be grouped into macro, meso and micro economic benefits (Banister and Thurstain-Goodwin 2011). Urban rail investment can help regenerate Central Business Districts (CBDs), boost employment, land and property prices and Benefit Cost Ratios (BCRs). Similar rail investments in different locations may not however have the same impacts - geography matters. Other conditions than just transport investment are also required for positive externalities, including supportive land use planning policies, inward investment, capturing increases in land and property values, and urban regeneration incentives.

Perhaps the most notable under investment in UK city transport outside London is the dearth of modern light rail and metro systems (Knowles 2007). The UK is near the bottom of the league when it comes to investment in rail transport in its provincial conurbations (Docherty et al. 2009). Light rail is defined for the purposes of this Report as light rail tramway systems and light metros.

Light Rail's advantages over heavy rail and bus include:

1. Much lower capital costs than either new underground metros or suburban railways
2. Ability to carry more passengers at higher speeds than bus systems
3. Proven ability, unlike bus schemes, to attract motorists to switch modes and thereby reduce traffic congestion (Knowles 1996; Knowles and Abrantes 2008)

Recent international research has reinforced the links between transport investment and improved economic performance (Banister 2011a; Banister and Thurstain-Goodwin 2011; Eddington 2006a,b; Hensher et al. 2012; Ibeas et al. 2012; Knowles 2012a; Lakshmanan 2011). In a key UK light rail Impact Study, Dabinett et al. (1999, pp.126-127) suggested that the improved accessibility resulting from investment in a light rail scheme can influence four different groups in different ways:

1. Households and individuals – shopping habits and engagement with the local labour market
2. Companies – labour market, access to customers, inputting supplies and transporting goods
3. Investors – especially inward investing non-local property companies and their agents
4. Enablers and regulators – particularly agencies inputting new investment and operating the local land use planning system

Dabinett et al. (1999, p.127) saw the key outputs of investment in light rail as new development, changes in property prices, new and retained jobs, and changes in the levels of business activity. Their five dimensions of urban regeneration were: Image; Property Values; Development and Land Use Impacts; Business Operations and Locations; and the Local Labour Market.

Report structure

Economic impacts of light rail systems on cities are assessed in this Report under nine thematic headings by interrogating evidence and findings from:

1. A very wide range of peer-reviewed, independent, academic research from various countries
2. Officially commissioned Impact Studies of light rail schemes in Tyne and Wear, Greater Manchester, Sheffield and London
3. Other non-peer reviewed UK evidence from The Passenger Transport Executive Group (pteg), provincial conurbation Passenger Transport Executives, and Transport for London; and non-peer reviewed evidence from various countries, from transport consultants, the Independent Transport Commission (ITC), Transit Cooperative Research Program (TCRP), and L'Union Internationale des Transports Publics (UITP)

SACTRA was asked by Government in 1996 to consider the effects of transport projects and policies on the economy. SACTRA adopted a general approach that treats even-handedly all types of transport investment and policy by all modes (SACTRA 1999, p6). SACTRA sought ways to assess whether transport improvements lead to increased or more efficient economic activity and identified a number of important mechanisms.

The first five thematic headings assessing the impacts of light rail on cities that are utilised in this Report are adopted from SACTRA (1999):

1. Extension of labour market catchment areas
2. Stimulation of inward investment
3. Unlocking previously hard to reach sites for development
4. Reorganisation or rationalisation of production, distribution and land use
5. Triggering fresh growth through elimination of significant transport constraints

Four further themes are adopted in this Report to ensure a more comprehensive assessment of the economic impacts on cities of investment in light rail systems:

6. Land value and property value increase and capture
7. Transit-oriented development
8. Cost benefit analysis of transport schemes
9. City image and quality

Conclusions are then drawn from the nine thematic sections in the Report.

An Executive Summary, at the beginning of the Report, draws together its key findings.

Recommendations are then made of measures that could be implemented to enhance economic impacts of light rail on cities.

Executive Summary

This Report summarises independent, peer-reviewed, and other evidence from the UK, mainland Europe, North America and elsewhere, and shows that investment in light rail systems can have positive economic impacts on cities. However, light rail investment alone is unlikely to be a sufficient catalyst for economic change without other supportive policies.

1. Extension of labour market catchment areas

Evidence shows that light rail systems usually increase accessibility and widen the catchment areas of CBDs and other activity sites.

- London Docklands Light Railway: Canary Wharf (see Theme 1.3.1)
- Tramlink: Croydon, Beckenham and Wimbledon especially to New Addington (1.3.2)
- Greater Manchester Metrolink: Manchester CBD and Salford Quays (1.3.4)
- Tyne and Wear Metro: Newcastle CBD (1.3.5)
- Midland Metro: increased commutable areas (1.3.6)
- Copenhagen Metro: Copenhagen CBD and Ørestad (1.5)
- Minneapolis, USA: CBD and North Line (1.6)

However, South Yorkshire Supertram had little effect in increasing accessibility in Sheffield as it competed with new high-capacity roads and opened four years after the Meadowhall out of town Shopping Mall (1.3.3).

2. Stimulation of inward investment

Light rail systems can improve economic growth by increasing the attraction of locations for inward investment. However, it is difficult to attribute specific investments in economic activity solely to light rail.

Some specific investments can be directly attributed to light rail, for example:

- A £20 million public sector investment in the MediaCity light rail extension was widely reported to be a pre-requisite for the British Broadcasting Corporation (BBC) to relocate a lot of its activities and employment from London to become the anchor tenant at Peel Holding's MediaCityUK development at Salford Quays (2.2.1)
- An initial £77 million public sector investment in Docklands Light Railway enabled Canary Wharf to be developed as a major new employment district by Olympia and York, which later invested directly in two subsequent DLR extensions to facilitate further investment in employment sites (2.2.5)

However, in most cases, in both the UK and elsewhere, further research is needed to isolate the role of light rail by comparing inward investments in areas benefitting from light rail with investments in similar control areas that do not have light rail. Timing within the economic cycle can also affect how quickly light rail corridors can attract new investment; light rail opening in a period of strong economic growth is more likely to be a catalyst for inward investment than in a period of stagnation or economic recession.

3. Unlocking previously hard to reach sites for development

Light rail systems can transform accessibility to previously hard to reach sites such as derelict docklands, brownfield former industrial areas and reclaimed land.

Docklands in the industrial era were usually poorly connected on their landward side with main road and passenger railway networks. When ports moved downstream to deeper water, traditional dock sites became derelict but lacked good land transport connections essential for their redevelopment. For example:

- The London Docklands Light Railway unlocked inaccessible former docks sites in the Isle of Dogs, Wapping, Poplar, Royal Docks and Leamouth areas for post-industrial mixed office, leisure, retail and residential uses, most notably at Canary Wharf, in the 1980s and 1990s (3.2.2)
- Manchester Metrolink's Salford Quays and MediaCity extensions, in 1999 and 2010 respectively, unlocked the inaccessible and derelict sites at Salford Docks at the head of the Manchester Ship Canal for post-industrial mixed office, leisure, retail, educational and residential uses (3.2.1)

Disused former industrial manufacturing sites and coalfields also often had poor connections with main road and passenger railway networks. Light rail can unlock these sites for development but the example of Sunderland's Metro extension into a former shipbuilding and coal mining area (3.2.4), has not yet proved to be a sufficient catalyst for substantial economic growth.

Undeveloped land on urban margins is often poorly connected with main road and railway networks. In Copenhagen, Denmark, land has been unlocked for urban expansion by building five new electrified commuter railway lines as part of its 1947 Finger Plan, and more recently, by constructing Ørestad linear New Town on reclaimed land for mixed office, educational, leisure, retail and residential use built around Copenhagen's new light rail mini Metro system (3.4).

4. Reorganisation or rationalisation of production, distribution and land use

By improving accessibility, light rail can provide a trigger to reorganise or rationalise production, distribution and land use. For example:

- In London Docklands, the DLR enabled the relocation of banks, newspaper offices and printing presses, and other businesses from the City of London (4.2.1)
- In Salford Quays at MediaCityUK, Metrolink enabled the BBC to relocate many jobs and activities from London and Manchester; ITV to relocate from Manchester; and many creative, digital and media companies to relocate or start up (4.2.2)
- In Ørestad New Town, Copenhagen, Denmark, Metro enabled the Danish Broadcasting Corporation (Danmarks Radio - DR) to move from 10 CBD sites to one site at Ørestad North and create DR Byen (Media City); Swedish pharmaceutical company Ferring to relocate from Malmö (Sweden), Kiel (Germany) and Copenhagen; and international engineering, design and consultancy company Rambøll to relocate from north Copenhagen and Copenhagen CBD (4.5)

5. Triggering fresh growth through elimination of significant transport constraints

Absence of a well-developed modern transport system can act as a serious constraint on growth. Transport constraints can be alleviated by increased capacity, better efficiency, new connections and improved accessibility. For example:

- In Greater Manchester, Metrolink improved accessibility, frequency and capacity and enabled more people to travel to work, shop, or leisure activities in Manchester's CBD and at Salford Quays (5.3.1)
- In London Docklands, the DLR transformed accessibility, frequency and capacity and enabled many times more people to travel to work or leisure activities in Canary Wharf (5.3.4)
- Copenhagen's commuter catchment area widened with the building of Metro, Ørestad New Town and the Øresund road and rail bridge from Sweden (5.5)

However, South Yorkshire Supertram may have had a negative impact on Sheffield's CBD by making it easier to access Meadowhall's out of town Shopping Mall.

6. Land value and property value increase and capture

Light rail systems improve accessibility, usually increase land and property values, and enable developer contributions to be made. Despite various mechanisms that can be adopted, increases in land and property value are often not captured. For example:

- The DLR triggered an increase in accessibility and land values in the Isle of Dogs, rising from £70,000 an acre in 1981 to £4.9 million an acre in 1988 (6.2.1)
- In Bremen, Germany, sites on a tram line usually have 50 percent higher land prices than sites with no public transport, or bus-only access (6.3)
- In Phoenix, Arizona, prices of vacant land sold, doubled for the first three years after light rail station sites were announced (6.4.1)
- Olympia and York made a £93 million contribution to two DLR extensions (6.6.1)
- After development stalled at Salford Quays in the early 1990s, developers made a land contribution worth £10 million towards the cost of a Metrolink extension, recognised as essential to kickstart the sale of remaining regeneration sites (6.6.2)

- Ørestad Metro in Copenhagen was partly funded by sale of public land at enhanced values to private developers (6.7)

- House prices often increase when light rail increases accessibility, such as in Croydon (6.10.5); Rouen, France (6.11); Portland, Oregon (6.13.1); San Diego and San Jose, California (6.13.2)

- House price changes can vary from increases to losses depending on location, as in Tyne and Wear (6.10.1). It can take several years for increases to occur, as in Greater Manchester (6.10.2)

7. Transit-oriented development

Light and heavy rail impacts are enhanced when planning policies are co-ordinated in a transit-oriented development (TOD) to focus investment in housing, employment, activity sites and public services around station sites. For example:

- Copenhagen and Stockholm have been global leaders in TOD for over 60 years. Ørestad New Town, in Copenhagen, is an important, contemporary light rail TOD (7.4)

- TOD has been important in Paris since the 1960s; light rail TOD in Grenoble since the 1980s has been copied by many French cities and towns (7.5)

- Vancouver's TOD is focussed around its light metro SkyTrain stations, notably Burnaby Metrotown shopping centre (7.7)

- Since the 1980s, 16 US cities have developed light rail TOD (7.8)

8. Cost Benefit Analysis (CBA) of transport schemes

CBA forecasts the costs and benefits of transport schemes, largely based on time saving and value of time. It has difficulty in valuing environmental, social and wider economic effects even after a New Approach to Appraisal (NATA) was adopted.

- Light rail Impact Studies were carried out in Tyne and Wear, Greater Manchester and Sheffield before NATA was adopted (8.2)

- Economic benefits of light rail were not fully assessed before light rail schemes in Leeds, Liverpool, Greater Manchester and Portsmouth were rejected for funding by the UK Government in 2004/5 (8.3 & 8.7)

- The future prices of oil and airline fuel have been underestimated by the UK Government since 2000, so future demand for light rail and other public transport investments has been underestimated and future demand for private car and air travel has been overestimated (8.7)

9. City image and quality

Light rail can boost a city's image and attract inward investment, employers, business and tourist visitors. It can help create a distinct 'sense of place' and has an iconic impact on the urban landscape. For example:

- In Greater Manchester, Metrolink has been described as icon and as buzzy, energetic, exciting (9.2.1)

- Tramlink has been used to market Croydon as a place with drive, ambition and a 'can do' philosophy (9.2.3)

- In Newcastle, Metro brings credibility to the area (9.2.4)

- DLR's high visibility has a positive effect (9.2.5)

- Midland Metro is seen as clean, fast and stylish (9.2.6)

- The 'Grenoble Effect' describes the revitalisation of city centres city centres as aesthetically landscaped pedestrian areas by combining light rail with positive planning policies. This has been copied by many French cities and towns (9.1 & 9.5)

- Copenhagen's Metro has an iconic impact on its urban landscape (9.8)

- Vancouver's SkyTrain is regarded as a visual icon (9.4)

Recommendations

- Supportive planning policies should be adopted to maximise the positive economic impacts of light rail investment. Transit-oriented development should become the norm.

- Mechanisms should be adopted to capture increase in land and property values resulting from light rail investment.

- Cost Benefit Analysis should be modified to place less emphasis on time saving and value of time, and more emphasis on environmental, social and wider economic effects.

- Government forecasts of the future price of oil should be reassessed to take more account of independent assessments and the increasing demand pressures as global Peak Oil approaches. This is critical to re-balance the assessment of light rail and other public transport schemes against road building schemes.

- Impact Studies should be commissioned to analyse the medium to long-term, 10-25 year, economic effects of light rail systems. 'Before and After' light rail Impact Studies have hitherto focussed on immediate economic impacts when economic opportunities are unlikely to have been realised.

- Impact Studies should use similar control areas to isolate light rail's impacts from other factors and temporal trends.

- Site specific and contextual factors should be taken into account as similar light rail investments in different locations will not necessarily have the same impacts.

1. EXTENSION OF LABOUR MARKET CATCHMENT AREAS

1.EXTENSION OF LABOUR MARKET CATCHMENT AREAS

1.1 Effects of transport innovations in urban areas on labour market catchment areas

As transport journey times and/or costs fall with the opening of new transport systems, labour markets expand as workers are prepared to make longer distance journeys within their same overall commuting time and cost thresholds (Pooley et al. 2005; SACTRA 1999). Firms may be able to attract more skilled workers because of easier access to a geographically enlarged labour market. Similarly, the catchment areas for retail outlets, shopping centres and leisure facilities can increase with new transport improvements, resulting in more employment in these activities at highly accessible locations. Some of this new employment may be displaced from elsewhere.

Venables (2007) adopted a theoretical model to demonstrate that there are significant gains to employment productivity from transport improvements, through drawing more people into the city centre from outside, and enabling more of the city's initial inhabitants to work - thus raising productivity of existing and incoming workers, and bringing net economic gains to the city centre.

1.2 Effects of light rail and other rail transit systems on labour market catchment areas

Light rail and other rail transit systems are usually focussed on CBDs in city centres. However, where land use and transport planning is coordinated, for example as part of a transit-oriented development (see Theme 7), light rail and other rail transit systems can also widen the catchment area of stations anywhere on their route network. "Investment in rail may also lead to network economies, as a new link results in increased demand across the network as a whole … and the overall impact is greater than the impact on the new link itself" (Banister and Thurstain-Goodwin 2011, p.215). A network of light rail routes as well as integration with heavy rail and bus networks, and Park and Ride sites will further extend the labour market catchment area.

1.3 Effects of light rail in the UK

1.3.1 Effects of light rail in London Docklands

Grant (1990) acknowledged the role of the Docklands Light Railway (DLR) in providing access to, and subsequent growth in demand for development in the Isle of Dogs and Leamouth areas. The initial DLR network linked Canary Wharf on the Isle of Dogs with Tower Gateway, on the edge of the city of London, Stratford and Island Gardens in 1987 (Figure 1.1).

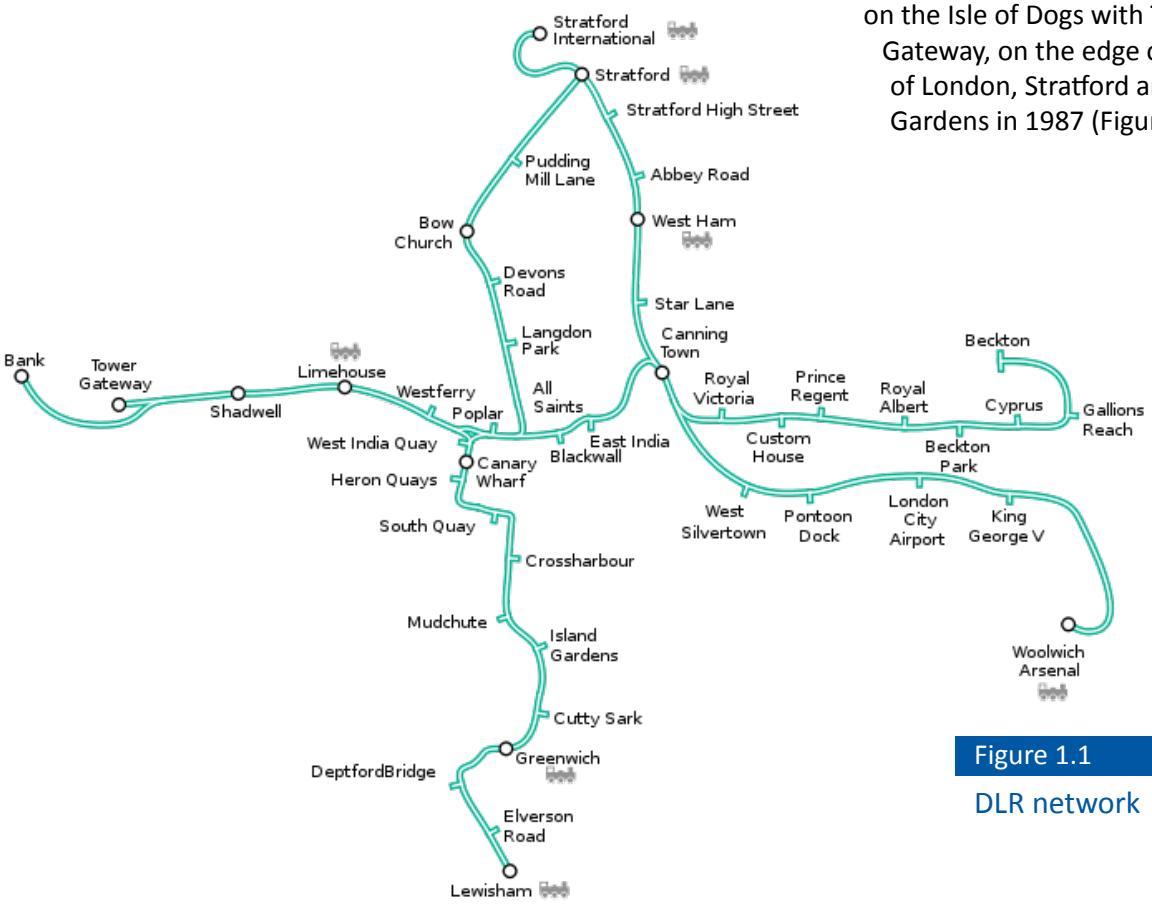


Figure 1.1

DLR network

At times, however, the demand for growth appeared to be constrained by limited capacity to and from the Docklands on key public and private transport corridors. Plans and projections for development of Canary Wharf estimated roughly 46,000 additional employees on the Isle of Dogs, and so it was considered necessary to increase transport capacity and provide a better connection into the London Underground network (Grant 1990).

Grant (1990, p.7) noted that as "The scale of the proposed development in London Docklands, especially in the Isle of Dogs, continued to expand, it became clear in 1989 that without an early decision to go ahead with provision of substantial additional capacity to central London and to Stratford, there would be severe overcrowding on the public transport services into Docklands by the late 1990s. This could be so serious as to impede the potential development of the area and to create very difficult travel conditions for the existing residents and workers in the area." (see Theme 2).

Subsequent DLR extensions to Bank, in the City of London, in 1991, Beckton in 1994, Lewisham in South London in 1999, London City Airport and North Woolwich in 2005, Woolwich in South London in 2011, and Stratford International in 2011 - serving London's 2012 Olympic Park and Westfield Shopping Centre - improved connections with the London Underground network and substantially widened London Dockland's employment and visitor catchment area, especially from south of the River Thames (Figure 1.1) (Knowles 2007; Knowles and Abrantes 2008).

SDG (2005a) noted that the DLR has been significant in providing sufficient capacity and accessibility for people to fill new jobs in the London Docklands areas: "There will be about 70,000 employees at Canary Wharf by the beginning of 2005 and about 88% of them will travel to work on public transport" (pp.51-52). "There is a general feeling among people in excluded groups that the DLR provides access to better jobs/homes" (SDG 2005a, p.70)

1.3.2 Effects of light rail in Croydon

According to Siraut (2004, p.876), "A third of the areas served by the tram were classified as being in the 20% least accessible areas in London before the tram opened". Once Tramlink was in operation, employers believed that it had been easier to recruit staff from further afield, particularly in areas that previously were poorly served by public transport (Figure 1.2). Some employers used the Tram to advertise staff vacancies, and a major multiple retailer used the service to second or transfer employees between sites along the route, thereby improving flexibility and staff development opportunities.

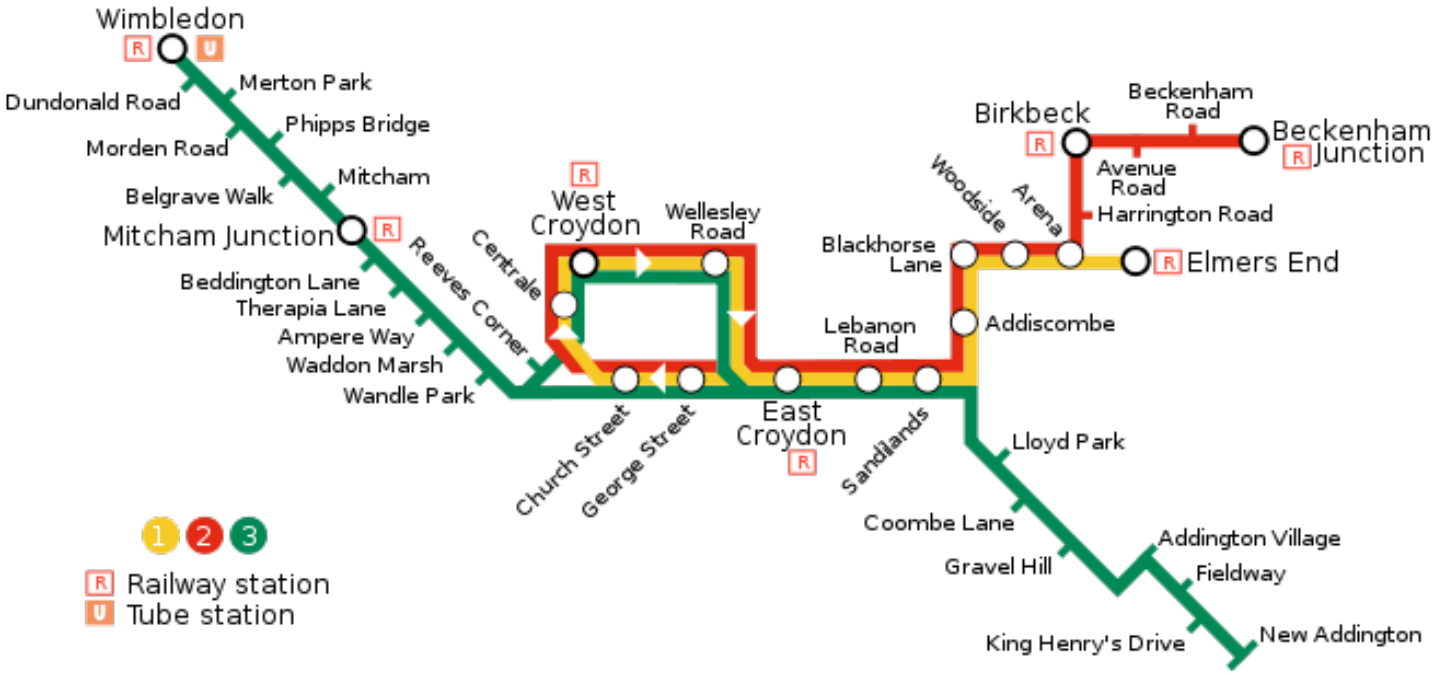


Figure 1.2

Croydon Tramlink network

From a survey and consultation carried out among public and private stakeholders in Croydon, RICS (2004) reported that Tramlink enabled employees to reach industrial work sites more easily and efficiently than previously. It was suggested that this may have halted economic decline in the New Addington area. These results are indicative rather than definitive, however, supporting evidence from Job Centre Plus in New Addington suggested that the area had become the best performing centre, out of 12 sub-regions, since Tramlink commenced service there, and that additional jobs in Beckenham and Wimbledon had been created. These results are specific to the New Addington area and, more generally, RICS (2004) concluded that the level of aggregate accessibility change was insignificant.

1.3.3 Effects of light rail in Sheffield

The South Yorkshire Supertram (SYS) Impact Study found no convincing evidence of an extension to the labour market catchment area (Crocker et al. 2000). At best, it might have enabled a small number of people to find work or to seek new opportunities (Figure 1.3) (Dabinett et al. 1999).

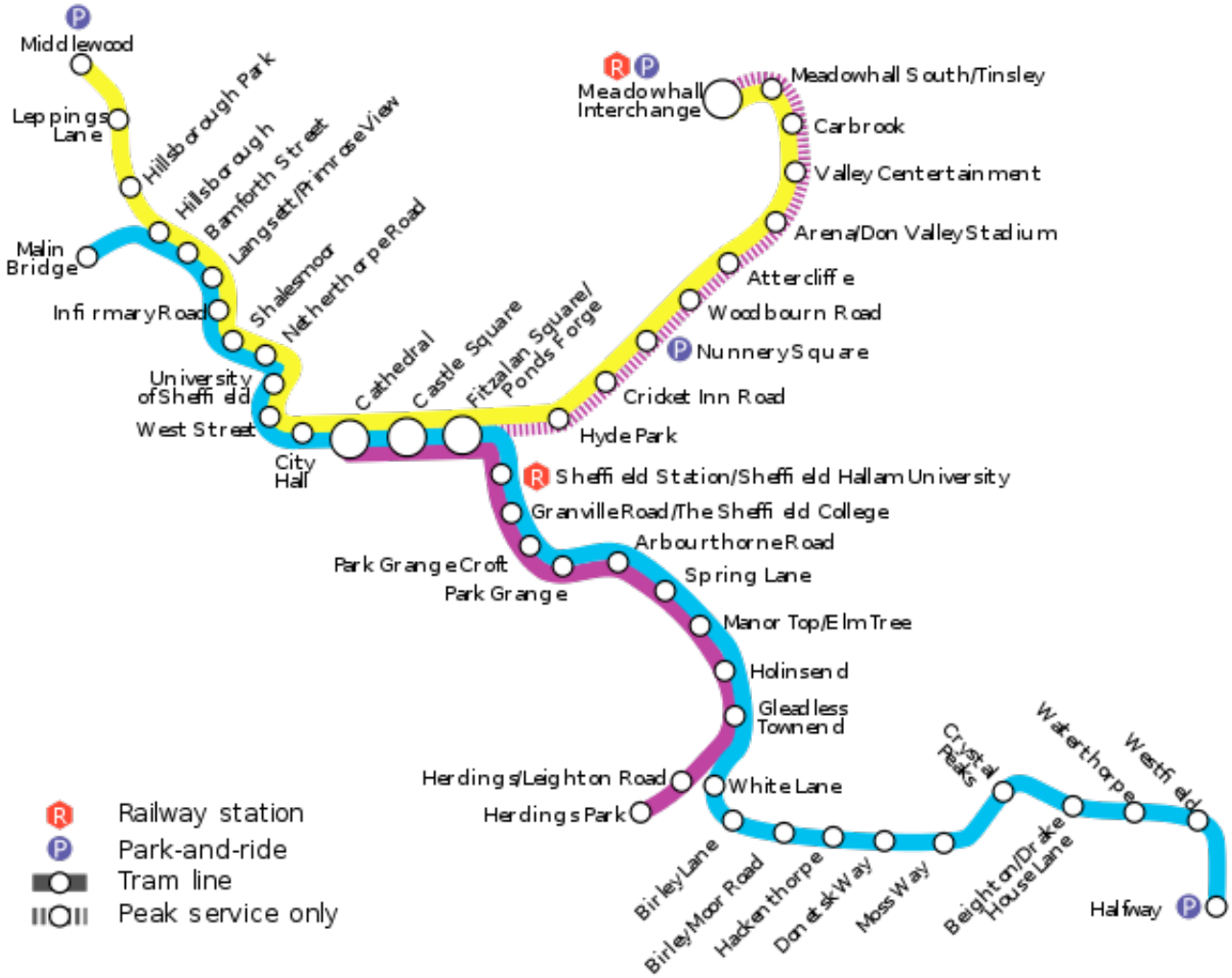


Figure 1.3

Sheffield Supertram network

Possible explanations for this, suggested that newly built high capacity roads were competing with Supertram in the lower and upper Don Valley, and that negative media publicity and economic recession, during Supertram's construction, affected the service when it commenced operation.

In addition, Supertram only served two large employment locations outside the CBD: Meadowhall and Crystal Peaks Shopping Centres, the former of which had already opened in 1990 when Supertram was integrated into Meadowhall's bus and rail public transport interchange.

1.3.4 Effects of light rail in Greater Manchester

Volterra Consulting's (2008) Report calculated the additional economic benefits of the proposed Manchester Metrolink Phase 3 extensions to Ashton under Lyne, Chorlton and East Didsbury, Manchester Airport, MediaCity at Salford Quays, Oldham and Rochdale, and measured the projected agglomeration benefits in terms of increased output from additional workers able to access employment in central Manchester (Figure 1.4).

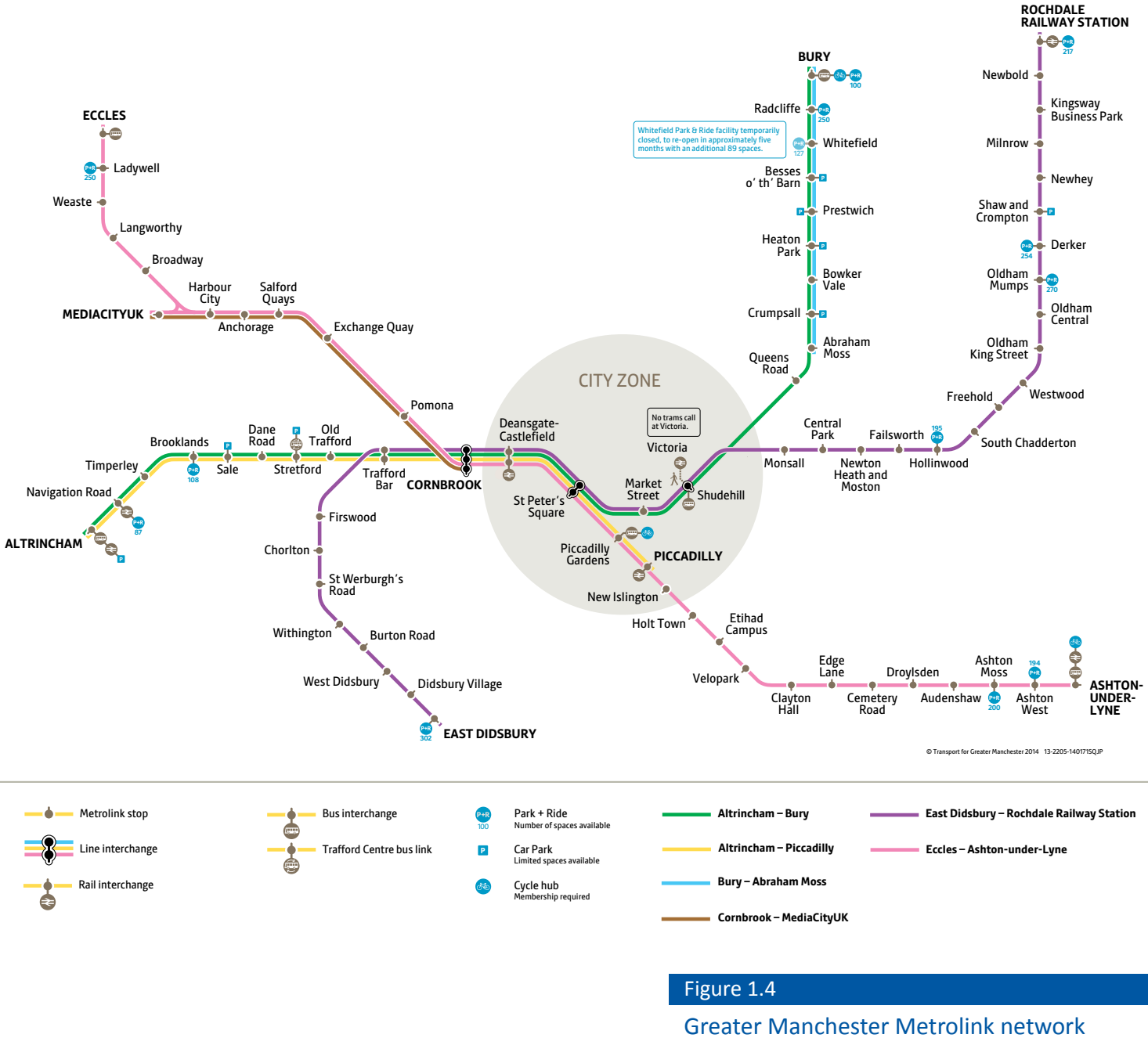


Figure 1.4

Greater Manchester Metrolink network

Volterra Consulting (p.6) referred to the extension of labour market catchment areas as a "move to more productive jobs" and noted that Metrolink provided a better commuting experience than other forms of transport (see Theme 8).

In Salford Quays, Metrolink extended the scale of the professional labour market by offering a congestion-free commuting mode for office workers employed there (Hass-Klau et al. 2004).

1.3.5 Effects of light rail in Tyne and Wear

The Tyne and Wear light rail Metro converted and electrified the heavy rail loop line on North Tyneside and the heavy rail South Tyneside line to South Shields and improved access to Newcastle upon Tyne's CBD by tunnelling under the city centre (Figure 1.5).

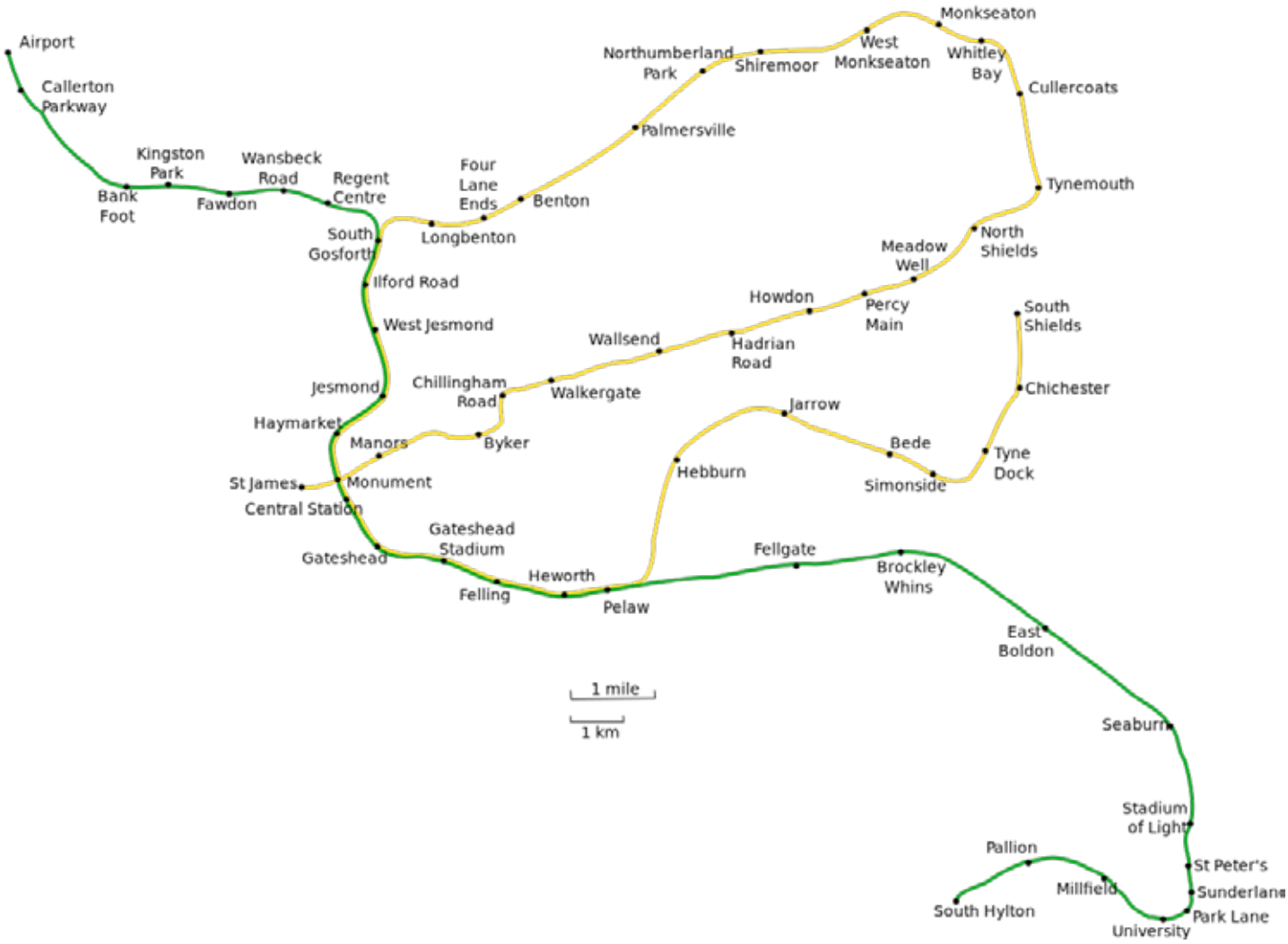


Figure 1.5

Tyne and Wear Metro network

Later extensions were built to Newcastle Airport in 1991, and to Sunderland city centre and a former shipbuilding and coal mining area in 2002. Hass-Klau (2004, p.141) considered the potential impacts of the Sunderland extension and noted a "gradual appreciation that the new link will have the effect of opening up a wider labour market and new commuting possibilities".

1.3.6 Effects of light rail in the West Midlands

Midland Metro Line 1 from Birmingham to Wolverhampton substantially increased the areas that were seen to be commutable. However, the line passed through economically depressed areas, such as West Bromwich, where unemployment rates were very high and car ownership low (Hass-Klau et al. 2004). Hass-Klau et al. suggested that despite social regeneration efforts, the fares represented a large proportion of people's wages in this area.

cebr (2008b) assessed proposed impacts by 2026 of the Midland Metro City Centre Extension. Two schemes were proposed: the 197 scheme with 10 trams per hour; and the 199 scheme with 15 trams per hour. They noted that improved connectivity would boost accessibility and make a more competitive, deeper and wider pool of labour available, thus potentially attracting additional business activity. The 197 scheme would potentially add 1,290 jobs by 2026, which equated to an extra £42 million of economic output, whilst for the 199 scheme, the potential increases were 1,930 jobs and £62.5 million in economic output.

cebr calculated that 68 percent of potential benefits from labour market improvements in regeneration zones across the West Midlands would accrue in regeneration zones, highlighting the significance of integrated transport and planning initiatives.

1.4 Effects of light rail in England and Canada

Knowles (2000, p.2) found in a survey of all the light rail schemes in England and Canada that "LRT patronage trends bear some relationship to CBD employment change, increasing in Calgary and London Docklands, but static or declining in Edmonton and Newcastle".

1.5 Effects of light rail in Copenhagen, Denmark

The light rail Copenhagen mini-Metro is part of a larger development and transport project that has improved accessibility to Copenhagen's CBD. It underpinned the development of Ørestad New Town and encouraged workers to commute from a wider area to newly created and relocated jobs, including employees from Sweden via the Øresund Bridge (Figure 1.6) (Knowles 2012a).

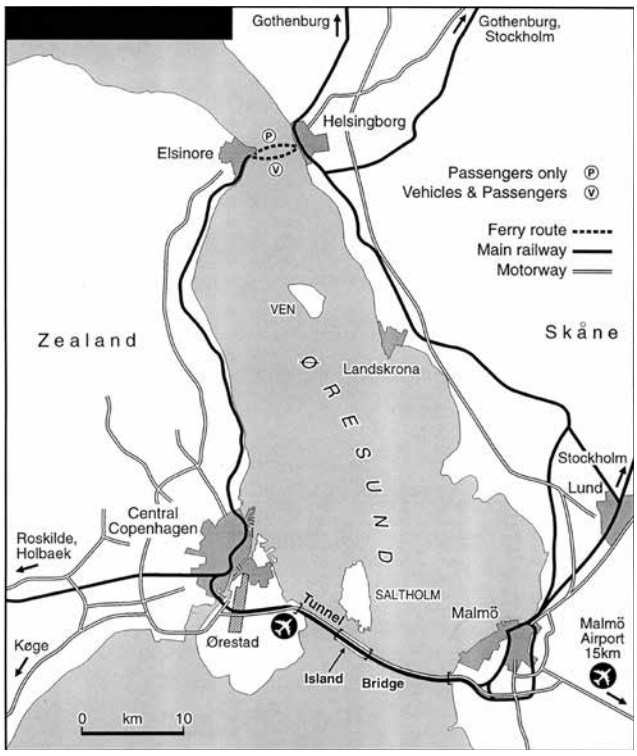


Figure 1.6

Extension of Copenhagen's labour market to Ørestad and Sweden

1.6 Effects of light rail in Minneapolis, Minnesota, USA

Fan et al. (2012) found positive results for improved job accessibility in Minneapolis, USA. Empirical analysis demonstrated that the Hiawatha light-rail line has generated significant changes to employment accessibility in low- medium- and high-wage jobs, since its introduction in 2004. The results indicated that 1,216 additional low-wage jobs, 833 medium-wage jobs and 5,075 high-wage jobs became accessible. While the greatest gains were recorded in areas that were served by light rail transit (LRT) stations, results showed the importance of broadening accessibility with interconnected bus routes and LRT stations. Accessibility improvements appeared to be coordinated with areas that have a higher concentration of low-income population. For example, in Downtown LRT stations, there was a 30 percent increase in low-wage job accessibility, compared with 23 percent medium-wage jobs and 18 percent high-wage jobs. In North LRT station areas, 40, 36 and 39 percent changes were measured, respectively. The magnitude of increase in high-wage jobs, for three remaining areas, was greater than for low-wage and medium-wage jobs, indicating that low-wage workers benefitted less than their higher earning counterparts.

2. STIMULATION OF INWARD INVESTMENT

2. STIMULATION OF INWARD INVESTMENT

2.1 Introduction

High quality transport infrastructure can help to improve economic growth by increasing the attraction of a location for inward investments (SACTRA 1999). Transport improvements can enhance accessibility of certain locations, thus influencing spatial relationships and potential agglomeration benefits, while also altering perceptions of inward investors, in terms of accessibility, distance, peripherality, disadvantage and attractiveness (SACTRA 1999). However, it is widely recognised that transport investment alone will not be sufficient to stimulate inward investment (Banister and Berechman 2001; Banister and Thurstain-Goodwin 2011; Docherty et al. 2009; SACTRA 1999).

While SACTRA (1999) showed that the quality of transport links was important in attracting inward investors to UK regions, so too were additional factors such as the availability of suitable sites, and a skilled workforce. Banister and Berechman (2001, p.210), argued that "Transport infrastructure investment acts as a complement to other more important underlying conditions, which must also be met if further economic development is to take place". The authors set out three sets of necessary conditions that, when operating together, will enable economic growth to ensue (Figure 2.1).

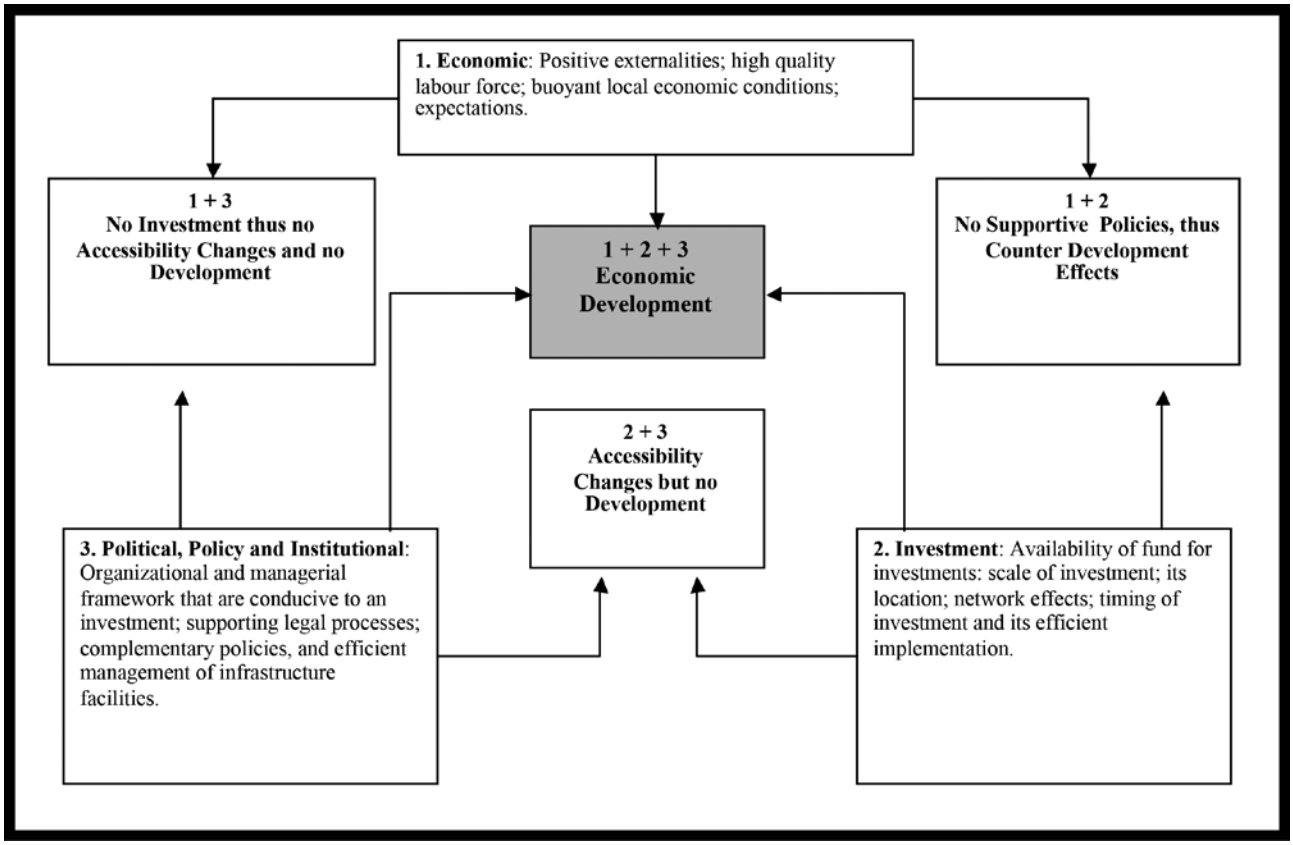


Figure 2.1

Three sets of conditions to enable economic growth

Inward investment may be attracted to an area through the opportunities that transport investment generates for agglomeration (Graham 2007). Banister and Thurstain-Goodwin (2011) defined agglomeration economies as "benefits resulting from the geographical proximity of firms to each other" where "transport contributes to the level of concentration and density through firm's (and people's) decision to relocate from lower to higher productivity areas" (p.215) (see also Banister and Berechman 2000). Examples include the clustering of media organisations at Salford Quays in Greater Manchester, and financial institutions at Canary Wharf in the London Docklands.

While inward investment largely focuses on attracting investors to an area, at a smaller scale inward investment also refers to the influence on retail, leisure and recreational facilities, which may benefit from the arrival of additional shoppers, visitors, students or tourists, who may spend more money in the area. Such findings are often presented in terms of the impact of transport on retail services (for example Crocker et al. 2000; Hass-Klau et al. 2004; Law et al. 1996).

Hass-Klau et al. (2004) argued that cities such as Freiburg, Rouen and Strasbourg show how light rail can influence the character of industrial areas, making them more attractive for leisure and culture activities to become established in the area. This, they argue, is based on one activity locating in a particular area, which stimulates further growth. However, it can be difficult to determine whether further activities are attracted owing to light rail access, or attracted by existing businesses (see also Banister and Thurstain-Goodwin 2011).

2.2 Inward investment in the UK

2.2.1 Inward investment in Greater Manchester

There was little evidence from the Metrolink Impact Study (Law et al. 1996) that Metrolink had attracted new offices, shops, leisure or recreation facilities to locate in the area. However, Law et al. (1996, p.30) noted that "development only occurs when it is profitable to someone" and despite Metrolink being planned during a period of strong economic growth, the system opened for service at the end of a two year recession in 1992, resulting in low demand and confidence. The authors thus concluded that "Any influence that Metrolink might have on development is therefore likely to be delayed" (p.30).

Metrolink impacted positively on the retail market in certain areas of Greater Manchester. In Bury, for example, most stores revealed an increase in turnover between 1990 and 1993, although Law et al. (1996) stressed that this was not wholly attributable to Metrolink. In addition, the office zone around Upper King Street, and retail zone along Market Street remained prosperous and well served by Metrolink in the city centre. Elsewhere in Greater Manchester, places served by Metrolink registered either stability or decline in retail turnover. Although this suggested that Metrolink may not have been particularly effective in terms of stimulating inward investment, Law et al. (1996) argued that without Metrolink, there would likely to have been an overall decline in retail activity in the city centre.

Law et al. (1996) were unable to find any significant influences of Metrolink stimulating inward investment in either leisure or recreation sectors. Six factors are suggested by Law et al. (1996, p.42) for the lack of inward investment in Manchester's office, retail and leisure sectors in the mid-1990s:

- The 1990-1992 recession coinciding with Metrolink's opening
- Uncertainties in the planning system
- Lack of pro-active planning to influence development towards Metrolink corridors
- Decision-makers' narrow perception of the system
- Lack of planning for an integrated transport system since bus de-regulation
- The relatively short time since the system opened.

Law et al. (1996, p.36) recommended that "a longer period is required before the influence of Metrolink can be assessed" (p.36) for its wider economic benefits (see also Hass-Klau et al. 2004). Subsequently, Manchester city centre's impressive renaissance, from the late 1990s, included numerous new leisure, recreational and shopping facilities, all influenced by the proximity of the growing Metrolink network.

More recently, Metrolink has stimulated inward investment via the Phase 2 extension to Salford Quays (Hass-Klau et al. 2004). This included property developments that were constructed on the expectation that Metrolink would serve the area. Hass-Klau et al. (2004) noted that development reached a peak while Phase 2 was being built, but continued to rise when Phase 2 opened. The authors stressed, however, that it was difficult to attribute property constructions solely to Metrolink, partly because development patterns reflected national economic trends.

MediaCityUK at Salford Quays is a unique investment in the UK centred on the clustering of creative media and digital industries. Major corporate and commercial players, as well as start-up firms, occupy the former site of Salford Docks, which now functions as an extension of Manchester's CBD. Occupiers include the BBC, ITV, 4D Creative, dock10, SIS, Lowry Outlet Shopping, University of Salford and Bupa, on a site that comprises roughly 15 hectares of mixed-use property development (Figure 2.2) (Binder and Knowles 2013). Metrolink supported this particular inward investment via a £20 million extension to MediaCityUK, a new MediaCityUK stop, which opened in 2010, and four extra trams.

Figure 2.2

New Metrolink-related office investment in Salford Quays

2.2.2 Inward investment in Sheffield

As part of the SYS Impact Study, Haywood (1999) argued that there was little evidence SYS had exerted a locational pull on the pattern of major developments, relative to elsewhere in the city. Between 1992 and 1995, there was a strong increase in planning applications in the Supertram corridors for major retail services and office developments, but a decline in all other categories (Table 2.1) (Lawless and Gore 1999). Overall, planning applications were down by 40 percent in the Supertram corridors, compared with an increase of 14 percent in adjacent road corridors, and a decline of 3 percent in the city more generally.

Supertram Corridors	
Major retail services	+127%
Major office developments	+31%
Minor office developments	-24%
Household planning applications	-20%
Major industry/warehousing	-36%
Minor industry/warehousing	-14%
Major other development	-13%
Minor other development	-6%

Table 2.1

Sheffield Planning Applications 1992/3 – 1994/5

Reasons proffered for this relative lack of inward investment included (Haywood 1999; Lawless and Gore 1999):

- Absence of well integrated development plans
- Lack of ideological commitment to transit leading to a lack of concentrated development around the SYS route.
- Limited powers among local planning authorities to shape development
- Development proposals focused on private car use, undermining the potential impact of SYS.

Haywood (1999, p.295) concluded that "in Sheffield the planning context within which the SYS was introduced was poorly focused on transit, the planning function was fragmented and, where planning powers were used pro-actively, they were used to support road-oriented development".

Lawless and Gore (1999) suggested that on average, 13 percent of new development in Sheffield could be attributed to SYS. From the same Impact Study, Crocker et al. (2000) identified 12-15 percent of land use change and development in three different city areas that could be attributed to SYS. Overall, it was noted that such developments would likely have occurred without Supertram, but Crocker et al. suggested that this infrastructure stimulated earlier investment than otherwise would have been achieved.

Buck Consultants International (2000) produced a later report on the impacts of SYS, and found that the Supertram corridor between Meadowhall and the city centre had experienced some positive impacts, particularly in terms of foreign investment. "The report suggests that a large-scale call centre built in the Lower Don Valley was partially triggered by the system and that it helps to attract the workforce" (SDG 2005a, p.54).

In 2000, it was noted that development was increasing adjacent to Supertram, including the construction of a Virgin entertainment complex called Valley Centertainment, with a multiplex cinema and Hollywood Bowl, new Sheffield College site and new development by the company Dixons (Figure 2.3) (SDG 2005a).

Figure 2.3

Valley Centertainment: cinema and bowling alley

2.2.3 Inward investment in Tyne and Wear

Despite considerable retail development constructed in proximity to the Tyne and Wear Metro, Heseltine and Mulley (1993) argued this to be "largely fortuitous" (p.53). They suggested that Metro had reinforced rather than stimulated retail development, and also that this had reinforced the strength of Newcastle's CBD, which might otherwise have declined in relation to out of town shopping centres (Robinson and Stokes 1987). These impacts are largely presented as subsequent benefits from travel time savings, improved transport connections and freedom from parking difficulties (TRRL 1986).

TRRL (1986) found that 33 percent of Newcastle City Centre retailers and shop managers believed that Metro had ssisted growth in retail trading, while in North Shields and South Shields, 60 percent of managers perceived that Metro had generated a positive impact in terms of increasing trade. In Gateshead, the Interchange Centre was developed with retail units, a supermarket and office space, and was perceived "as a clear demonstration of the commercial value of efficient access" via the Metro (TRRL 1986, p.35).

Similar results emerged for office development where Metro "cannot claim to have influenced the location of office development" (Heseltine and Mulley 1993, p.53). While much new office development has taken place beyond the areas served by Metro, Robinson and Stokes (1987) suggested that Newcastle had continued to be the main office area of the region.

The low level of inward investment associated with Metro in Newcastle is partially explained through the alignment of the Tyne and Wear system, which used existing rail rights of way that offered little opportunity for new development along the line (Heseltine and Mulley 1993). Considering the Metro extension to Sunderland's CBD and its former shipbuilding and coal mining area, Du and Mulley (2007) noted that development is influenced by wider economic conditions and that the area does not enjoy favourable regional economic, social or physical trends in the Northern Region of the UK.

2.2.4 Inward investment in the West Midlands

According to the West Midlands Passenger Transport Authority (PTA), Metro had a direct regenerative effect in Handsworth and Soho. Positive signs of inward investment included a rise in custom for businesses in Birmingham, West Bromwich and Wolverhampton, although the report stressed that these were not necessarily wholly attributable to Metro. For businesses located along access routes to Metro stops, many owners reported an increase in passing trade (SDG 2005a).

2.2.5 Inward investment in London Docklands

In 1987, the DLR commenced operation, providing access to the largely-derelict area of the London Docklands. Grant (1990, p.4) described the DLR as a key factor "in the phenomenal growth in demand for development in the Isle of Dogs and Leamouth", in terms of both number of workers, and development of the area as a commercial centre.

Also in 1987, the building of the Canary Wharf was confirmed by Canadian multinational developers, Olympia and York (Carter 1991). "Original plans envisaged 1m-1½m square feet a year of new office space in the LDDC area till the mid-1990s; Canary Wharf will add 2 million square feet annually in 1991-96 alone. The related developments for retail and leisure at Port East and residential use at Heron Quays will increase passenger demand even more. In what is billed by the developers as 'London's third business district', 50000 people will work at Canary Wharf, with a further 80000 working elsewhere in the Isle of Dogs/Leamouth area" (Carter 1991, p.67).

While an economic recession in the late 1980s hindered development in the London Docklands, Carter (1991, p.77) concluded that "the transport infrastructure in Docklands is taking shape. £3 billion is being spent supporting the £8 billion of private investment in Docklands committed since 1981. The £500 million upgrading and expansion of the DLR will be an essential part of this support".

The London Docklands has stimulated inward investment in terms of new jobs. SDG (2005a) stated that about 70,000 employees would work at Canary Wharf in 2005. In addition, new housing and apartments have been constructed with net in-migration taking place.

2.2.6 Inward investment in Croydon

RICS (2004) noted that by increasing the catchment area for central Croydon, Tramlink has caused retail turnover to increase. Oscar Faber (2002) found, from interviews among city centre business stakeholders, that "some town centre retailers report increase in trade; one supermarket reports increase in: numbers of shoppers; number of purchases", and hence "benefits experienced by some in the retail sector" (pp.51-52).

Colin Buchanan and Partners (2003) suggested that some high profile office-based employers had recently moved into the area, and that major developments were considering Tramlink in their decisions to locate in Croydon. In addition, Tramlink was influential in the development of a new leisure complex which was constructed without any new on-site car parking.

2.2.7 Inward Investment in Nottingham

SDG (2005a, p.65) reported "intensive development in the immediate vicinity of the tram route in Nottingham city centre, particularly in the Lacemarket area. Many are mixed use developments, combining living spaces with commercial and light industrial uses, much favoured by media and culture enterprises. There are also indications that NET is benefiting some business parks on the periphery of Nottingham by providing a link to the main rail station in the city centre". It is unclear, however, the extent to which these developments can be attributed to NET.

2.3 Inward Investment in France

2.3.1 Inward investment in Nantes

Nantes' first light rail line opened in 1985 along a disused railway track and offered little scope for development (Hass-Klau et al. 2004). However, Line 2 opened in 1992 and has had a strong economic impact on the city centre redevelopment that was already taking place (Hass-Klau et al. 2004). Inward investment has included Fnak, the large bookseller, moving into the city.

2.3.2 Inward investment in Montpellier

Hass-Klau et al. (2004) observed new economic development along the Light rail line in 2002, two years after the line had opened. This included new residential blocks, offices, shops, restaurants and cafes already completed or under construction. Ten years earlier, the land alongside the rail line was fields and " economic development can be an important part of light rail alignment considerations" (p.103).

2.3.3 Inward investment in Rouen

Hass-Klau et al. (2004) noted key economic impacts from surveys undertaken in Rouen, comprising residential, office, commercial and educational buildings being developed along the line and near to stations.

2.3.4 Inward investment in Orléans

According to Hass-Klau et al. (2004), LRT in Orléans has not had the same economic success and acceptance by the local population as in other light rail towns in France. It is noted that there has been little economic development in the city centre that is attributable to light rail. Even so, new development has taken place in the wider metropolitan area with residential and commercial buildings being constructed, as well as a supermarket (Hass-Klau et al. 2004).

2.3.5 Inward investment in Lille

Much recent development in Lille has been focused on the Euralille site, which included a high-speed rail station, office, retail and commercial development. Inward investment was stimulated by high speed rail in Lille and the arrival of the Trains à Grande Vitesse (TGV) was linked to the regeneration of the city. The TGV provided an anchor point for high-value service, commerce and leisure industries (ITC 2014b) and the entire integrated transport and urban planning development has been considered generally positive for the city's economy (Figure 2.4).

Figure 2.4

Euralille, Lille, France

2.3.6 Inward investment in Strasbourg

Light rail in Strasbourg was associated with a change in the type of retail outlets being established in the city centre. Rental and property prices increased after the light rail line opened in 1994 and it became impossible for small shops to remain in the area. Such shops have now been replaced by large chain stores and higher-class shops (Hass-Klau et al. 2004). Linked to this inward investment from large retailing agents, "surveys in Strasbourg show that the number of shoppers attracted to a town centre can be increased, sometimes substantially, and that there can be a higher growth in property or office rents along light rail corridors compared to elsewhere" (p.125).

2.4 Inward investment in Copenhagen, Denmark

"Ørestad has helped Copenhagen to increase its international competitiveness, attract substantial inward investment and create thousands of new jobs. Ørestad's location at an international crossroads on the Øresund Fixed Link railway and motorway routes, as well as its local accessibility via Metro into Copenhagen, has also helped to expand Copenhagen's catchment area" (Knowles 2012a, p.260).

The Metro was one of the four mega projects approved for development in Copenhagen in the 1990s, and linked Ørestad New Town with central Copenhagen. It thus played a complementary, as well as influential, role towards successful inward investment (Knowles 2012a).

Inward investment in Ørestad New Town, supported by Metro, has been considerable, including many new businesses, educational establishments, extensive residential developments, retail, leisure and recreational facilities. Knowles (2012a) referred to the Swedish pharmaceutical company Ferring as an example of international inward investment, which was established in Ørestad from Malmö (Sweden), Kiel (Germany), and Copenhagen in 2002. The Ferring office tower (Figure 2.5) is located next to Ørestad's Metro and heavy rail stations, as well as the Øresund motorway, and Knowles argued that this illustrated the international accessibility that can be generated through transport infrastructure investments. Furthermore, "Nearly a third of Ferring's employees commute daily from Sweden. Three quarters of its Swedish employees travel to work by rail and one quarter by car over the Øresund Bridge. Just over half of its Danish employees travel to work by metro, rail or bus, 37% by car and 10% cycle . A total modal share of nearly 60% by public transport and 7% by bicycle and just one third by car demonstrates that Ørestad's urban development is sustainable" (Knowles 2012a, p.259).

Figure 2.5

Ferring, Ørestad New Town, Copenhagen

2.5 Inward investment in Canada

2.5.1 Inward investment in Calgary

Knowles (2000) noted that in Calgary, light rail had permitted further development in the downtown area, and some office development at Franklin and Southland. Light rail was described among key city stakeholders as a "tool for attracting inward investment" (p.11).

2.5.2 Inward investment in Vancouver

Since the Vancouver SkyTrain was constructed in the mid 1980s, inward investment has included the development of new commercial and retails centres, alongside a range of new housing that included high-rise blocks, condominium style developments, and town houses (Babalik 2000). SDG (2005b, p.42) remarked that "The pace of redevelopment around many Skytrain stations is reported as extraordinary, and is continuing, particularly near city centre" (Figure 2.6).

This development was supported by re-zoning policies (see Theme 7) (Babalik 2000). Babalik (2000) noted that developments along the SkyTrain corridor were enabled by urban renewal projects as some of the land was abandoned or vacant from its previous use as an industrial area. Although plans for redevelopment existed, prior to SkyTrain, when the scheme was announced, development plans were reshaped so that most areas were regenerated for residential, commercial and retail useage. Babalik (2000, p.147) concluded that "the SkyTrain proved to be a useful instrument" to realise mixed-use development in the city centre, and it had a positive and significant impact on revitalising an old industrial area. Babalik (2000) concluded that the combination of planning policy and SkyTrain were effective in attracting other developers into the area.

Figure 2.6

Vancouver SkyTrain stimulates urban investment

2.6 Inward investment in the USA

2.6.1 Inward investment in Dallas, Texas

It has been noted that the influence of the Dallas Area Rapid Transit (DART) light rail system on regional growth has been difficult to ascertain (Hass-Klau et al. 2004, p.25). "The economic expansion of the past ten years masks the influence of DART on the regional economy. ... The siting of a new development may be impacted by its relative proximity to a DART light rail station, but the decision to make the initial investment may be more directly related to the overall economic conditions" (North Central Texas Council of Governments 2001, in Hass-Klau et al. 2004, p.24). Hass-Klau et al. (2004) reported anecdotally that developers held a positive impression of light rail's role in development, but they also acknowledge that, on the basis of the evidence "the role played by the LRT line is impossible to judge with any precision" (p.25).

2.6.2 Inward investment in Portland, Oregon

Ohland and Poticha (2009) reported that Portland's light rail system, constructed in 2001, resulted in $2.3 billion worth of investment within two blocks of the line. This included over 7,000 housing units and 4.6 million square feet of office, retail, institutional and hotel space that was largely funded by private investors, and completed by 2005. The authors argued that transit alone does not cause development to happen but quote Portland Streetcar Chief Executive Officer, Rick Gustafson, who suggested that LRT can "create the right decision-making environment" for development (p.67).

2.6.3 Inward investment in St Louis, Missouri

Babalik (2000) defined the St Louis Metrolink as one of the most significant US light rail systems in terms of impact on the CBD. According to planners, retail turnover had increased in the city centre since the system was opened. This stimulation of inward investment in spending has helped to slow the decentralisation of businesses from the CBD. In addition, the city planning agency initiated new development of retail centres, a sports stadium and a convention centre at station sites. Tax incentives were also introduced to attract private sector developers, thus supporting the view that rail infrastructure alone will not bring economic benefits.

2.6.4 Inward investment in Buffalo, New York State

Berechman and Paaswell (1983) explored the potential impact of light rail to revitalise Buffalo's CBD. A key objective for investing in light rail was to stimulate investment in economic and land development, and to create jobs in the CBD. Berechman and Paaswell noted that:

- Light rail will benefit the economy by increasing service employment - a net increase in total employment of between 7,000 and 10,000 employees is expected
- Private investment will be stimulated
- Light rail will have a positive impact on downtown attractiveness and, if so, a larger share of regional retail trade will be captured by the CBD, all other factors remaining the same

Berechman and Paaswell (1983) noted that capital expenditure was anticipated to generate $1,040 million in regional income over the light rail investment period, from 1978 to 1985. Overall, however, it is unknown whether non-light rail public policies would enhance or conflict with light rail benefits and the authors conclude that light rail was "necessary but not a sufficient condition for CBD revitalisation" (p.483).

2.7 Inward investment in Beijing, China

Zhang and Wang (2013) examined the impact of two light rail lines in Beijing: the City Rail and Batong. City Rail was planned and constructed in the late 1990s in an area that was mainly farmland. Since then, there has been a steady stream of development along the light rail route. This was particularly evident within the Haidian District, which is where a new high-tech park is situated, as well as many universities and state research institutes. Along the route, 30 residential projects were completed by 2003, providing dwellings for 100,000 residents.

Beijing's Batong light rail transit line is much developed to the north, but less so to the south where, despite initial investment to promote development, this did not happen. The authors suggested that the system's alignment in the median of an expressway is partly responsible, and they also noted the weakness of the economy in the district. However, "there have been no published empirical studies to verify the observations" (p.128).

3. UNLOCKING PREVIOUSLY HARD TO REACH SITES FOR DEVELOPMENT

3. UNLOCKING PREVIOUSLY HARD TO REACH SITES FOR DEVELOPMENT

3.1 Introduction

"The complete absence of a well developed transport system acts as a serious constraint on growth" (SACTRA 1999, p.35; see also Hoyle and Smith 1998). Transport infrastructure can have a positive impact on an area by helping to unlock previously inaccessible or hard to reach sites for development (Eddington 2006a,b). This might include areas such as the London Docklands or Salford Quays, which were principally accessible by water transport; brownfield former industrial areas, such as Sunderland's former shipbuilding and coal mining area; and areas of reclaimed land, such as Ørestad in Copenhagen. These type of sites often require new infrastructure to connect them to surrounding areas, and the CBD.

Without major infrastructure investment, areas such as the London Docklands and Ørestad remain difficult to reach and might remain undeveloped, abandoned or largely derelict. However, transport investment is only a partial means of unlocking sites for development. Knowles (2012a), for example, showed that Ørestad City lacked local shops, amenities and street life, which meant that Ferring, established in 2002, remained isolated within the district for a brief period. Hence, despite the vital role of transport, it is argued that transport alone will not be sufficient to promote economic growth (Banister and Thurstain Goodwin 2011; SACTRA 1999).

Unlocking previously hard to reach sites is largely a question of accessibility. Transport infrastructure can generate accessibility and open areas to development, for example, in terms of alleviating trade barriers, providing access to derelict sites or vacant floorspace, or to new employment opportunities where labour and/or land have been under-utilised. As an example of alleviating trade barriers, the Øresund Fixed Link constructed between Copenhagen and Malmö (Sweden), helped the Danish city to expand its catchment area internationally and attract foreign inward investment (Knowles 2012a). However, it has also been noted that areas with low levels of development rarely lack just good accessibility (Parkinson 1981, in SACTRA 1999, p.34). Other disadvantages are likely to impact the area, such as insufficient skilled labour or inappropriate sites for development, for example contaminated land. Dickens (1992) raised the question whether transport infrastructure "merely enables growth to occur - that is, the latent demand is there already and is only held back by congestion - or whether is actually promotes it - that is, the demand is created" by the transport link (p.12). It is noted that in developed economies where well-developed transport networks already exist, new connections are less likely to stimulate economic activity in the same way as alleviating transport congestion (Eddington 2006a,b). However, SACTRA noted that "if the market for land were in perfectly elastic supply, there would still be no argument for additionality since any newly attractive sites becoming available would simply displace others in the pecking order. But it has been put to us that this is not the case that because of a mixture of planning restrictions, imperfect markets and longevity of investment decisions, cases arise in which there are few or no available sites for particular sorts of investment and that transport investments can, as a by-product, create genuinely new opportunities which could not otherwise be satisfied" (p.217).

3.2 Effects of light rail in the UK

3.2.1 Effects of light rail in Greater Manchester

Salford Quays was previously an area considered to be at a competitive disadvantage due to the absence of public transport services (Roger Tym and Partners Ltd 1996). In 1995, for example, 472,840 square feet of vacant office space was available in Salford Quay and Exchange Quay - an indication of the lack of economic investment in the area where "these high levels of vacancies have persisted despite the very competitive deals offered by owners/developers - is attributable almost wholly to the relatively poor accessibility of the Quays by public transport" (Roger Tym and Partners Ltd 1996, pp.4-5). Salford Quays had never been served by bus or heavy rail and "Without a significant, reliable and marketable improvement in public transport provided in Salford Quays, it is highly unlikely either that the office development proposals will be completed or that the public sector investment in the proposed Lowry Centre could be justified and therefore committed" (p.6). Hence, investment in Metrolink to extend the line to Salford Quays was critical to unlock the site for development.

Salford Quays is now largely perceived as 'a spectacular success' in terms its regeneration, comprising mixed use, office, residential, retail, leisure and cultural activities. Central to this vision is the notion that Salford Quays is "quite dependent on light rail" (Hass-Klau et al. 2004 p.136).
One example of the importance of Metrolink is given by Law et al. (1996) whose surveys found that Barclay's Bank, which developed a large site at Salford Quays, selected the location partly based on the knowledge of a top priority bid to extend Metrolink to the dock site.

£20 million was invested from Northwest Development Agency through Salford City Council to MediaCityUK for construction of the Metrolink extension, station and four additional trams (Figure 3.1) (Binder and Knowles 2013).

Figure 3.1
MediaCityUK's £20 million Metrolink Extension

Siraut (2004 p.878) presented anecdotal evidence that "Light rail schemes can assist the regeneration of areas that were previously derelict", and referenced the old dock area of Manchester and the Metrolink extension to Eccles through Salford Quays as examples. However, Siraut suggested that "While the regeneration of Salford Quays is not as dependent on light rail as much as the London Docklands its ability to attract high density executive housing is. House prices in Salford Quays are now twice the level of similar properties in the rest of the city." (p.878).

3.2.2 Effects of light rail in London Docklands

From the mid-1960s, until the 1980s, the London Docklands was largely derelict following the closure of its docks. It was a difficult area of east London to reach, given that it was cut off from the main radial road and railway routes, and was described as "more inaccessible by public transport than any comparable area of London" by the Docklands Joint Committee (1976) (Church 1990 p.300). Similarly, Roberts (1985 p.125) argued that "the obvious bottleneck was the lack of a visible link plugging in Docklands to the heart of London".

In 1981, the London Docklands Development Corporation (LDDC) was established by government to regenerate the area of Surrey Docks, Wapping, Poplar, the Isle of Dogs, the Royal Docks and Leamouth (Carter 1991). The LDDC believed that a low-cost transport link was essential to improve accessibility to the London Docklands and thus attract private sector investment.

The DLR opened in 1987 and provided access from the Island of Dogs to central London and Stratford, a nodal point in east London's transport network (Grant 1990). SDG (2005b, p.9) described the DLR as "part of a broader programme of infrastructure investment..., to support modest regeneration of the redundant docks and surrounding areas to the east of the City of London" (see also Buck Consultants International 2000).

Grant (1990) listed the DLR as one of four key factors that unlocked the area for development; stimulating "a scale of development which would not otherwise have happened" (p.11). In addition, Carter (1991, p.67) noted that "the whole scale and pace of Docklands development changed" in 1987 when Olympia and York, Canadian multinational developers, committed to building 10 million square feet of new office floorspace at Canary Wharf.

Growth in the London Docklands has clearly been enabled by transport infrastructure, and growth has in turn enabled the DLR and other heavy rail services to connect the centre of London to Docklands and Stratford (Carter 1991; Church 1990; Dickens 1992; Grant 1990; Truelove 1997). Olympia and York, for example, provided roughly £68 million of the £160 million costs to extend the DLR to Bank (Carter 1991). Grant (1990), however, drew attention to the difficulties of justifying transport infrastructure on proven development requirements, arguing that in 1981, even if the degree of development could have been foreseen, "it could not have been proved or guaranteed rigorously enough to justify the scale of investment in public transport which is now proposed" (p.2).

DLR extensions further enhanced access to London Docklands. For example, the extension to Beckton was built to provide "a direct link to central London for those living and working in the Royals [Docks], as well as a means of internal circulation along the key spinal route" (Grant 1990, p9). In particular, the DLR unlocked access to Leamouth and Royal Docks and provided the "backbone" (SDG 2005a, p.51) to development of what was "widely-regarded as two of the best remaining development sites in Britain" (Carter 1991, p.75).

The DLR has also provided scope to "attract much existing and new traffic to the [London City] airport" (Carter 1991, p.76) where previously "a lack of good roads and railways to the airport has hindered its growth" (Carter 1991, p.76). Since 2005, DLR has served the London City Airport via the London City Airport DLR station where there is a direct link between the airport concourse and the platform.

SDG (2005b) confirmed that the role of the DLR has changed: "The original purpose of the DLR was to provide direct access from the City to help spark regeneration. This was boosted by the extension to Bank which provided better access to labour markets beyond the City via the Underground as well as better links between the City and financial businesses in the Isle of Dogs. The Beckton extension has helped regeneration further to the east in and around the Royal Docks. The Lewisham extension provides much better access to jobs for those living south of the Thames" (pp.11-12).

3.2.3 Effects of light rail in Croydon

Tramlink has improved accessibility in Croydon. "A third of the areas served by the tram were classified as being in the 20% least accessible areas in London before the tram opened" (Siraut 2004, p.876). In particular, accessibility has been improved via Tramlink Route 3 running between Croydon town centre and New Addington where substantial reductions in journey times have been made. Travel time savings solely attributable to the impact of Tramlink, are illustrated in Table 3.1. Forest Dale to Beckenham Station experienced the greatest reduction in journey time at 24 minutes. More generally, all trips ending at Beckenham Station, and all trips originating at New Addington benefited from a reduction in travel time (Oscar Faber 2002). Emphasising the importance of accessibility, Oscar Faber found that the main reason for travellers switching to Tramlink from other transport modes was that Tramlink was perceived to be faster (1,382 respondents) and more reliable (984 respondents).

Sector	Bank	Beckenham Station	Canary Wharf	East Croydon	Piccadilly Circus	Purley Way	Wimbledon Station
Addington Hill	-8	-19	-8	-8	-8	-4	-8
Addiscombe	0	-19	0	0	0	-1	0
Beckenham	0	-2	0	-11	0	-10	-3
Central Croydon	0	-20	0	0	0	-1	-1
Elmers End	0	-5	0	-7	0	-7	-5
Forest Dale	-12	-25	-12	-12	-13	-10	-12
Merton	0	-4	0	-7	-1	-7	-5
Mitcham	0	-6	0	0	0	0	0
Mordon	0	-10	0	0	0	-1	-5
New Addington	-16	-13	-15	-22	-16	-23	-23
Shirley	0	-6	0	-1	0	-3	-1
South Northwood	-1	-18	0	-1	-1	-2	-1
Thornton Heath	0	-8	0	0	0	0	-1
Waddon	0	-13	0	-1	-1	0	-11
Wimbledon Town Centre	0	-5	0	-2	-1	-23	0

Table 3.1

Differences in accessibility (minutes) in 2000 between 'Before' and 'After' Tramlink

3.2.4 Effects of light rail in Tyne and Wear

The Tyne and Wear Metro was extended to Sunderland in 2002, providing access to a former colliery area that has experienced industrial change through decline of mining and shipbuilding. "It was known that the large (100 hectare) substantially disused dockside area would benefit from a spur link off the Metro line" (Hass-Klau et al. 2004, p.142). The Metro has provided better links within Sunderland, between Sunderland and Newcastle, and through intermodal transport connections to the wider Tyneside area.

It was noted by SDG (2005a, p.50) that "One of the key objectives of extending Metro to Sunderland was to address the longheld perception that Wearside was the "poor relation" in the Tyne and Wear area". SDG (2005a, p.50) concluded that "The extension has clearly improved accessibility, but it is too early to gauge the effect on specific development sites in the corridor.

Hass-Klau et al. (2004, p.141) suggested that "Sunderland extension's main advantage is not in the new right-of-way as such but in increased frequency and opening new access opportunities through 7-8 new stations, with several others refurbished and made part of the Metro network". Hass-Klau et al. (2004) also indicated that the Sunderland Metro operated through empty brownfield sites and that "Nexus, the public transport operator, are very hopeful that they could work closely with Sunderland ARC [a private regeneration company] to expedite future development of these sites" (Hass-Klau et al. 2004, p.142). Hass-Klau et al. (2004) found some signs of new property development that has "clearly benefited from the new Metro link" (p.142) at East Boldon, and Hendon.

3.2.5 Effects of light rail in the West Midlands

SDG (2005a, p.55) reported on plans for "regeneration of a corridor of land shadowing Midland Metro from Hill Top in Wednesbury, through West Bromwich to Smethwick. An estimated £1.6 billion of public and private sector investment will go into the area over the next 10 to 15 years". The council's Cabinet member for regeneration in the area said "It unlocks the potential for development right along the Metro corridor from Smethwick to Wednesbury, creating thousands of new jobs that will alter the economic landscape of the Borough for the better". Midland Metro is central to the implementation of this vision, through the connections that it provides.

3.3 Effects of light rail in Paris, France

In Paris, the neighbourhood of Bercy was cut off from the city by poor accessibility. Despite an urban planning programme for regeneration from 1982 onwards, the ITC (2014b) argued that the project started to come together in 1998 when Line 14 of the Paris Subway (heavy rail) was opened and stopped at two stations situated either end of Bercy neighbourhood, roughly 800 metres apart. For residents who had previously lived with poor accessibility, the centre of Paris was now only 5 minutes journey time by Metro, and direct access was also established to two major Parisian rail stations. With additional pedestrian access across the river, Bercy is now considered an active and lively neighbourhood, and a centre for thousands of people (residents, shoppers and visitors).

3.4 Effects of light rail in Copenhagen, Denmark

"Ørestad is Copenhagen's linear new town being built over a 30 year period around stations on an elevated, driverless mini-metro line" (Knowles 2012a, p.251). Ørestad New Town in Copenhagen was built on reclaimed land and major transport infrastructure was central to its accessibility. Knowles (2012a) reported that from the outset, Ørestad was planned with the Metro at its core with urban development focused around its Metro stations. With the Metro as part of a broader mega development project, Copenhagen has experienced considerable economic growth, including the four urban districts of Ørestad New Town and their key developments (Knowles 2012a).

3.5 Effects of light rail in the USA.

In the USA, LRT has been an integrative part of transit-oriented development, which has helped to unlock previously hard to reach sites for development (see Theme 7).

In San Diego, the Light Rail East Line helped to overcome topographic constraints at Grossmont where a ravine separated the station from a nearby shopping centre and hospital, and which had previously limited development opportunities (Boarnet and Compin 1999).

Cervero (1998) noted that the 1989 Eastside line had failed to spawn the amount of development that had been anticipated. They attributed this to proximity to single-family neighbourhoods and its location partly in a freeway central reservation. However, the Lloyd District is one of the most successful inner-city redevelopment projects

anywhere served, and spurred, by light rail. The Oregon Convention Centre, The Rose Garden Avenue, and a large enclosed shopping complex have opened since Metropolitan Area Express (MAX), and light rail was a decisive factor in locating a key sports arena in the Lloyd District. "MAX supporters credit light rail with physically as well as psychologically bridging the river that divides the Lloyd District and downtown" (p.418), thus providing important accessibility. By 1996, more than 6,000 dwellings and $230 million of mixed land-use developments were constructed, permitted or proposed within 800 metres of Westside MAX stations since its go-ahead in 1990.

Arrington (2009) concluded that nearly every light-rail stop and corridor in Portland had witnessed some TOD activity. This occurred despite the first line (Eastside light-rail line 1986) being planned before TOD considerations were given, and the second line (Westside light-rail line 1998) as an example of "building transit first, literally in fields, in the hope developments follow" (Kandell 1995, in Arrington 2009, p.112). There are four light-rail lines, which form part of a broader mass transit system. Future plans to develop a new light-rail station at Gresham have TOD in mind. More than half a billion dollars in new development consistent with TOD plans had occurred before the Westland LRT opened in 1998 (Arrington 2004). The Airport light rail extension opened in 2001, financed by TOD but Arrington (2004) suggested that a slow economy had frustrated the realisation of any immediate development.

3.6 Effects of light rail in Beijing, China

Zhang and Wang (2013) studied Beijing's Batong light rail transit line and found that although there is much development to the northern part, much less development has taken place to the south. The authors indicated that the Batong "alignment and station siting have limited the system's integration with the development of the surrounding area" as "passengers have to climb up and then walk down the skyway from either side of the street in order to use the system" (p.128). This, they argue, has decreased the attractiveness of the Batong service.

4. REORGANISATION OR RATIONALISATION OF PRODUCTION, DISTRIBUTION AND LAND USE

4. REORGANISATION OR RATIONALISATION OF PRODUCTION, DISTRIBUTION AND LAND USE

4.1 Introduction

Transport improvements can impact on local areas or regions by overcoming barriers to trade with other areas of economic activity (SACTRA 1999). However, better transport on its own is unlikely to stimulate economic activity. Empirical evidence suggests that areas with low levels of development lack skilled labour or development sites and not just accessibility problems (Parkinson 1981). Transit systems, including light rail, can provide a trigger to reorganise or rationalise production, distribution and land use by improving accessibility (SACTRA 1999).

Knowles (1992, p.127) noted that unlike the 19th century and early to mid 20th century, "transit impact is more related to redevelopment and intensification of existing urban land than greenfield suburbanisation".

Banister (2005, 2007) argued that "In general terms, transport has clear impacts on land use and urban form" and suggested that empirical evidence leads to the following conclusions:

- New development should be planned within a certain population threshold, and provision of local facilities and services should be organised to encourage development of local travel patterns
- Developments should be mixed-use to minimise trip lengths and dependency on cars.
- Development should be located near public transport interchanges and corridors to enable high levels of accessibility.

Banister and Thurstain-Goodwin (2011) argued that time is important when measuring changes in land and property values: first, in advance of the completion of the transport investment, as developers and property developers invest in the expectation of improvements in the transport system; second, immediately before the transport investment is opened; and third, in the future as full benefits are recognised.

Rietveld (1994) employed a theoretical framework and modelling analysis to measure the impacts of transport infrastructure on productivity changes and relocation behaviour, at both intra-urban and intra-regional levels. Each of the five models yielded different levels of infrastructural impacts on spatial development, but showed that impacts were usually small for industrialised countries. One model, the Production Function model, indicated that transport investment would lead to considerable positive impact on regional productivity.

According to the UK Government's Eddington Report (2006a,b), London transport schemes have overall played a key role in facilitating clustering and agglomeration in the city, and have added 30 percent in terms of time saving benefits.

Giuliano (1995) explored the relationship between transport investments and land use impacts, mainly using American evidence, and theorised relationships between transport, accessibility, land use and activity patterns. Giuliano's analysis was based on highway and heavy rail infrastructure but light rail is anticipated to have similar impacts. WShe concluded that (p.333):

- "Rail transit systems generate changes in accessibility only in the immediate vicinity of the rail line itself
- Construction of a rail transit system should improve accessibility along the rail line corridors and increase the relative advantage of rail corridors compared to areas that are not served by the rail system.
- Activity location should shift towards the rail corridors, and this shift should be reflect in increased land values, all other things being equal.
- The position of the CBD as the most accessible point in the area should be enhanced leading to an increase in activities and land values in the CBD."

4.2 Light rail's impacts in the UK

4.2.1 Light rail's impacts in London Docklands

The successful transformation of redundant docklands in the Isle of Dogs into Canary Wharf, a major post-industrial, mixed-use commercial office complex with supplementary retail, leisure and residential development, was enabled by the construction of, and later extensions to, the DLR and Jubilee Underground line extension (Figure 1.1) (Carter 1991; Church 1990; Knowles 2007).
The DLR enabled the relocation of businesses from the City of London into cheaper office space at Canary Wharf. For example, banks such as HSBC and Barclays, newspaper offices and printing presses, and many other relocated and newly established private sector offices (Figure 4.1).

Figure 4.1

Bank headquarters relocated to Canary Wharf, London Docklands

In terms of employment, Canary Wharf has grown to become the second largest CBD in the UK, and is effectively an extension of the City of London.

4.2.2 Light rail's impacts in Greater Manchester

The successful redevelopment of the redundant Salford Docks, at the head of the Manchester Ship Canal, into Salford Quays, a post-industrial mixed-use commercial office, retail, leisure and residential waterfront complex, was facilitated by the Metrolink Phase 2 extension that opened in 1999 (Figure 1.4). This gave direct and frequent connection with Manchester city centre 2 kilometres away, and Salford Quays in effect became an extension of Manchester's CBD. Many firms relocated to Salford Quays.

Peel Holdings more recently developed MediaCityUK as an extension to Salford Quays. MediaCityUK is a world ranking media city focused on creative and digital industries. It is a successful mixed-use development containing business, studios and production space, residential, retail, hotel, leisure and education facilities. MediacityUK was enabled by both, a new £20 million Metrolink extension and station, and by the BBC's decision to relocate, from 2010, many of its departments to Salford from its London headquarters, as well as the whole of BBC Manchester's (Oxford Road) regional base, including 800 jobs, from each site (Figure 4.2) (Binder and Knowles 2013).

Figure 4.2

The Studios and MediaCity, Salford Quays

Salford University opened a new media-focussed campus at MediaCityUK in 2011 whilst ITV relocated its base there from Manchester city centre in 2013. Many creative, digital and media production companies have also started up or relocated to MediaCityUK creating employment synergy.

4.2.3 Light rail's impacts in Newcastle

Robinson and Stokes (1987) found that Tyne and Wear Metro had a "marginal impact on land use and development" (p.18). It "has not stimulated significant economic regeneration of the inner areas of the conurbation apart from the enhancement of shopping and office activities in the prime commercial areas of Newcastle city centre" (p.16).

Davoudi et al. (1993) found that housing, retail, office, industry development and employment had been unaffected by accessibility to the Tyne and Wear Metro. No statistically significant relationships were

found between these potential economic impacts and the Metro. Analysis was based on secondary data of land use change, development competitions, house prices and employment, and primary data from a survey among property developers and agents. Developments that have taken place were linked more strongly with land availability, public policies and market demand. However, while there is no direct relationship between the Metro and economic impact, Davoudi et al. noted that the Metro was believed to have helped maintain the dominance of Newcastle CBD as a centre for retail and offices. Some competing policies, for example an Enterprise Zone, had attracted developers away from Metro station areas.

In later research, Babalik (2000) found that as part of a broader urban renewal project around the stations of Monument and Haymarket, the opening of Newcastle Metro was partially responsible for the relocation of retail and commercial activities, including the Eldon Square Shopping Centre (Figure 4.3)

Figure 4.3

Monument Metro station, Eldon Square shopping centre and 'M' logo

Pedestrian areas, environmental improvement and new development were said to have economically strengthened Newcastle's CBD. However, no improvements were noted at the St James Park Station other than the redevelopment and enlargement of Newcastle United's football stadium.

4.2.4 Light rail's impacts in Sheffield

As part of the SYS Impact Study, Lawless (1999) and Lawless and Gore (1999) argued that Supertram was relatively insignificant for explaining the operational and (re)location decisions of businesses in Sheffield. It was found, in 1993 and 1995, that only a small proportion of companies acknowledged transport-related issues to have been influential in their locational decisions (Lawless 1999). It did not help that Supertram received considerable negative publicity during its construction phase, which caused disruption to traffic and pedestrian flows in the city centre. Many city centre retailers did not perceive Supertram to be important for their future custom where "Only a small proportion of more than 300 employers considered that the SYS... would impact positively on business performance" (Dabinett et al. 1999, p.130). Many employers considered Supertram to be a waste of resources and a flawed initiative. Lawless and Gore (1999) thus concluded that there was limited support for Supertram among the business community in and around Sheffield.

However, Lawless and Gore (1999) argued that Supertram did offer potential opportunities for development, in particular where the corridor passed through the upper and lower Don valleys, city centre, and Mosborough to the southeast.

Dabinett et al. (1999), noted that in terms of land use, it is difficult to ascribe generally positive trends to transport investment in Sheffield. However, they did note that planning applications were greater along road corridors than the Supertram corridors (see Theme 2). It was claimed that "The apparent inability of the SYS substantially to encourage development is confirmed when efforts are made to disaggregate attributes of land use change" (p.129). While 29 percent of all new development occurred within 100 metres of a SYS station in the Lower Don Valley, only about 13 percent can be ascribed to SYS. In the Upper Don this figure was less than 20 percent and perhaps only 10 percent of new development can be "even generously" (Dabinett et al. p.130) ascribed to SYS.

4.2.5 Light rail's impacts in Croydon

RICS' (2004) analysis of planning applications, up to two years after the Croydon Tramlink opened and in wards adjacent to the line, revealed no significant difference in land use change or development over this period.

4.3 Light rail's impacts in the UK, Canada and the USA

Mackett and Babalik-Sutcliffe (2003) analysed the success of thirteen light rail systems across the UK, Canada and USA. A key objective shaping investment in these various LRT systems was "to improve the land-use and urban growth patterns" through:

- Stimulating development in the CBD
- Stimulating development in declining slum areas
- Improving patterns of urban growth through transformation of a car-oriented to public-transport oriented pattern (p.153).

Their results showed that:

- Vancouver Sky Train, and Rouen Tramway achieved the objective in all three areas.
- San Diego Trolley, and Portland MAX LRT were able to stimulate CBD development and improve urban patterns.
- San Jose Light Rail improved development in the CBD and declining areas
- Calgary C-train, St Louis Metrolink, Manchester Metrolink, and Tyne and Wear Metro stimulated development in the CBD
- Baltimore Light Rail improved patterns of urban growth.
- Los Angeles light rail achieved none.

4.4 Light rail's impacts in the USA

Giuliano (1995) recognized the importance of local economic and political conditions in determining whether transport investment would have an impact. Buffalo LRT was given as an example where its redevelopment effort was unsuccessful "because there was no shortage of office or retail space in the metropolitan area, and even with extensive subsidies, the downtown area could not compete with cheaper suburban locations." (p.338). Presenting a more positive outcome, Portland, Oregon, LRT was said to demonstrate how favourable public policies can promote desired development whereby "LRT provided a focus for a policy program aimed at revitalizing downtown but possibly had little to do with the outcome" (p.339).

However, Giuliano (1995, p.333) cautioned that "because rail service (in the USA) usually replaces existing bus service, its effects on accessibility can actually be slight and that the transit system accounted for a very small portion of the entire transportation network."

As private cars in the USA are overwhelmingly dominant, and public transport's modal share is tiny in most cities, the evidence provided by Impact Studies, and particularly San Francisco's heavy rail Bay Area Rapid Transit (BART), indicated that rail transit has had no systematic or significant influence on urban structure and land use in the post- World War II era.

4.5 Light rail's impacts in Copenhagen, Denmark

Knowles (2012a) found that reorganisation through relocation was a key part of the development of sites in the four districts in Copenhagen's Ørestad New Town based around six stations on Copenhagen's new light rail Metro. The Danish Broadcasting Corporation (Danmarks Radio), for example, moved 3,000 of its employees from 10 separate sites in Copenhagen's CBD to a new site in Ørestad North, between 2005 and 2007, creating DR Byen, a world ranking Media City (Figure 4.4).

Figure 4.4

Copenhagen Metro and DR Byen (Media City)

Similarly, Copenhagen University relocated part of its activities from various sites in Copenhagen CBD. Ferring, a Swedish pharmaceutical company,

relocated in 2002 from three sites in Malmö (Sweden), Kiel (Germany) and Copenhagen to a new site in Ørestad City next to a light rail Metro station, a rail station on the Copenhagen to Malmö heavy rail line and the trans-Øresund motorway. Rambøll, an international engineering, design and consultancy company, relocated its headquarters and Danish operations in 2010 from Copenhagen CBD (400 employees) and Virum in north Copenhagen (1,200 employees) to a site in Ørestad South next to a metro station, heavy rail station and facing Ferring across the Øresund motorway (Figure 4.5).

Figure 4.5

Ferring Pharmaceuticals relocated to Ørestad New Town, Copenhagen

4.6 Light rail's impacts in France

4.6.1 Light rail's impacts in Strasbourg

The first line of the Strasbourg Tramway commenced operation in 1994. Between 1994 and 2004, property rates increased in the city centre and influenced the type of shops occupying central premises. Hass-Klau et al. (2004) noted that small businesses and traditional shops were generally priced out of the city centre and replaced by larger chain stores. In addition, when Tramway Line B opened in 2000, more high-quality shops moved into the CBD. Egis Semaly Ltd and Faber Maunsel (2004), similarly noted that since the tram system opened in 1994, growth in retail services had been the major change in land use.

4.6.2 Light rail's impacts in Grenoble

Since the Grenoble light rail scheme opened in 1987, the main land use change has been the amount of service-based activity locating in tram corridors. Egis Semaly Ltd and Faber Maunsel (2004), noted that property prices and quantity of properties rose as soon as construction began, but that effects diminished after 3 to 4 years.

4.6.3 Light rail's impacts in Nantes

Docherty (2004, p.6), concluded that in Nantes, "Policy makers in the city regard the transformation of Nantes city centre as having hinged on land use and behavioural changes brought about by the tramway. In particular, they point to the fact the [sic] for every new trip by tram created, an additional unrelated trip on foot is made, which is seen to explain the renewed vitality and retailing and other key city centre activities" (SDG 2005b, p.38).

4.7 Light rail's impacts in Germany

4.7.1 Light rail's impacts in Freiburg

Hass-Klau et al. (2004) were informed during interviews with city stakeholders that the cost of commercial land for development was expensive along the light rail line. They also noted that "differences are striking between commercial centres like Haid, which is located at the end station of Line 5 and other commercial centres without light rail access" (p.120). Linked to this, office rents with direct tram access were nearly 40 percent higher than those without.

4.7.2 Light rail's impacts in Hannover

In Hannover, interviews revealed that there was no demand for office properties without light rail access (Hass-Klau et al. 2004). Hass-Klau et al. (2004) reported differential effects on large and small shops, and between those stocking high quality and low quality goods. Retail turnover generally increased in city centre locations but with impacts on the pattern of shops and the goods being sold.

4.8 Light rail's impacts in Manila, Philippines

Pacheco-Raguz (2010) assessed the impacts of light rail transit in Manila and found that in terms of accessibility and distance, there was no correlation with changes in commercial or residential land use. One explanation was that the city was completely built up when Light Rail Transit Line 1 was implemented, diminishing the opportunities for land development and thus lowering the potential impacts of this investment on land use. Observed changes were only weakly related to light rail.

5. TRIGGERING FRESH GROWTH THROUGH ELIMINATION OF SIGNIFICANT TRANSPORT CONSTRAINTS

5. TRIGGERING FRESH GROWTH THROUGH ELIMINATION OF SIGNIFICANT TRANSPORT CONSTRAINTS

5.1 Introduction

SACTRA (1999 p.35) reported that the "absence of a well developed transport system acts as a serious constraint on growth" (p.35) and some places have been unable to achieve their full potential through lack of an effective transport network. The UK Government's Eddington Report (2006a,b) claimed that 89 percent of transport delays are caused by congestion in urban areas, while Shaw and Docherty (2014) noted that congestion represents a cost to the UK economy of between £7 billion and £30 billion per year, depending on which source one uses. Rail unreliability alone is said to cost businesses at least £400 million per year (Eddington 2006a,b). Thus, network delays and unreliable services are costly for people and businesses, and impact significantly in terms of productivity costs and innovation.

While new transport connections have contributed to economic growth in many places (see Theme 3), the Eddington Report (2006a,b) claimed that in developed countries such as the UK, where well-connected transport networks already exist, economic growth is more likely to be stimulated by alleviating transport constraints, such as congestion and unreliability, than by investing in new connections (see also Banister and Berechman 2001).

"On this basis, the strategic economic priorities for long-term transport policy should be growing and congested urban areas and their catchments; and the key inter-urban corridors and the key international gateways that are showing signs of increasing congestion and unreliability" claimed the Eddington Report (2006b, p.6): "These are the places where transport constraints have significant potential to hold back economic growth" (p.6).

In general, transport constraints can be alleviated by increasing network capacity and improving efficiency, as well as providing new connections and improving accessibility (SACTRA 1999; Banister and Berechman 2001; Eddington 2006a,b). Eliminating such constraints enables reduced journey times that might translate into improved productivity, enhanced opportunities for consumption, competitiveness and further growth. For example, Banister and Berechman (2001) argued that to compete internationally, efficient transport infrastructure is essential in terms of providing high accessibility to new global markets.

Accessibility refers to the ease of movement between places, and is thus related to transport constraints. The structure and capacity of the transport network can affect accessibility levels within a given area (Giuliano 1995). For example, changes to accessibility as a result of transport infrastructure investments can enable redistribution of employment as access is opened to opportunities located in other places. Similarly, businesses can gain access to wider markets, availability of skilled labour and other necessary support in infrastructures, such as intermodal transport networks (Banister and Berechman 2001). It is less clear as to what extent changes in accessibility create fresh growth, particularly in developed countries where levels of road and rail transport networks already tend to be high. For example, it has been noted that changes in accessibility may be expected to have a growth impact, particularly in the case of sparse networks, poorly constructed networks, critical interchanges, bottlenecks and bypasses, or complementary infrastructure (Banister and Berechman 2000; 2001). On the other hand, Banister and Berechman (2001) stressed that in such countries, accessibility improvements tend to enhance existing trends rather than create new ones.

Geography matters too, for "transport infrastructure investments are location specific and have potential growth effects on local economies" (Banister and Berechman 2001, p.212), and while investment in transport infrastructure in one location may be beneficial to that particular area, this can sometimes lead to negative impacts in competing locations. Results analysed at the local level may show these differences, but within the metropolitan areas more broadly, the effect may be marginal. Thus, transport developments are said to impact the whole system in only a marginal way. The exception to this trend is where major investment opens up a previously inaccessible location, which may trigger major relocation and economic development (see Theme 3). It is important to identify such thresholds if accessibility changes are to be beneficial to improve relational positions of regions by increasing inwards investment and employment (Banister and Berechman 2001).

5.2 Eliminating transport constraints with light rail

Turton and Knowles (1998) argued that city centres have become less accessible, in particular, due to road congestion and parking difficulties. Traffic congestion is a capacity issue where transport systems become overloaded, for example at peak times. Light rail, as an example of rapid rail transport, is one means by which some places have addressed urban congestion through providing an alternative transport mode to cars and buses (Turton and Knowles 1998). Seven light rail systems across the UK, Canada and USA, Babalik (2000) found that six (in Manchester, Sheffield, Vancouver, St Louis, San Diego and Sacramento) were developed with an objective to relieve car traffic, alongside goals for economic growth (see also Mackett and Edwards 1998).

5.3 Triggering fresh growth in the UK

Summarising overall findings from the UK, SDG (2005a) indicated that alleviating transport constraints has generated benefits for businesses in terms of widening customer, employee and resident catchment areas through better access provision. It was also found that businesses were more confident about making decisions given the obvious commitment to improved public transport.

Light rail offer a permanent and visible transport link which has been perceived as reliable and dependable in contrast to bus services, for example (SDG 2005a; see also Bråthen 2001), and tram schemes bring a 'buzz' to areas that has inspired increased development activity (SDG 2005a).

5.3.1 Triggering fresh growth in Greater Manchester

Babalik (2000) highlighted how Metrolink improved accessibility and service frequency and led to an increase in the number of people travelling to Manchester's city centre. Metrolink accessibility played a role, alongside the redevelopment activities of the Central Manchester Development Corporation, in reinforcing the recovery of central and southern areas of the CBD (Law et al. 1996). Babalik (2000), for example, referred to a reported increase in business, retail and leisure activities in these areas.

Metrolink also stimulated fresh growth and regeneration in the area of Salford Quays, through major office development, housing and an increasing range of retail, entertainment, leisure and cultural facilities, such as the Lowry Centre and Imperial War Museum North (see Figure 5.1) (SDG 2005a). The Metrolink extension to Eccles, through Salford Quays, was part of a larger redevelopment package, and it is difficult to isolate the impacts of Metolink from other factors. For example, SDG (2005a) reported that the proximity of Metrolink to a new business park at Quays Reach proved a selling point for the developers.

Figure 5.1

Lowry theatres and art gallery, Salford Quays

A key development at Salford Quays is MediaCityUK, where the BBC became the anchor tenant attracting other media organisations. Its central location within the MediaCityUK complex is also expertly situated in relation to transport accessibility. As Eady (2014, p.26) explained, "The Metrolink Development Manager expressed how the Metrolink extension to the site was specifically designed to arrive "on the BBC's front doorstep"".

"Beyond the immediate Quays area, the provision of Metrolink has also attracted new development along the Eccles New Road corridor. Salford City Council believes that Metrolink has made the corridor a more attractive place for residential and commercial development. The proximity of Metrolink to a new business park at Quays Reach has proved a selling point for the developers. Quays Reach consists of two business village blocks of 100,000 sq feet, over half of which was already taken by tenants by the beginning of 2004. Once complete, the site will accommodate 800 jobs." (SDG 2005a, p.53)

5.3.2 Triggering fresh growth in Sheffield

SDG (2005a) reported that development opportunities that could have been stimulated by Supertram were not fully exploited. Elsewhere, there is little empirical evidence of fresh growth stimulated in Sheffield by Supertram (Babalik 2000; Crocker et al. 2000). Babalik even suggests that Supertram may have had a negative impact on the CBD by taking people away from city centre to Meadowhall, the out-of-town shopping centre, situated at the end of the tram line.

Lawless and Gore (1999) found that for many businesses in Sheffield, access to private transport infrastructure, such as motorways, was of greater importance than access to public transport. In this way, Supertram has been limited in its ability to alleviate transport constraints.

5.3.3 Triggering fresh growth in Croydon

Siraut (2004) noted that "Major developments are now taking Tramlink into account and high profile office based employers have recently moved in, quoting high accessibility as a key factor in their choice" (p.880).
Anecdotal evidence in RICS (2004) reported similar results of accessibility improvements for passengers and highlighted two other positive impacts:

- A rise in turnover in central Croydon as a result of a widened catchment area
- A boost to industrial business by enabling employees to reach industrial area estates more easily

These effects might thus raise productivity levels and offer a stronger sense of stability for businesses. In turn, these have perhaps contributed to the sense of slowed or halted decline that RICS reported in the area.

5.3.4 Triggering fresh growth in London Docklands

Regeneration of the London Docklands, for example the Canary Wharf development, is strongly related to opening up of the area, initially with the construction of the DLR (see Theme 3). Dickens (1992) argued that the DLR further enabled growth by releasing latent demand in the London Docklands, which had been held back by congestion.

Carter (1991) described transport as one of the more pressing issue in the London Docklands, not least in terms of rising passenger demands. 1982 passenger forecasts estimated that 11,500 passengers per day would be using the DLR, but within months of opening, twice this number used the service. In the 1990s, DLR carried 33,000 passengers per day, 12,000 more than forecasts had estimated (Carter 1991, p.68). Grant (1990) also acknowledged how forecasts continued to be exceeded through increases in traffic volumes and claimed that "the pressure on the transport-network within Docklands must also be seen against a background of a substantial increase in traffic on both the road and public transport links in East and South-East London, constraining the capacity available for movements to and from Docklands" (p.5). SDG (2005a) noted that as levels of employment have risen, "providing sufficient capacity and accessibility for people to fill the new jobs became critical. There will be about 70,000 employees at Canary Wharf by the beginning of 2005 and about 88% of them will travel to work on public transport" (pp.51-52). However, "development of this scale would never have been achievable or sustainable without the access provided by the DLR" (SDG 2005a, p.52). Subsequently, the DLR has been systematically upgraded and expanded to cope with passenger flows (see Figure 1.1).

SDG (2005b) reported continued growth in passenger numbers, particularly at peak periods and at stations on the Lewisham extension. "Other stations with significant growth have been Canary Wharf, Canning Town and Limehouse, driven either

by continuing development at Canary Wharf and elsewhere on the Isle of Dogs or the introduction of the Jubilee [Underground] Line" (p.12).

5.3.5 Triggering fresh growth in the West Midlands

cebr (2008b) suggested that proposed impacts from the Midland Metro City Centre Extension, would generate a boost in business-to-business spending, as a result of accessibility and productivity improvements.

5.3.6 Triggering fresh growth in Nottingham

SDG (2005a, pp.64-65) claimed that "Even before NET opened, there were discernable regeneration impacts in the city. During 2003 six months before the scheme was due to open, local agents were reporting an upturn in the market specifically in those areas through which the tram now runs. This not only applied to the city centre, which witnessed a lot of activity and very buoyant prices for sites at Commerce Square, Plumptree Street and Fletchergate, but also in Hucknall, where "first time buyers who might have opted for the leafy suburbs are wondering why they should pay £140,000 to live somewhere without the tram when they could pay £100,000 and live on a tram stop"".

5.4 Triggering fresh growth in Nantes, France

Economic impact in Nantes has been concentrated in the city centre. Beyond this there is less potential for further development, although the line is significant in providing access to the university and schools (Hass-Klau et al. 2004).

Egis Semaly Ltd and Faber Maunsel (2004) suggested that LRT has had a standardised effect on commercial and residential development with 25 percent of the city's new office development and 25 percent of the city's residential development taking place within light rail corridors, since 1985.

5.5 Triggering fresh growth in Copenhagen, Denmark

Mass transport investment in central parts of Copenhagen has increased the city's accessibility and triggered fresh growth through widening the commuter catchment area; 19,380 commuters a day travelled into Copenhagen from Malmö, southern Sweden, 55 percent of them by heavy rail (Knowles 2012a). In addition, the development of Ørestad New Town, on reclaimed land, has enabled Copenhagen to expand its CBD through fresh growth and relocations, thereby helping to improve the city's international competitiveness. Ørestad New Town and transport infrastructure have supported the growth of highly accessible sites for office, media, retail and leisure activities (Knowles 2012a).

6. LAND AND PROPERTY VALUE INCREASE AND CAPTURE

6. LAND AND PROPERTY VALUE INCREASE AND CAPTURE

6.1 Transport investment and land and property value increase

Transport is an enabling technology (Knowles 2006). Investment in urban rail and road transport systems increases the accessibility of land around light and heavy railway stations and new road junctions and this usually increases the value of land and of commercial and residential property at these locations. Berry et al. (1963) acknowledged that land values are higher in city centres and along major transport corridors and have local peaks of higher value at intersections. Hansen (1959) perceived land being developed and allocated to different uses as a function of that land's accessibility. Light and heavy rail transit has the potential to increase land and property values and create valuable development opportunities (Figure 6.1). Value capture harnesses part of that value increase to fund transit infrastructure or station area improvements. Light rail systems have frequently, but not always, increased land values.

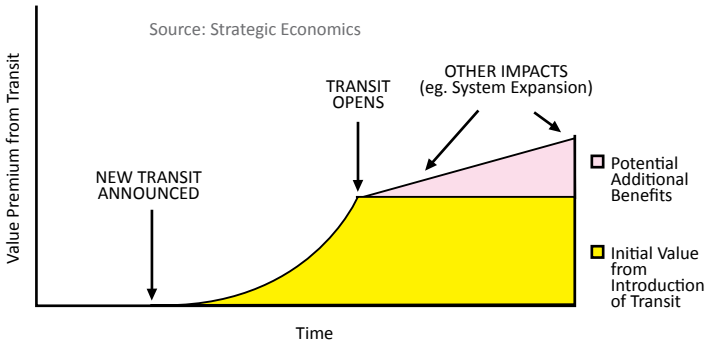


Figure 6.1

The value premium of rail transit

Mohammad et al. (2013) reviewed research into impacts of light rail on property values in cities in the USA, UK and South Korea (Table 6.1). For residential property, eight studies showed an increase in selling price, one negative and three a range from negative to positive values. Commercial properties experienced a greater increase in their rental values than residential properties in their purchase price. Office rents mostly rose whilst retail and commercial property values increased sharply. In addition, "the value change of land due to rail investments appears to be generally higher than property value changes." and "land and property values vary spatially due to certain characteristics of properties, neighbourhood, accessibility, etc." (p.161). The impact of light rail on land and property value changes range from negative to positive, whereas commuter rail seems to enhance values at a greater rate.

Author & Year	Type	Measure	Location	% change
Al-Mosaind et al. 1993	Residential	Purchase	Portland USA	10.6
Chen et al. 1997	Residential	Purchase	Portland USA	10.5
Dueker & Bianco 1999	Residential	Purchase	Portland USA	6.5
Weinstein & Clower 1999	Residential	Purchase	Dallas USA	-5.2 & 7.7
Clower & Weinstein 2002	Residential	Purchase	Dallas USA	7.2 & 18.2
Bae et al. 2003	Residential	Purchase	Seoul, S. Korea	0.13 to 2.6
Cervero 2003	Residential	Purchase	*San Diego USA	-12 to 46
Du & Mulley 2007	Residential	Purchase	Tyne & Wear UK	-42 to 50
Duncan 2008	Residential	Purchase	San Diego USA	5.7 & 16.6
Bollinger et al. 1998	Office	Rent	Atlanta USA	-7
Weinstein & Clower 1999	Office	n.k.	Dallas USA	10.1 & 22.7
Weinberger 2001	Office	Rent	Santa Clara USA	7 to 10
Weinstein & Clower 1999	Retail	Purchase	Dallas USA	4.6 & 29.7
Cervero & Duncan 2002	Commercial	Purchase	Santa Clara USA	23
Cervero 2003	Commercial	n.k.	*San Diego USA	71.9 to 90

Key: * light & heavy rail;
n.k. – not known

Table 6.1

Impacts of light rail projects on property values

Mohammad et al. (2013) identified a range of contextual internal and economic factors, and external factors, including location, transport schemes and surrounding amenities, that affected land and property value. They also identified methodological factors affecting land and property value including type of data, model type and analysis method.

Debrezion et al. (2007), based on systematic analysis of 57 studies in the United States of America, presented the impact of railway (commuter, heavy and light) and bus stations on residential and commercial property values. While individual results cannot be identified for light rail, the findings indicated that commercial processes increase 0.1 percent every 250 metres closer to a station. The highest price increases were measured closest to commuter rail stations.

6.2 Land value increase in the UK

6.2.1 Land value increase in London Docklands

In the London Docklands, land values in the Isle of Dogs rose from £70,000 an acre in 1981, in what was then a disused and abandoned Port of London docks, to £4.9 million per acre in 1988 (Knowles 1992). DLR was designed to facilitate the transformation of London Docklands into a post-industrial financial, office, shop, hotel, leisure and housing development. When construction began in 1984, land rose in value from £300,000 to £2million per acre.

6.2.2 Land value increase in Salford Quays

The building of the Metrolink extension in the late 1990s from Manchester city centre to the Salford Quays waterfront redevelopment complex of offices, housing, shops and leisure facilities, was partly financed by a developer land contribution. SDG (2005a) stated that in Salford Quays "land values are now expected to be in the order of £500,000 per acre" (p.53).

6.3 Land value increase in Bremen, Germany

Hass-Klau et al. (2004) explained that in Bremen, tram access largely determines land values. The most expensive commercial areas, based on average land prices, are those at either end of Tram Line 6,which was constructed to serve and strengthen the economic potential of the university and airport. In addition, sites located on a tram line, with the exception of one, have roughly 50 percent higher land prices than those with bus but no light rail access, or no public transport access at all. Land available for office and commercial use belongs to the city of Bremen and is sold to investors.

6.4 Land value increase in the USA

6.4.1 Land value increase in Phoenix, Arizona

Kittrell (2012) reported the impact on vacant land values around light rail station areas in Phoenix, Arizona. Sales values for vacant land more than doubled for the first three years after the station areas were announced (1998-2000/1), before returning to normal levels. Kittrell suggested that this may have marked a land-assembly phase and stimulated long-term redevelopment.

6.4.2 Land value increase in San Jose, Santa Clara County, California

Weinberger (2001) focused on San Jose in Santa Clara County, California to explore the impact of light rail on 3,400 commercial lease transactions between 1984 and 2000. Drawing from 4,600 observations, it was found that rents within 400 metres of the light rail stations were 13 percent higher than those more than 1,200 metres away. The presence of LRT confers a premium on office properties within its service area.

Cervero and Duncan (2001) examined capitalisation benefits of land values in proximity to LRT and revealed that commercial land immediately adjacent to stations tended to be worth more per square foot than elsewhere. However, beyond roughly 400 metres of LRT, which is considered an acceptable walking distance, there was no appreciable benefit. "A policy implication of this is that the benefits of transit-oriented development in settings like Santa Clara County are likely to occur through densification, in-fill, and re-fill of sites fairly close to a rail stations [sic]" (p.16) (see Theme 8). Non-residential land parcels in the heart of the CBD, within 400 metres of the Santa Clara LRT station, were measured on average $19 more per square foot than those near to other stations, thus emphasising the capitalisation benefits within the central downtown area. Cervero and Duncan (2001) concluded that "placing significant shares of future commercial development within walking distance of stations can yield significant benefits, as revealed by land-value premiums" (p.16). Land value of parcels within 400 metres walking distance of an LRT station were on average over $4 higher (23 percent) in relation to mean area size of sampled commercial parcels. Comparing these figures with land values near commuter rail found that the capitalisation benefits of being near LRT were smaller.

6.4.3 Land value increase in San Diego, California

Land values changed with the construction of San Diego's light rail (Trolley) system, but varied depending on the type of land use and rail corridors (Cervero and Duncan 2002a). Premiums of 91 percent were accrued near downtown Coaster stations and 72 percent for land parcels near Mission Valley Trolley stations. Small premiums of 4 percent accrued to offices and retail establishments near downtown Trolley stations, and negative premiums along the South Line (-9 percent) and East Line Trolley stops (-10 percent). The most substantial bonuses were linked to land developed with offices, retail shops, restaurants and other commercial uses, which were located near rail stations in major business-retail settings. It was also noted that commercial values tended to be higher in higher-income and predominantly white neighbourhoods. Cervero noted the importance of understanding land-market impacts for measuring benefits of LRT, providing evidence for developing financial arrangements as part of public-private development deals, and to help in creation of new infrastructure finance such as value capture.

6.5 Mechanisms for capturing land value increase

Medda (2012) positioned accessibility at the centre of the relationship with land value capture as the key element that may induce land value increases. Other important factors to the successful implementation of land value capture mechanisms, included the context of urban area and transport mode, and the economic relationship between the life cycle of the transport system, its profitability and the property market. Although land values often increase as a result of light or heavy rail development, it is difficult to capture that gain to help fund the transport investment or invest in public realm or other public benefits, especially if the land is privately owned. The added accessibility value of developments as transit nodes can in theory be captured through developer contributions (Knowles 1992).

Cervero (2010) focused on Hong Kong and Tokyo as examples where private railway companies have exploited land value gains from improved accessibility of proposed and constructed rail transit infrastructure. Relying also on property development to generate profits, Hong Kong and Tokyo are offered as excellent examples of successful land value capture. Cervero and Murakami (2009) examined how the MTR Corporation's (MTRC) 'Rail + Property' (R+P) development programme in Hong Kong has enabled the possibility of financing railway infrastructure by pursuing transit value capital. For example, net yields from R+P project income along the Airport Express Line (heavy rail) were used to finance the Tseung Kwan O extension. MTRC purchases land grants with exclusive development rights from the Hong Kong SAR Government at a 'before rail' price and sells the rights on to developers at an 'after rail' price. Cervero and Murakami concluded that "differences between land values 'with' versus 'without' rail services are often substantial, easily covering the cost of railway investments" (p.2024). MTRC also receives a share of property development profits from this land. Between 2001 and 2005, property development provided 52 percent of MTRC's revenue, with rail fares just 28 percent. With majority ownership of MTRC, the Hong Kong Government received nearly $140 billion in net financial returns between 1980 and 2005, based upon earned income of $171.8 billion from land premiums, market capitalisation, shareholder cash dividends and initial public offer proceeds less the value of $32.2 billion injected equity capital. The estimated $140 billion return was said to be "direct financial benefit" from the R+P programme (p.2025).

6.6 Developer contributions to light rail systems in the UK

6.6.1 Developer contributions: London Docklands Light Railway

Although the Government funded the original £77 million, 12.1 kilometre long DLR system, developer contributions were important in financing later extensions. In London Docklands, Canary Wharf developers Olympia and York made a £25 million contribution towards the cost of Canary Wharf station and a £68 million contribution to the £160 million DLR extension to Bank to connect with the London Underground network and the City of London (Carter 1991). Developers later contributed £400 million to the cost of the heavy rail Jubilee Line underground extension to Canary Wharf (Knowles 2000). The £240 million DLR extension to Beckton was financed by borrowing and by selling adjacent land belonging to the LDDC (Carter 1991).

6.6.2 Developer contributions: Greater Manchester Metrolink

Greater Manchester Metrolink's Phase 2 extension in the late 1990s on a new route to Salford Quays, the former Salford Docks located at the head of the Manchester Ship Canal, received a substantial developer land contribution valued at about £10 million, around 7 percent out of the total cost of land acquisition, development and construction costs for this light rail line (Knowles 1999). Value may also be captured through the anticipation of future operating costs or future construction costs. Knowles (1992) explained how the GMA Group, the successful tenderers for the buildings and operation of Metrolink Phase 1, from Altrincham to Bury through Manchester city centre, were set to invest £5 million into the scheme as private constructors and operators.

6.7 Developer contributions: Copenhagen Metro's Ørestad Line

Copenhagen's Ørestad New Town is built on reclaimed land on the island of Amager on development sites surrounding six stations on a new light rail Metro line. The land was reclaimed from the sea in the early 20th century and is owned 55 percent by Copenhagen City Council and 45 percent by the Danish Government.

The construction costs for the Ørestad Metro were partly covered by land value capture through land sales to private sector developers for office, shopping centre and housing developments, and to public institutions including the Danish Broadcasting Company (Danmarks Radio), the University of Copenhagen and new schools (Knowles 2012a). The successful development of Ørestad New Town relies heavily on Copenhagen's light rail Metro to provide accessibility between Copenhagen's CBD and Ørestad's development sites.

6.8 Other land value capture mechanisms

Medda (2012) identified and analysed three main land value capture financing mechanisms, which have been used to recover capital costs of transport investment:

- Betterment tax
- Accessibility increment contribution
- Joint development

6.8.1 Betterment Tax

Roukouni and Medda (2012) evaluated the effectiveness of the Business Rate Supplement (BRS) as a mechanism to capture value accrued from the development of London's Crossrail (heavy rail) and fund construction costs amounting to £4.1 billion. While the authors argued that BRS has been financially viable, they suggested two problems:

- Inequity of a flat tax rate applied to properties both nearer to, and further away from the Crossrail route, and thus properties which will benefit differently
- Future property value growth rates were based on optimistic assumptions.

A Business Improvement District (BID) is a tax based approach designed to develop or redevelop urban areas, and an additional tax is levied on all properties and businesses in a specified area (Medda 2012). In 2008 there were 7,000 BIDs in the USA, and this policy has also been adopted in Germany, Canada, New Zealand, South Africa and the UK.

6.8.2 Accessibility Increment Contribution

Public improvement expenditures can induce growth in urban areas with low accessibility. Private sector investors are encouraged to invest in specified areas to finance development and provide financial gain. Tax Increment Finance (TIF) is a popular private-public financing tool used in urban redevelopment projects and transport investments (Medda 2012). There were 291 TIF districts in 51 US cities in 2007 but their outcomes are mixed. For example, 130 TIF districts cover 30 percent of Chicago and in Arlington Heights property values have risen sevenfold. However, if TIF Captures 40 percent of the tax base, these districts will have a lower tax base and therefore a higher tax rate compared with non-TIF districts.

6.8.3 Joint Public/Private development

Joint development between the public sector councils or government, light or heavy rail companies and private sector property development companies can provide opportunities to exploit value capture. Cervero et al. (2004), quoted in Medda (2012, p.158), noted that "joint development at transit stations includes air-rights development, ground-lease arrangements, station interface or connection fee programmes and other initiatives that promote real-estate development at or near transit stations for the mutual benefit of public and private interests."

Mathur and Smith (2013), explored the value capture mechanism of joint development, between public and private entities, to determine its ability to generate revenue for transit, and drew on five US heavy rail examples. Findings revealed that geography matters, most noticeably through real estate market conditions.

Priemus and Konings (2001) concluded that "The involvement of the Japanese railway companies (heavy and high speed) in real estate development has resulted in substantial additional income" (p.194) and the railway companies benefit from land value increases around the line: "With land they already owned they achieved large profits from real estate development" (p.194). Along the Tokaido (high speed) line, near Tokyo, commercial land parcels within 50 metres of stations increased by 57 percent. "Nowadays the railway companies cooperate with the real estate developers, who provide cheap land for the construction of rail lines, partly finance the investments and pay over a part of the increase in land values to the railway company" (p.194).

6.8.4 Sale of Air-Rights

TRCP (2004) noted that DART had been able to lease and sell surplus property, such as underused parking space, for affordable housing and other ventures. "At the Arena Station, currently under construction, DART sold its air rights, (starting at 26 feet above grade) for 55% of the land value" (p.300). Surplus parking was also being sold to an affordable-housing developer at the 8th and Corinth Station and "In other cases, DART has proactively acquired surplus property to one day be exchanged for station-area infrastructure (and good transit-oriented development)" (p.301).

6.9 Property value changes

Bid-rent theory has been used to help explain the impact of accessibility on land/property value. Bid-rent assumes that the price a consumer is willing to pay for a particular land/property decreases with increasing distance to a certain attraction, such as the CBD (O'Sullivan 2003, in Mohammad et al. 2013, p.161). Thus, a zone that is perceived to have added benefits to residents, commuters or users of an area can have an effect on land and property values around that attraction. Access to transport services can impact on property values surrounding them.

Duncan (2008) examined factors affecting changes in value of residential property including property type and railway type. Mohammad et al. (2013) noted that although their analysis of 23 studies reveals a majority positive effect on land and property value changes, estimates vary considerably between positive and negative values, and some reveal very little impact. On average, "rail schemes tend to have economic benefit on land and property values" but there is "a large variation in estimates across case studies." (p.161). Some of this variation can be explained by the use of different models used to analyse data. "Overall, the changes seem to be specific to the study area and no particular pattern may be found" (p.161). The particular studies examined revealed that the impact on land/property values was found to be higher in East Asian and European cities than in North American cities.

Ibeas et al. (2012) argued that research on the impact of transport infrastructure on real estate prices can be split into two key aspects: first, in terms of theorising the trade-offs in choice of location "mainly between the transport costs of getting to the CBD and the cost of the space, which can be modelled using bid-rent functions." (p.371); second, in terms of empirical work exploring relationships between transport and real estate values, often using hedonic regression analysis.

Ryan (1999) presented explanations for the inconsistency in results examining the relationships between rail transit and property values. She focused on the different methodologies used, for example whether travel time or travel distance was used as a measure of accessibility. Ryan argued that "Light rail transit should have less effect on property values than heavy rail because light rail systems have lower average speeds and capacities" (p.422) and therefore time saving will be less than for heavy rail.

Hess and Almeida (2007) argued that the published evidence of the impact of transit proximity on property values appears inconsistent and is based on relatively weak evidence, which may be due to the complexity of city development and unpredictable travel patterns. They also noted that studies employ different research methods, thus making results difficult to generalise. However, Hess and Almeida noted that "There is general agreement amongst most researchers that property near heavy rail accrues greater benefits than property near light rail, owing to faster speeds, frequent trains and greater geographical coverage of heavy rail. Studies of the effect of proximity to commuter rail have shown that property near commuter rail stations can have higher premiums than light rail or heavy

rail, especially when a commuter rail station is at the centre of, or within easy walking distance of, a commercial core or main street" (p.1043).

Diaz (1999) argued that "[heavy] rail transit investments have proven positive effects on property values" (p.7), first, through convenience of access, and second through enhancing the attractiveness of a property. Diaz found that "Property value premiums due to increase in accessibility range between 3% and 40%" (p.8). Property values can be impacted negatively by noise and visual intrusion. Diaz argued that transit agencies and joint development initiatives can help to implement a number of strategies to improve property values when planning rail lines, through increasing the effect of improved accessibility, for example pedestrian accessibility to station areas, and enhancing the environment to make the attractiveness of properties more apparent.

Bartholomew and Ewin (2011) reviewed hedonic price effects on properties in relation to rail transit and found that "amenity-based elements of transit-designed development play an important role in urban land markets, in addition to the accessibility benefits provided by transit" (p.30). They therefore argued "the benefits of transit accessibility and TOD-based design are linked synergistically and may be, to a degree, mutually dependent" (p.30). They concluded that planners, transit agencies and other organisations involved in urban design and transport development should pay closer attention to non-transit elements of land developments close to transit facilities.

Hass-Klau et al. (2004, p2) reported changes in property prices or rent at light rail stations in the UK, France and Germany, with variations ranging from increases of 20 percent down to no change (Table 6.2).

City	Residential property price differential in neighbourhood of public transport improvement
Newcastle upon Tyne (house prices)	+20%
Greater Manchester	+10%
Portland (house prices)	+10%
Portland Gresham (rent)	>5%
Strasbourg (rent)	+7%
Rouen (rent and houses)	+10%
Hannover (rent)	+5%
Freiburg LRT stops (rent)	+3%
Montpellier (property)	expensive housing, but no figure known
Orléans (apartment)	none - at the beginning negative because of noise
Nantes	small increase
Saarbrücken	none - at the beginning negative because of noise

Table 6.2

Change in property prices or rent at light rail stations.

6.10 House price changes in the UK

6.10.1 House price changes in Tyne and Wear

The first Impact Study on the Tyne and Wear Metro revealed a rise in house prices close to two of the metro lines, but a fall in prices for the other two metro lines (Hass-Klau et al, 2004). Davoudi et al. (1993), however, found no statistical evidence of land value uplift that could be attributed to the Metro.

Hass-Klau et al. (2004) reported that, in the previous 3 to 4 years, estate agents had used proximity of property to public transport to sell or rent properties outside of Newcastle centre, for example in Jesmond and Gosforth. "Two separate estate agents suggested a price differential of about 20% between properties with and without good Metro access" (p.140).

Du and Mulley (2007) analysed the effect of Tyne and Wear light rail Metro on house prices and found large variations ranging from -42% to +50% depending on location. In the vicinity of the Sunderland Metro extension's stations they did not find positive changes in property prices. The scope of the study only allowed for short-term impacts to be seen and the authors acknowledged that a longer period might be necessary before the effects of improved accessibility are reflected in residential property values. However, the authors also reported that land use impact in Sunderland might be smaller than observed elsewhere due to a lack of favourable economic, social and physical conditions.

6.10.2 House price changes in Greater Manchester

Forrest et al. (1996), as part of the Metrolink Impact Study (Law et al. 1996), used hedonic regression analysis to estimate the impact of Metrolink on house prices. Using a Nationwide Building Society database of all house sales in Greater Manchester, 'Before' Metrolink prices in 1990 were compared with 1992/1993 'After' Metrolink prices. They found no immediate impact of Metrolink on the housing market in Greater Manchester, where prices remained "extraordinarily stable" (p.26) after a period of economic recession. Placing this result in context, Forrest et al. acknowledged that Metrolink was constructed on a brownfield site, thus offering a revised rather than new facility, which might account for lack of uprising in property values. In addition, the fares for Metrolink were notably higher than for other rail services and it is noted that user benefits might have been captured by the (private) operator, thus accounting for there being no impact on the housing market. Housing markets can take a longer time period to adjust to transport improvements. Ovenell (2007, in Senior 2009, p.191), using a Nationwide Building Society database of all house sales in Greater Manchester in 2004-2005, identified "a positive price effect of Metrolink averaging £19058 for houses located 0.5-1 km away from Metrolink stations".

Hass-Klau et al. (2004) found that house prices along the Altrincham line in Manchester were higher. Estate agents suggested increases of 10 percent and also that good access was linked to quick sales.

6.10.3 House price changes in Sheffield

Crocker et al. (2000, p.18) found that Supertram "has had a measurable impact on house prices in Sheffield. The prices of houses close to it fell about 7% relative to prices elsewhere between 1988 and 1993. Concerns about the disruptive effect of the construction of the tram system were a likely cause of this fall. By 1996, two years after the Supertram system opened, prices of houses near SYS were the same... as those elsewhere. This relative shift in house prices - a recovery in prices for those houses near SYS - may simply represent the re-establishment of previous differentials. However, if it continues, then the system's long term effect may prove positive".

6.10.4 House price changes in Nottingham

"During 2003 six months before the scheme was due to open, local agents were reporting an upturn in the market specifically in those areas through which the tram now runs. This not only applied to the city centre, which witnessed a lot of activity and very buoyant prices for sites at Commerce Square, Plumptree Street and Fletchergate, but also in Hucknall, where "first time buyers who might have opted for the leafy suburbs are wondering why they should pay £140,000 to live somewhere without the tram when they could pay £100,000 and live on a tram stop"" (SGD 2005a, pp.64-65)

6.10.5 House price and land value changes in London

Du and Mulley (2007) found that "The increase in house prices in London as a result of new rail transit has been dramatic. In relation to Croydon Tramlink, Colin Buchanan and Partners (2003) found that "Economically, the tram has a positive impact on residential property. Areas served by Tramlink saw a rise in property prices and, since Tramlink opened, property prices in Croydon have risen by 4% more than in areas not served by the tram" (p.6).

Riley (2001), a south London property developer, estimated that land values around the stations of the heavy rail Jubilee Line extension had increased by £13 billion when the cost of the extension itself was only £3.5 billion. These positive results were confirmed, in more modest terms, by a study on the impact of the London Jubilee Line Extension which found positive but variable results in residential property prices" (p.224). Riley (2001) found that the Channel Tunnel rail link had caused house prices to rise significantly in Stratford and east London.

SDG (2005a, p.69) noted that "regeneration has brought house price increases that may have exacerbated social exclusion. This view is re-enforced by a report for DETR [Department for Environment Transport and the Regions], which stated that while the arrival of the DLR may have improved mobility for local inhabitants, new office employment and more expensive housing are often not available to locals. For some, the arrival of rail transport ("not for us" is the opinion of many) may be an additional symbol of an unequal society".

6.11 House price changes in France

"House prices grew in Rouen by about 10% in close proximity to light rail stations but they also increased along the new TEOR [Transport Est-Ouest Rouennais] busways." (Hass-Klau et al. 2004, p.1). Orléans was the only French city in Hass-Klau et al.'s (2004) study to show considerable decline in house prices during construction of the light rail system.

6.12 House price changes in Freiburg, Germany

"In Freiburg the rent was slightly higher in houses with good accessibility to tram stops" (Hass-Klau et al. 2004, p.1).

6.13 House price changes in the USA

6.13.1 House price changes in Portland, Oregon

In Portland, Oregon "house prices close to light rail stations were 10% higher than further away" (Hass-Klau et al. 2004, p.1). Around the Orenco Station, west of Portland, house prices had risen: a one-bedroom condominium costing $85,000 in 1995, cost $107,000 in 2003. Hass-Klau et al. (2004) remarked that this 26 percent rise represented 5 percent growth over the average inflation rate.

Dueker and Bianco (1999) examined the residential property purchase prices in Portland and found that property value declined on average $1,593 for every 200 feet out of the station.

6.13.2 House price and land value changes in California

Drawing on analysis of five Californian rail transit systems, Landis et al. (1994) found limited price benefits of property close to light rail stations. In San Diego, this tended to be more than US$2.72 per metre closer to the stations compared with US$1.97 per metre closer in San Jose, and no effects were discerned in Sacramento. They noted that commercial projects were constructed closer to rail stops. Hess and Almeida (2007) noted "The effects on nearby property values have been well-documented for BART, a heavy-rail system serving San Francisco and Oakland, California, where the effect on property values increased as the rail system's maturation strongly influence commuting patterns and affect, to a lesser degree, land use" (p.1043).

Cervero and Duncan (2002a) found that the most appreciable land value premiums in light rail corridors serving San Diego County were those for multi-family housing: 17 percent near East Line stations and 10 percent near South Line stations. "Apartment complexes within a half mile of East Line Trolley stops were worth, on average, over $100,000 more than otherwise comparable ones that were beyond walking distance to a station." (p.11). Condominiums near Trolley stations accrued price premiums of 3 to 6.5 percent.

Duncan (2008) examined the influence of light rail on condominium and single-family residential sales. He found that condominiums within 400 metres of the station sell for $22,000 more than those 1,600 metres away, and houses within 400 metres sell for $12,000 more.

Cervero and Duncan (2002a) identified strong variations in multi-family house, condominium and single-family housing, and land value premiums or discounts for Trolley stations on four light rail lines and one commuter rail line (Table 6.3). Apartments also experienced strong increases.

Type	Multi-family housing	Condominium	Single-family housing
Trolley South Line	9.90%	3.50%	0.60%
Trolley East Line	17.30%	6.40%	-1.50%
Trolley North Line	3.80%	3.00%	-4.20%
Trolley Downtown	5.10%	2.20%	
Coastal commuter service	-7.10%	46.10%	17%

Table 6.3

Land value premiums and discounts in San Diego's rail corridors

6.13.3 House price changes in Dallas, Texas

Hass-Klau et al. (2004) referred to the 'Before' (1994) and 'After' (1998) Impact Study in which property value and land value changes were calculated for retail, office, industrial, residential and vacant land use. They argued that "It is difficult to generalise from 5 land use types and 5 station areas. Double-figure land value gains were evident in 4 out of the 5. Property values showed that attractive gains were to be made in at least one of the retail, office or residential sectors, but not in all of them" (p.24).

Although theory suggests that light rail systems confer smaller benefits to commercial properties, premiums for office and commercial-retail parcels near light rail have been comparable or even higher than near heavy-rail systems in Santa Clara County, and suburban Dallas (TCRP 2004). Near the Mockingbird light-rail station, office and retail space rent was $40 per square foot - about 40% above market rates (TCRP 2004).

6.13.4 House price changes in Houston, Texas

Pan (2013) found that light rail had significant positive effects on some residential property values, although it was noted that residential values were largely influenced by the size of the property and its age. In addition, Pan found that neighbourhood characteristics and locational amenities influenced prices. The more positive impacts affected properties further away from rail stations: properties within 400 metres of stations were negatively impacted, while property values between 400 and 1,600 metres were insignificant, and positive values were found at distances of between 1,600 and 4,800 metres from stations.

Al-Mosaind et al. (1993, in Pan 2013, p.149) found "Positive capitalization of 10.6% higher values for [residential] properties within 500 meters of the LRT stations. Average property values are US$4.32 higher within 500 meters to station than outside and decrease US$2175 for every 100 meters away from station". Chen et al. (1998, in Pan 2013, p.149) found a positive impact on residential property values "Starting at a distance of 100 meters from the station, property values decline US$32.2 for each meter away from station".

6.13.5 House price changes in Phoenix, Arizona

Atkinson-Palombo (2010, p.29) found that "for houses and condos within walking distance to transit, those in mixed-use neighborhoods receive premiums of 6 percent and 28 percent, respectively; those in residential-only neighborhoods receive a 12 percent - 13 percent discount."

6.13.6 House price changes in Minneapolis, Minnesota

Goetz et al. (2010) reported that homes within 600 metres of light rail stations sold at 16.4 per cent less than the surrounding area, before light rail was introduced. Afterwards, condominium and single-family residential properties sold for 4.2 percent more. Properties with good access to station platforms indicated premiums of $350 (condominiums) and $45 (single-family houses) per metre of proximity. Those properties separated from stations by an arterial road and industrial uses revealed no premium benefit.

6.13.7 House price changes in Charlotte, North Carolina

Yan et al. (2012) examined the influence of a newly added light rail system in Charlotte, on single-family housing values during four different development phases: pre-planning, planning, construction and operation. Before the system was in operation, house prices were negatively impacted by proximity to the future rail corridor "likely due to the presence of industrial land use zones around existing stations" (p.66). House prices began to rise once the system was operational.

6.13.8 House price changes in Buffalo, New York State

Hess and Almeida (2007) focused on light rail and heavy rail in Buffalo. Results demonstrated a positive relationship between light rail and property values. Across the system, a typical home located within 400 metres of a rail station can earn a premium of $1,300-3,000, or 2-5 percent of the city's median home value. The greatest premiums were found at University Station where rail proximity is just one attraction among others that are known to influence property values. In contrast, the most negative effect on price was at Summer-Best Station "where there is a significant negative premium associated with being close to a transit station in addition to other likely factors that negatively influence property values" (p.1061). However, it was also noted that other variables were more influential than rail proximity in predicting property value, including the number of bathrooms, size of the land parcel, and location on the East Side of Buffalo. Light rail has positive impacts on residential property values in high-income station areas, and negative impacts on house prices in low-income station areas. Hess and Almeida concluded that "proximity to stations increases property values, but the effect in Buffalo is weak, especially compared with growing West Coast and Sunbelt cities" (p.1061).

6.14 House price changes in China

In Beijing, Zhang and Wang (2013) examined the impact of light rail transit on property values in relation to the City Rail, and Batong light rail systems and found that "transit impacts on land development or capitalization of transit investment are unlikely to occur automatically; they rely greatly on supportive regional and site conditions" (p.132). City Rail was said to impact significantly on the price of residential property; for every 100 metres closer to the station, the housing price increased by 0.35 percent, all else being equal. This would represent approximately 20.7 Yuan (approximately US$3) per square metre. Furthermore, for every kilometre closer to the city centre, house prices increased by 4.19 percent. In contrast, Batong showed no measureable impact. The different design of the two routes, and the weaker economic position of the district served by Batong were given as reasons why these two light rail systems differed in terms of their influence on the property market.

Using different modelling techniques, Wang et al. (2004, in Zhang and Wang 2013, p.125) examined house prices changes in relation to the Light Rail City Line and "found that home price decreased 236 Yuan (about US$36.2² per sq. m.) for every kilometre increase in distance to the station". Zhang and Wang suggested that these findings were based on simple price comparisons that did not control for other influential factors. They concluded that "the difference in average prices provides limited information on the independent effect of City Rail" (p.125). Results from "a more rigorous study" (p.125) by He and Zhang (2004, in Zhang and Wang 2013), revealed an average price premium of 1000 Yuan (about US$147 per square metre) for housing within 500 metres of a station, in contrast to properties beyond 500 metres.

In another study, Zhang et al. (2007, in Zhang and Wang 2013) "concluded that the influence of City Rail on housing price took place in the areas of 1km from the station and the most significant effect was observed in the 0.3km distance buffer. The magnitude of the price premium was measured at approximately 206 Yuan (US$30.3 per sq. m.)" (p.125). Results by Liang et al. (2007, in Zhang and Wang 2013) demonstrated a price premium of 0.464 percent (28 Yuan (US$4.12) per square metre) for every 100 metres closer to the station. Their study included 16 control variables in an attempt to isolate City Rail light rail impact from regional access, structural characteristics and neighbourhood amenities.

Tian (2006, in Zhang and Wang 2013) focused on Metro Line 2 in Guangzhou and found that it had a positive impact on residential property values. In addition, results indicated "that for every minute decrease in walking time to Guangzhou's metro station, price increased by 5449 Yuan (US$801) per housing unit" (p.126). The property premium was approximately 68 Yuan (or US$10) per square metre for every 100 metres closer to the station.

7. TRANSIT-ORIENTED DEVELOPMENT

7. TRANSIT-ORIENTED DEVELOPMENT

7.1 Transit-oriented development principles

Transit-oriented development (TOD) occurs where the development of housing, employment, activity sites and public services are focussed around existing or new railway stations with high frequency intra-urban heavy or light rail services (Knowles, 2012a). TOD is designed to create a relatively high density, compact and mixed urban form (Loo et al., 2010). TOD is part of a broader 'Smart Growth' and sustainable approach to urban development, including new urbanism, urban infill, urban growth boundaries, historic preservation, affordable housing and inclusionary land use zoning (Goetz 2013). TOD is not just a recent phenomenon, as there was a close association between both tram and train route development, and urban expansion in the late 19th and early 20th centuries, before private car ownership developed (Knowles 2012a). TOD is much more difficult to deliver in developed countries now that it has to compete with most people owning and having the choice of using cars.

Transit development should be seen as part of larger pro-development policies, including marketing of air-rights above the transit line and of excess adjacent land, zoning changes to high density development and direct access between stations, shops, offices and housing (Knight and Trygg 1977). Based on analysis of Toronto's heavy rail Metro and other North American rail transit systems, Knight (1980) created a diagram of factors that influenced land use impacts, which can be applied to both heavy and light rail transit.

Knight and Trygg (1977) concluded that development occurred near rail transit stations when other factors, such as strong market demand, low-cost available land at attractive sites, and supportive land use policies, were in place. Knowles (in Williams 1985, p.49) noted that land use impacts around transit stations in Canada and USA had taken several years to emerge and were also dependent upon other factors, such as local government policies for development, favourable regional development trends, availability of developable land and physical site constraints.

Babalik-Sutcliffe (2002) presented a comprehensive list of urban and planning factors, operating and urban planning policies, and external factors, which lie behind the success of seven light rail systems in the USA, Canada and UK (Table 7.1) (see also Babalik 2000).

	Factors that enhanced success	Factors that hindered success
St Louis Metrolink	Radial corridor Location of line and stations Providing access over the river Improvement and integration of bus services Free journeys at the city centre at off-peak Security staff on board and at stations Providing car parks at station sites	Weak and declining CBD Lack of comprehensive redevelopment project for the CBD Using most station areas for surface car parks
San Diego Trolley	Location of the first line Integration of buses within the system City centre development project Joint development projects Transit oriented development schemes	Weak integration of local plans with the trolley in some municipalities
Sacramento Light Rail	Strong and economically vital CBD Integration of buses with the system Free transfers between buses and the system Pedestrianization of a city centre street	Inconvenient urban form and low density Part of the route serving high income neighbourhoods that are against transit oriented development Inconvenient location of routes Lack of funds to improve buses Poor service levels (low frequency)

Table 7.1

Factors behind the success of light rail systems

	Factors that enhanced success	Factors that hindered success
Vancouver SkyTrain	Medium-high density urban area Substantial levels of public transport useage High frequency of service Integration of buses with the system Planning the system as a part of the regional plan Adapting local plans to the rail system Redevelopment of old industrial sites Development bonuses (TOD incentives) Joint development schemes Relocating government buildings at stations Early opening of a section for demonstration	Provision of only one park and ride facility
Tyne and Wear Metro	High density urban area with radial corridors Substantial levels of public transport usage Location of lines and their extensiveness City centre redevelopment project Integration with buses in initial years	Lack of integration with buses Poor co-ordination between the metro and the local plans and recent urban projects
Manchester Metrolink	High density urban area with radial corridors Substantial levels of public transport usage Providing rail access through the city centre High frequency Location of lines: replacing rail commuter service and providing city centre rail link Renewal of some city centre buildings Pedestrianization of a city centre street	Lack of integration with buses Poor integration of local municipal plans with LRT
Sheffield Supertram	Medium density urban area with radial corridors Substantial levels of public transport usage Ticket sales on board by an additional staff Signalling priority has been improving	Small and weak CBD System serving low income neighbourhoods combined with competition from buses Low segregation and low signalling priority Demolition of high density residential areas Poor co-ordination with the renewal project

Table 7.1 (continued)

Factors behind the success of light rail systems

Key findings indicated that the urban environment is enhanced and the rail corridor developed efficiently, when urban planning policies are coordinated with LRT investment.

Bernick and Cervero (1997) drew from existing examples to list a range of planning and financing tools that are vital to transit village implementation:

- A market based site and phasing plan
- Land assembly
- Infrastructure investment, directly or through tax-increment financing
- Shared parking
- Expedited permits and reviews
- Write-down of land costs, in return for project revenue participation
- Direct financial participation, insurance of tax-exempt bonds, low-interest loans, loan guarantees, equity participation.

The authors argued, however, that geography matters and that such tools should be selected on the basis of local circumstances.

Based on evidence of heavy rail in Toronto and San Francisco, among other places, Cervero (1998) identified important lessons concerning the likely impact of transit investments on urban form. He argued that light rail investments generally reinforce the following:

- Transit redistributes rather than creates growth, often from one radial corridor to another
- A healthy regional economy is a pre-requisite for success as transit will exert negligible land-use impacts in areas with weak economies
- Timing is important as land-use impacts are greatest when transit investments occur just prior to an upswing in regional growth
- Radial rail transit systems can strengthen downtown cores in jobs and retailing
- Pro-active planning is necessary if decentralised growth is to take the form of transit-oriented sub centres
- Transit can spur central-city redevelopment under the right conditions
- Other pro-development measures must accompany transit investments.

Planning and place-making (see Theme 9) are influenced by environment, culture, politics and economics, but transport itself shapes places and spaces very differently across car dependent and public transit-oriented areas (Dorsey and Mulder 2013; Knowles 2006). Cervero (2010) noted that TOD can be shaped to establish civic and public spaces as well as high-density and high-rise buildings. TOD may lever capital investment, reduce personal expenditure on transport, foster vibrant mixed-use neighbourhoods, pedestrian and bicycle-friendly high density development, reduce private car dependency and improve local air quality (Belzer and Autler 2002, in Dorsey and Mulder 2013).

Bertolini et al. (2009), argued that TOD facilitates enhanced accessibility as it takes place within walking and cycling distance of transit stations - usually within a 10-minute or 600-800 metre walk of a high frequency transit node. TOD developments that include designated walkways and cycle routes can produce more sustainable urban environments by offering transport choices, as well as lifestyle choices that are not based on private car access (see also Renne 2009).
TOD is also considered a mechanism for creating public domains in which people can interact, something that is more difficult to achieve in more car dependent and socially segregated urban environments.

Cervero et al. (2004, p.119) acknowledged that "The literature is replete with platitudes that have been heaped on the TOD concept: however, relatively few serious studies have been carried out that assign benefits to TOD in any quantitative.... sense". The authors proposed a classificatory system of primary and secondary TOD benefits, which could be used to measure TOD success (Table 7.2).

	Primary Recipient of Benefit	
Class of Benefit	**Public Sector**	**Private Sector**
Primary	1. Increase ridership and farebox revenues	5. Increase land values, rents, and real-estate performance
	2. Provide join development opportunities	6. Increase affordable housing opportunities
	3. Revitalize neighbourhoods	
	4. Economic development	
Secondary/Collateral	A. Less traffic congestion and VMT-related costs, like pollution and fuel consumption (a)	G. Increase retail sales (1,2)
	B. Increase property - and sales - tax revenues (5)	H. Increase access to labour pools (A,6)
	C. Reduce sprawl/conserve open space (1,3,6)	I Reduce parking costs (C,2)
	D. Reduce road expenditures and other infrastructure outlays (1)	J Increase physical activity (C,E,F)
	E. Reduce crime (3,4)	
	F. Increase social capital and public involvement (3,4)	

Note: Values in parenthesis represent primary benefits and/or secondary benefits that are the source(s) of the secondary/collateral benefit listed

Table 7.2

Primary and secondary TOD benefits

Cervero (2010) identified the key motivation of land value capture to secure profits, but also acknowledged that recent changes in the way that TOD is planned and constructed, means there are wider benefits for creating sustainable urban cities. Smart growth and private profiteering can be mutually reinforcing.

Priemus and Konings (2001) examined examples of urban revitalisation related to urban transport investment in France and Germany, and argued that "the development of public transport lines and the revitalization of central cities can go forward together" (p.193) on the basis of high-quality, organisation and long-term policy vision. Strasbourg was given as an example where the CBD has been restructured through a synergy of urban revitalisation and public transport improvement. In Strasbourg, public transport has priority over private transport, and all modes of public transport have been harmonised.

Drawing on Japanese cities, Priemus and Konings (2001) also emphasised a close relationship between public transport and real estate as the key factor to achieve effective TOD. They noted that, in Japan, "companies develop new residential areas, apartment complexes, department stores, shopping centres and office locations" (p.193) along public transport corridors. Some areas also have recreational facilities such as amusement arcades, sports centres and museums. Land value capture is an important part of TOD: "The involvement of the Japanese railway companies in real estate development has resulted in substantial additional income" (p.194) as the railway companies benefit from land value increases around the line (see Theme 6).

7.2 Barriers to transit-oriented development

Hass-Klau et al. (2004, p.5) concluded from research in France, Germany, UK and USA, that "transport agencies and operators have little knowledge about the best alignments for development. This is one of the reasons why economic development along light rail lines is not as successful as it could be. In some cities, in particular in Germany there was no policy to promote transit-oriented development simply because the current economic climate was seen to be too weak."

Arrington (2004) examined light rail TOD development in several US cities, but noted that "it is amazing how many new LRT lines have been designed in a manner that is hostile to TOD - surrounding stations with parking, locating stations in areas with little or no development potential, and providing for poor pedestrian connections from the station to the community" (p.194).

Boarnet and Compin (1999) identified four key barriers to TOD, based on research in San Diego:

- Constraints imposed by existing rights-of-way
- Difficulty of assembling land in already developed areas
- Market conditions
- Fiscal and economic disincentives

They concluded that "The most likely way for regional and local governments to facilitate TOD would thus appear to be to align rail transit systems in ways that make TOD more feasible" (p.92), so that "TOD prospects are heavily influenced by the alignment of a rail line and the placement of stations" (p.92).

7.3 Transit-oriented development in the UK

Light and heavy rail investment in the UK has been justified mainly on the basis of transport user benefits. Although economic development, city centre and inner area regeneration have often been identified as non-user benefits of light rail investment, for example in Greater Manchester's Metrolink Phase 1, specific planning mechanisms to facilitate TOD have not been adopted (Table 7.3) (Knowles 1996).

a)	**Rail user objectives**
1.	To provide a north-south link through the regional centre in order to minimise interchange on journeys within the county
2.	To provide stations within the city centre in order to improve access to activities there
3.	To make the rail network more cost effective and therefore reduce the need for revenue support
4.	To upgrade the infrastructure, services and image of the rail network in line with most major cities and conurbations in Europe and beyond
5.	To increase travel opportunities for the less mobile (disabled, elderly, people with pushchairs etc)
b)	**Non-user objectives**
6.	To provide a better alternative to road travel in order to reduce congestion, travel time accidents and air pollution
7.	To support strategic planning policies by encouraging increased activity and development in the regional centre and other urban centres within the county
8.	To assist in the regeneration of the inner areas by attracting investment and by improving travel opportunities for its residents (particularly in areas of multiple deprivation)

Table 7.3

Greater Manchester Metrolink Phase 1: Rail user and non-user objectives

Law et al. (1996), in the Metrolink Impact Study, noted that hypothetically, economic development could have taken place easily alongside the Metrolink line because land was already zoned appropriately for office development. However, this potential was not fulfilled, partially because there were no additional incentives to assist the clustering of offices near to stations. Nevertheless, Canary Wharf in London Docklands, and Salford Quays and MediaCityUK in Greater Manchester have been cited as successful examples of TOD in the UK.

Light rail development is often linked with urban regeneration and economic initiatives, and is of interest to real-estate developers (Dwarka and Feitelson 2013). In Manchester, private finance part funded Metrolink's capital costs and the private sector operator assumed for a time all of the downside revenue risk. In London, the LDDC defined the land use agenda for Docklands and the position of the DLR as essential for regeneration. The DLR attracted some private capital for its Lewisham, London City Airport, and Woolwich Arsenal extensions.

7.4 Transit-oriented development in Scandinavia

Copenhagen pioneered mid-20th century planned TOD with its world famous 1947 Finger Plan (Egnsplan) which developed new planned high density suburbs around stations on five radial rail corridors connected to Copenhagen's CBD like 'beads on a string' (Fullerton and Knowles 1991). Cervero (2009, p.23) concluded that "On the global stage, TOD is most fully developed in Europe, and in particular Scandinavia. Step one, in bringing TOD from theory to reality, has been the formulation of a vision and conceptual image of the future metropolis, such as the celebrated 'Finger Plan' of Copenhagen, Denmark and the 'Planetary Cluster Plan' of Stockholm, Sweden. In both of these instances, corridors for channelling overspill growth from the urban centres were defined early in the planning process, and rail infrastructure was built, often in advance of demand, to steer growth along desired growth axes."

In Copenhagen, Ørestad New Town forms a new finger of planned urban development, conceived in the mid-1990s, built on reclaimed land around six stations on Copenhagen's new light rail mini-Metro (Knowles 2012a). Many commuters, residents and shoppers have the option of using cars, unlike in the original Finger Plan suburbs where rail transit had a captive market. TOD in Ørestad New Town has created mixed development in terms of 12,000 newly created or relocated jobs, housing (socially mixed), retail, and leisure and education facilities, with 500,000 square metres of sites developed by 2010, and 192,000 metres square planned, ahead of its 30 year 1995-2025 schedule (Knowles 2012a). Key public sector developments include the Humanities Faculty of Copenhagen University, a new IT University, and a new world-ranked Media City (DR Byen) anchored by the Danish Broadcasting Corporation which was relocated from Copenhagen's CBD. Other developments include private sector offices, a major shopping centre, schools, a mixture of housing types, a hospital, hotels and conference centre. Higher density building development and taller buildings are permitted in Ørestad than in Copenhagen's historic CBD (Knowles 2012a).

7.5 Transit-oriented development in France

In the 1960s, French planners were able to channel much of Paris' urban growth into new TOD suburbs along heavy rail transit lines (Knowles 2012a).

In Grenoble, when the light rail system was built in the 1980s, the town of Fontaine had a choice of locating the tramway in back streets, to limit disruption in the CBD, or to direct it through the centre (Walmsley and Perrett 1992). The latter option was selected as part of a broader strategy to redevelop the 19th century city centre and make the tramway more effective economically. This city centre revitalisation has been referred to as the 'Grenoble Effect' (SDG 2005a). A range of commercial (2,150 square metres) and housing developments (more than 80 dwellings, including social housing) were being constructed along the tram route in the early 1990s.

In Lille, the high speed TGV was routed through the city centre to help it regenerate. Euralille includes the Lille Europe station, with TGV and light metro service, Cite des Affaires with World Trade Centre (WTC), and Credit Lyonnais office towers above it, and the Euralille Centre with offices, apartments, shopping centre, hotel, and the Grand Palais Congress Centre (see Figure 2.3) (ITC 2014b).

Euralille has been important for the image of the city and has been said to play a key role in attracting private investors (ITC 2014b).

7.6 Transit-oriented development in the Netherlands

Utrecht is integrating heavy and light rail in redeveloping the central station and surrounding area, based on Utrecht City Project Masterplan (ITC 2014b). The new terminal will integrate all modes of public transport and direct access will be provided to train, tram and bus services. The terminal will also connect directly with a new shopping centre, bicycle parks and pedestrianised public spaces.

7.7 Transit-oriented development in Canada

Vancouver's SkyTrain mini-metro light rail corridor is notably denser than its surroundings, having become the focus of planning around the development of the SkyTrain (Babalik 2000). Office and retail developments were enabled and facilitated by rezoning plans to increase heights and densities, as well as tax incentives and development bonuses. Relocations of government buildings and company headquarters also stimulated development at SkyTrain stations. An example of successful transit-oriented development in Vancouver is Burnaby Metrotown, one of four designated regional town centres along the SkyTrain corridor (see Figure 2.5) (Cervero 1998).

Metrotown is a moderate-density retail, office, and entertainment development where public utility companies BC Hydro and BC Telephone have relocated their headquarters. Government offices are the largest single employer in the area, and Cervero (1998) noted their considerable influence over local real estate markets.

However, prospects for TOD in Canada can be negative. Lavery and Kanaroglou (2012) employed an Integrated Urban Model to explore the potential TOD that might be stimulated by new LRT in Hamilton, Ontario. Results were "underwhelming" and suggested that "adding LRT cannot cause real estate investment or significance changes in population and employment redistribution unless there are external factors at work that support these goals" (p.222).

7.8 Transit-oriented development in the USA

Ratner and Goetz (2013) noted that since the 1980s a range of US cities have started new LRT systems and are experiencing dramatic increases in TOD activity. They list Baltimore, Buffalo, Dallas, Denver, Houston, Los Angeles, Minneapolis, Phoenix, Pittsburgh, Portland, Sacramento, Salt Lake City, San Diego, San Jose, Seattle and St Louis, as key cities.

7.8.1 Transit-oriented development in Portland, Oregon

Hass-Klau et al (2004) noted that Portland has one of the best TODs in North America. The MAX light rail system in Portland has played an important role in revitalising the city centre, although anecdotal evidence suggests that MAX accelerated rather than created developments. Correlation existed between proximity to light rail stations and public investment, and the ripple effect on surrounding private sector property market. While a survey among 60 developers in North America revealed that none of them had made investment decisions based exclusively on light rail, investment was enhanced by the proximity of light rail. Portland provides an example where land value is determined by what can be built on that land. Hence, land value increases are related to policies, for example determining minimum density or minimum floor areas.

Cevero et al. (2002) reported that local transport funds were invested into a regional TOD programme that included 9 different projects ranging from $50,000 to $2,000,000 for strategic planning, site enhancements and direct financial participation. MAX also helped fund station-area planning on Portland's Westside MAX light rail corridor.

However Hass-Klau et al. (2004) noted that efforts to combine land use and transport planning in Portland had both successes and failures. SDG (2005b, p.42) concluded that "...the overall effect [of Portland's TOD] has been modest and, if anything, conveyed the concept that more must be done to achieve full benefits from the transport and land use interplay". For the second light rail line into the Western suburbs, much more was done and TOD took place as part of an urban development plan to convert each station area into a node of activity and high-density development. Before the line opened in 1988, private developers within 800 metres of the future shops had invested US$500 million.

7.8.2 Transit-oriented development in San Diego, California

Boarnet and Compin (1999) explored the opportunities and barriers for implementation of TOD projects in San Diego County. They found that the number of existing TOD projects is small and that they have tended to concentrate where TOD was consistent with other goals. For example, the East Line extension to the Trolley (light rail) service influenced development possibilities at La Mesa Village Plaza, a mixed-use project at the La Mesa Boulevard LRT station. Redevelopment around the Grossmont Trolley station was linked to the proposed intersection of LRT and freeways 8 and 125. Development at the Spring Street station was linked to LRT access, as well as freeway access, and a 244-unit complex of Navy housing opened there in 1989. Cervero et al. (2002) noted that regional authorities should attempt to understand market demand, land availability, fiscal pressures, and local goals. Along San Diego's Mission Valley Trolley corridor, the Hazard Centre has evolved into a successful mixed-use, pedestrian-scale community huddled around a light rail station (Cervero et al. 2002).

However, Bragado (1999) concluded "the majority of the development that takes place in the region still follows an automobile-oriented pattern" (p.29) and "it is difficult to find large-scale developers that are interested in designing their sub-divisions and shopping centres in a transit-supportive manner" (p.29). Bragado also identified some examples of successful TOD:

- James R. Mills 10-story office building above the San Diego Trolley, with 18 percent of the building's users arrive by transit
- American Plaza, a downtown office tower and trolley transfer centre
- Rio Vista West, a privately initiated TOD - prospective development
- Redevelopment at City of La Mesa especially the La Mesa Village Plaza mixed-use project.

7.8.3 Transit-oriented development in Sacramento, California

In Sacramento, two government buildings were relocated to an out-of-town location served by LRT, to help attract other developers but this was unsuccessful due to private developers not investing (Babalik 2000). In Sacramento generally, light rail has not been seen as particularly effective in terms of stimulating high-density development along its corridor and affecting urban development.

7.8.4 Transit-oriented development in San Jose, California

In San Jose, the city of Mountain View has promoted TOD in proximity to the West light rail, opened in 1999, including developing 40 acres of industrial land for 520 housing units adjacent to the Whisman station (Arrington 2004).
In Santa Clara County, about 4,500 housing units, and 9 million square feet of commercial-office floor space were developed within walking distance of the Tasman West LRT corridor between 1997 and 1999, and 500 housing units were constructed adjacent to the Whisman LRT stations (Cervero and Duncan 2001; 2002b). These were achieved through rezoning 40 acres of land. Elsewhere, in the Northside Industrial District near Borregas and Fair Oaks LRT stations, density bonuses were used to encourage infill development near the transit line. Several thousand luxury apartments were under construction in 2002 within walking distance of LRT stations in north San Jose.

7.8.5 Transit-oriented development in Phoenix, Arizona

Atkinson-Palombo and Kuby (2011) considered the idea of Advanced TOD and reported that planning shaped TOD in Phoenix and brought almost $1 billion worth of advance economic benefits to light rail station areas ahead of a system opening. In this instance, from 2000 when funding was approved for the LRT system, eight years ahead of its opening, overlay zoning, "a targeted layer of regulations" (p.189) to help promote specific types of development. was employed in Phoenix. Findings indicated that advance TOD varied much between stations and was influenced by existing land use. The areas attracting most advance TOD were those already associated with public amenities such as 'Employment and Amenity Centres'.

7.8.6 Transit-oriented development in Denver, Colorado

The City and County of Denver produced a new land use and development plan in 2002 that created a new TOD zoning code allowing higher-density mixed-use development to occur in station areas and along transit corridors (Goetz 2013). Goetz linked this 'Smart Growth' movement, as a new paradigm of urban growth based on high-density, to mixed-use neighbourhoods that are more amenable to walking, biking and transit use. Denver was described by Goetz as a successful example of 'smart growth' where initiatives in the 1990s and 2000s have been widely supported by many different stakeholders, and have been longer lasting and more successful than growth control efforts of 1970s, which were based on low-density construction.

Five of Denver's nine transit corridors are light rail and they have received the largest share of new TOD (Ratner and Goetz 2013). The largest proportions of TOD were located along the Central corridor in station areas closest to the Downtown, typically transit hubs and intermodal facilities. More generally, TOD is greater in newer corridors (Southeast and, still under construction, West corridors), than in the older and less populated Southwest corridor. TOD is becoming more important compared to development in Denver as a whole, amounting in 2009 to 66 percent of regional residential development and 60 percent of regional office development. Since 2006, over 20 percent of all regional residential development has been TOD. Overall, the results indicated that transit, of which LRT is a major concern in Denver, has been influential in land use patterns and urban form through processes of high density TOD, particularly in Downtown station areas.

7.8.7 Transit-oriented development in Jersey City, New Jersey

When construction began on the Hudson-Bergen light rail line in the 1990s, the pattern of office and residential development moved southwards to follow the light rail alignment (Fitzsimmons and Birch 2004). This was not wholly attributed to light rail, but linked to the mass transit line (PATH). "Development projects have come on line rapidly as the construction of the rail alignment and stations has been completed" (p.211). This example demonstrates how development will follow adequate planning measures, including zoning changes, custom zoning, site acquisition and tax abatement. Light rail has facilitated the infill of residential properties and this has brought development into locations that developers would not be interested in, thus facilitating greater density along the line.

7.8.8 Transit-oriented development in Dallas, Texas

In Dallas, a 24.7 percent increase was recorded in office property values near a DART LRT station. Office values near LRT increased 53 percent more than comparable properties not near rail (Weinstein and Clower 2003). DART, in 2001, had $1 billion worth of new development built or under construction near station areas, and land values around DART stations were double those in non-DART rail neighbourhoods (Ohland 2004). The value of office property near DART increased 53 percent more than comparable property not close to rail between 1997 and 2001. Since DART opened in 1996, more than $1.2 billion worth of new commercial and residential developments have been constructed within walking distance of DART (TRCP 2004). However, this is considered more "transit adjacent" than "transit oriented". Mockingbird Station is given as a key example of TOD as a mixed-use, urban 'chic' village. Ohland suggested that up until 2002, TOD success in Dallas had been driven by the market, and facilitated by both a developer-friendly transit agency, and savvy developers who implemented construction.

8. COST BENEFIT ANALYSIS OF TRANSPORT SCHEMES

8. COST BENEFIT ANALYSIS OF TRANSPORT SCHEMES

8.1 Deficiencies in traditional Cost Benefit Analysis

CBA is widely used in many developed countries for ex ante ('Before') evaluations of transport infrastructure projects (van Wee and Rietveld 2013). CBA attempts to measure the costs and benefits of as many aspects of a project as possible. Its evaluation is based on the willingness of consumers to pay for the effects. Two criticisms of CBA are its heavy emphasis on time saving, based upon value of time, and the difficulties in valuing environmental, social and wider economic effects.

A New Approach to Transport Appraisal (NATA) was adopted in England in 1998 as part of the Government's Integrated Transport Policy (Walton and Shaw 2003). CBA was adapted to include accessibility and integration and it could then be used to evaluate the relative benefits of intermodal as well as intra-modal transport investment schemes. Assessment of projects would now be assessed against five criteria: environmental impact, safety, economy, accessibility and integration (Walton and Shaw, 2003).

SACTRA (1999) found that total welfare increases of infrastructure projects are up to 30 percent higher than changes in consumer surplus on transport markets. Positive impacts in some areas could have negative repercussions in other The relative impacts from different scales of project can be important and even quite small projects that have the effect of unlocking the potential development of land could have disproportional impacts while large projects may have much less impact. SACTRA (1999) believed that for many projects, it would be impossible, in practice, to demonstrate any wider economic benefits not already counted. SDG (2005a) noted that SACTRA's emphasis was therefore that appraisal of schemes should be on transport and environmental cost benefit analysis. However, SACTRA also agreed that economic benefits and dis-benefits could be considered in justifying a scheme if the appraisal includes an 'incorrect' or 'incomplete' cost benefit analysis, or in the case of there being market imperfections and the perfect competition assumptions do not hold.

The Department for Transport (DfT 2005, p.5) accepted that "Wider economic benefits are not always trivially small, so failing to incorporate them risks distorting between transport schemes or between programmes across government" and "the wider economic benefits that are missing from conventional appraisal reflect the main market imperfections: agglomeration externalities, imperfect competition and the economic benefits of increased employment and productivity".

The House of Commons Transport Committee (2005, p.11) maintained that evaluation of light rail benefits should be assessed over a long time period. This gives a clearer view of when light rail is most effective in securing regeneration, and which measures should be taken to maximise wider economic benefits.

The Eddington Report (2006b) argued that current project appraisal does not capture all relevant potential impacts of transport projects. If benefits of transport schemes were assessed on an individual projects basis, and were to include new evidence concerning the significance of reliability and agglomerations, then "assessment of overall benefits...could increase by up to 50 per cent" (p.14). This report also noted that many assessment methods do not take into account all environmental impacts.

Lakshmanan (2011, p.1) argued that CBA is "deficient in not treating the further 'network' of the general equilibrium effects of transport improvements on transport-using sectors in the broader economy". Complementing calls for a broader and more comprehensive assessment of the economic contribution of transport infrastructure investments than CBA currently captures. He proposed an analytical framework to capture wider economic impacts, notably how transport influences productivity on a broader geographical scale. Lakshmanan highlighted several analytical frameworks that have been used to assess the nature and magnitude of economic impacts, ranging from micro-economic models of CBA to macro-economic models incorporating economic externalities. He argued that to acknowledge broader impacts, a general equilibrium model is required, which will help to identify "market expansion, gains from trade, technological shifts, processes of spatial agglomeration and processes of innovation and commercialisation of new knowledge in urban clusters" (p.1). General equilibrium models had been used to estimate the growth in the European Union's Gross Domestic Product (EU GDP) from the Trans European [Transport] Networks (TENs). These were calculated to add 0.25% to EU GDP and 0.11% to employment over 25 years.

Venables (2007) reported that "The same forces that cause cities to exist - agglomeration benefits - provide additional effects that should be included in urban transport appraisal" (p.187). Venables demonstrated that productivity in the city centre may be increased by additional employment - drawing more people into the city as a whole, and enabling more of the city's initial inhabitants to work - thus raising productivity of existing and incoming workers. This yielded net gains for the CBD "several times larger than those that would be derived from a standard cost-benefit analysis" (p.186). A weakness of Venables' approach is that is does not account for the possible impact of productivity loss following decline in employment levels outside of the city. However, it is noted that transport improvements also increased the effective density of activity by bringing employment areas closer together, as in the case of financial institutions in Canary Wharf, and media and digital industries at Salford Quays.

Banister and Thurstain-Goodwin (2011) presented a range of wider economic effects of rail investments that could influence UK governmental decision-making beyond current assessment based on financial appraisal and CBA. They argued for the need to distinguish appraisal at three levels of analysis (micro, meso and macro). Their paper highlighted additional non-transport benefits accruing at all three levels, in particular at the micro and meso levels. On this basis, Banister and Thurstain-Goodwin (2011) recommended that a more holistic analysis should be used to capture a wider range of non-transport impacts. To show that some of the economic benefits are not captured in standard appraisal, they cited the example of the Crossrail Line in London, an appraisal at a meso scale of analysis. They identified increased labour force participation from lower commuting costs (see Theme 1) and agglomeration benefits to existing jobs resulting from an increase in employment density. These wider economic benefits are substantial, for example, the estimated net effect in BCR of Crossrail increases from 1.8:1 (with transport analysis) to 2.6:1 (transport and wider economic benefits) indicating a much higher value for money (Banister and Thurstain-Goodwin 2011, p.216). Traditional CBAs for transport schemes, including light rail and heavy rail, fail to account for these total benefits. The DfT's yardsticks for measuring whether transport schemes represent value for money are: poor (BCR less than 1); low (BCR 1-1.5); medium (BCR 1.5-2); and high (BCR over 2). Only high value for money schemes are normally given approval (Table 8.1) (DfT 2007).

		Costs to Government
Net benefits (benefits minus costs) to society including	Positive	High VfM - Total benefits at least double costs Medium VfM - Total benefits between 1.5 and 2 times costs Low VfM - Total benefits between 1 and 1.5 times costs
monetised and non-monetised impacts	Negative	Poor VfM - Total benefits less than 1

Table 8.1

Value for Money matrix

Vickerman (2008) explored a cost-benefit analysis framework that recognises externalities (agglomeration) and imperfect competition. He showed that adding non-used benefits to a standard cost-benefit analysis can, on average, generate a figure that is 10-20 percent higher, although he stressed the need to take local conditions into account. Applying this to the Crossrail heavy rail project, analysis of non-user benefits was estimated at £19.99 billion: a critical figure above the £16 billion cost of the project. "In part this was because of the large agglomeration effects that could be identified for certain sectors, particularly financial services, highly clustered in London and that have a wider effect on the UK economy as a whole" (Vickerman 2013, p.388). The identification of the expected wider benefits of the Crossrail project were used to justify its approval, to raise funding from the private sector and to justify additional tax levies on development in the areas expected to benefit (Vickerman 2013, p.389).

Another example of a CBA taking account of non-user benefits, Banister and Berechman (2000) and Vickerman (2013) reported the wider economic benefits of the heavy rail Jubilee Line to the London Docklands on labour markets, property markets and land use that were roughly 34 percent of the direct transport user benefits. This raised the BCR from <1 to 1.3. Graham (2007) argued that agglomeration effects from all types of transport investments matter and that they can make a positive difference to the BCR.

Vickerman (2008) acknowledged that geography matters when assessing transport infrastructure: "it cannot be assumed that there is a simple rule which can be applied to all such projects" (p.114). He noted that cost-benefit calculations must be based on specific conditions of each city examined. Vickerman also warned that "the greatest danger is that we transport evidence on agglomeration economies from one city to another and apply them without due regard to the industrial structure or market structures of that city". (p.114).

In Australia, Hensher et al. (2012) developed an integrated model (TRESIS-SGEN), where a number of wider economic impacts were identified for the proposed North West Rail Link Sydney (2011) heavy rail rapid transit project. This indicated additional benefits of transport investment beyond CBA of 18 percent for this scheme. The model indicated benefits associated with redistribution of employment activities and increases in labour productivity through agglomeration effects.

However, recent American research disagrees. Gordon and Kolesar (2011) considered the proposition that allowing for non-user benefits can offer a more favourable cost-benefit analysis than simply considering user benefits. They concluded that including non-user benefits did not change a negative assessment. They carried out a standard CBA for 34 rail transit systems, 20 of which were light rail. The average annual operating deficit for LRT systems was US$48 million. Adjusting this for non-user benefits, including private car trips avoided by any new-to-transit passengers, and private car externality costs (for example the sum of congestion costs plus pollution and accident costs less fuel taxes), the authors found "nothing to modify the assessment that introducing rail transit systems into modern cities cannot be justified on economic grounds." (p.109). Gordon and Kolesar acknowledged that any CBA will leave out various difficult-to-quantify intangibles.

8.2 Weaknesses in the Cost Benefit Analysis of the UK's light rail Schemes

8.2.1 Sheffield

Dabinett (1998) pointed out that the Sheffield Supertram Impact Studies were carried out before the introduction of new environmental impact assessment procedures, which themselves largely excluded economic impacts.

Townroe and Dabinett (1995) argued that 'Before and After' evaluation of rail transit investments is important, but appraisal of such schemes is more complex than for single major road schemes. They discussed the process for appraising transport investment schemes in the UK, on the basis of 1993 guidelines, and noted that at that time, assessment for routes within cities was less well established than for inter-urban transport. Using SYS as an example, Townroe and Dabinett explored the financial, economic and environmental issues that arose in evaluating costs and benefits for intra-urban schemes. They found that:

- Financial appraisal is not a one-off task, but estimates require a dynamic approach to take into account changes and external factors.
- Economic appraisal risks double counting and is likely to be more complex if the private sector is involved, rather than just the public sector.
- Appraisal should include primary impacts and three secondary impacts (employment impact, land and property impact, business investment impact) even though they can be difficult to quantify with a high degree of certainty.
- Environmental assessment has typically been seen through the negatives to society, but light rail may confer environmental benefits. These can be ambiguous and in the case of SYS, it was noted that environmental impacts were listed as clear improvements without a detailed assessment.

With regards to 'Before and After' evaluations for light rail proposals in the UK in 1995 "an informed ex-ante evaluation of a scheme in one city has to borrow heavily on data emerging from experience with earlier schemes in that city or with schemes in other cities" (p.186). However, this can be challenging as characterises of the systems are different. For example, SYS tried to learn from the experience of the Tyne-Wear Metro but problems arose trying to compare these cities, which pursued different strategies for economic regeneration – such as availability of land for development, housing policies, urban form, and linkages with neighbouring cities. Townroe and Dabinett (1995, pp.186-187) summarised that "If the new system is being justified in part as an instrument of inner city regeneration, then there is another set of lessons to be learnt. These include the impacts on local labour markets, on property values and land development, and on the image of the city for the attraction of business investment and of day visitors and overnight tourists."

8.2.2 Greater Manchester

BCRs for Greater Manchester Metrolink's Phase 3 lines to Oldham and Rochdale, Ashton-under-Lyne, and Manchester Airport (Table 8.2) in October 2003, all fell within the DfT's 'high' value for money category (Table 8.1) (see DfT 2009; Knowles 2007). In comparison, transport BCRs for Crossrail and the Jubilee Line were 1.8 and less than 1 respectively, but were nonetheless given UK Government funding despite being categorised in the DfT's Value for Money classfification as 'medium', and 'poor' (see Table 8.1). Nevertheless, the Government refused to fund Metrolink's Phase 3 lines in 2004. They were all later funded by a combination of local funding from the ten Greater Manchester Councils' 2009 Transport Fund, and some UK Government finance.

Route	Benefit to cost ratio
Oldham and Rochdale	2.5:1
Ashton-under-Lyne	2.1:1
Manchester Airport	2.7:1
TOTAL	**2.6:1**

Table 8.2

Greater Manchester's Metrolink Phase 3: Cost Benefit Ratios

Volterra Consulting (2008) quantified additional economic benefits of the Greater Manchester Metrolink Phase 3 extensions (Figure 1.4) beyond those benefits valued by conventional transport appraisal methods. This included measuring improvements in agglomeration as a result of more productive jobs (the value of the increased output created by the workers who can now access employment in central Manchester as a result of the increased capacity), by pure agglomeration (the value of the uplift in output triggered by the increased density of central Manchester) and by house price impacts. Results showed that in terms of agglomeration benefits, "Metrolink expansion is facilitating just over 3,200 completely new jobs in central Manchester which are creating output of between £4k and £109k more per annum due to their location in a well connected urban core" (Volterra Consulting 2008, p.5). Breaking down the agglomeration benefits, the 'move to more productive jobs' estimate for 2026 (at 2006 prices) is £28million and for pure agglomeration is £4.2million.

8.3 Government funding of light rail schemes

Prior to 2000, Government had provided capital grants towards the cost of light rail schemes in Newcastle, London, Manchester and Sheffield, justified on the basis of user and some non-user benefits but with little or no assessment of the potential for positive economic impacts. Knowles (2007, p.81) examined why "ambitious targets in the Ten Year Transport Plan 2000 to more than double light rail journeys and financially support the opening of 25 new light rail lines were scrapped after just 2 years". Government support for light rail weakened in 2002 and 2003 as bus and light rail growth targets and cost inflations on light and heavy rail schemes were altered. The costs and benefits of LRT were duly affected. Knowles (2007) highlighted the influential role played by the National Audit Office (NAO) Report 2004 in enabling Government to marginalise new light rail schemes outside of London, and noted that "the high cost of light rail routes and vehicles and the very long lead time to opening new routes, usually of at least 10 years, have deterred successive Conservative and Labour Governments from investing heavily in light rail." (p.83). In 2004, the NAO Report identified five barriers to new light rail schemes:

- High cost
- Poor financial performance
- High cost of promoting light rail schemes, and the need to utilise new funding sources including congestion charging, capture of increased land value and trade from regeneration
- Slow planning and funding approval process
- Insufficient in-house expertise in some local authorities.

This "made it easier for Government to justify a 'U' turn on funding of new light rail projects on grounds of 'value for money'" (Knowles 2007, p.84). Government contended that it was not practical or affordable to invest £1.4 billion towards building up to 25 new lines by 2010. This indicated "the need to both find ways of reducing the high cost of building and operating light rail routes and buying trams and of becoming less dependent on Government for capital funding" (p.86).

8.4 New approaches to Cost Benefit Analysis

The UK Government's adoption of a New Approach to Transport Appraisal (NATA), and the later NATA Refresh (DfT 2009), both broadened the scope of CBA but did not include the full range of non-user impacts of transport capital investments. CBA still treats modal switch from cars to public transport as a negative factor because the government loses tax revenue from fuel duty, so sustainability is penalised (Knowles 2012b).

Vickerman (2013) developed an approach to appraisal that is based on the Economic Impact Report concept suggested in SACTRA (1999). He made a theoretical and empirical case for exploring the wider economic impacts that are not captured by traditional appraisal methods but claimed that wider economic impacts are incorporated into formal appraisal more fully in the UK than in other countries.

Mackie and Worsley (2013) undertook a theoretical and empirical analysis of appraisal schemes across a range of developed countries and investigated how wider impacts, defined as external economies at the national level, have been incorporated into appraisal. This excludes meso and micro level impacts, the latter being of most importance to light rail schemes. Mackie and Worsley noted that English appraisal was based on the proposition that the measured transport benefits were an acceptable proxy for the final economy wide benefits. This proposition had come under scrutiny in the 1999 SACTRA Report on Transport and the Economy. Subsequently, a Department for Transport work programme led to a Discussion Paper (DfT 2005), the current WebTAG guidance and computation software (WITA)." (p.9). The guidance noted four sources of additional wider impacts on economic efficiency:

- Agglomeration impacts
- Output changes in imperfectly competitive markets
- Labour supply impacts
- Move to more or less productive jobs.

DfT commissioned further research on the connectivity impacts of joining up regional labour markets and on international business impacts.

8.5 Alternatives to Cost Benefit Analysis

Macharis and Nijkamp (2013) evaluated six different methods for assessing mega-projects, including light rail schemes:

- Cost Effectiveness Analysis (CEA)
- Economic Efficiency Analysis (EEA) including impacts on GDP, employment and government revenue
- CBA with all factors converted to monetary values, but with a high weighting given to travel time savings, which often benefits road schemes, and the difficulty in valuing external effects
- Private Investment Analysis (PIA)
- Social CBA (SCBA)
- Multi-criteria Analysis (MCA).

Macharis and Nijkamp (2013, p.246) noted that "Mega-projects affect multiple layers of our society, who have different interests and needs. In that case, looking at the direct economic effects will not suffice, because there is a need to evaluate the project from the point of view of society as a whole". They highlighted a major weakness with CBA in that everything has to be transformed into monetary value, which is problematic, particularly in terms of external effects, which are difficult to determine.

van Wee and Rietveld (2013) also explored the weaknesses and strengths of CBA and the importance of considering wider economic benefits and distinguishing between SCBA and CBA - the former including impacts that count from a broad welfare perspective, including social and environmental impacts. However, the benefits of innovation, image and prestige are not included in CBA (see Theme 9).

van Wee and Rietveld (2013, p.281) concluded that "in virtually all cases the standard [CBA] approach leads to an underestimate of total benefits. Apparently transport improvements tend to reduce the size of the adverse economic effects of market imperfections, implying a positive additional welfare effect". Scale is important and they found that wider economic impacts are likely to be larger for mega-projects than smaller transport infrastructure projects.

Annema (2013) considered the use of CBA in decision-making, drawing on empirical research within the Netherlands concerning mega-projects. She argued that CBA outcomes have influenced decision-making in some way, but that ultimately their use has been limited.

8.6 Factors shaping future demand for transport

The Eddington Report (2006b) identified a number of factors that would shape future demands for transport in the UK: the rate of economic growth; population growth and migration patterns; oil prices; and price of carbon (p.29). Eddington (2006b, p.125) considered four cost-benefit measures:

- Conventional benefit/cost ratio (NATA BCR) - the most certain measure but an incomplete measure. It included changes to the overall costs of travel; value of changes to travel times; safety benefits; financial costs of undertaking the project. However no monetary value was placed on environmental benefits, nor on a range of GDP impacts.
- GDP per pound - this approach did include wider economic impacts such as agglomeration, labour market effects, competition impacts and reliability. These effects were indicatively estimated in the Eddington Report.
- Wider benefit/cost ratio (BCR) – this added the 'missing' GDP affects in conventional NATA BCR.
- Value for Money (VfM) BCR – this was the most complete metric in the Eddington Report. It was broader in terms of monetarising the most significant environmental effects (for example carbon, air quality, noise and landscape)

8.7 Carbon emissions and the future price of oil

Banister (2011b) argued that owing to the ubiquity and cheapness of oil, energy costs had not been perceived as problematic in transport. With the growth in travel distances and speeds, more energy and carbon have been used. Banister argued that this dependence on oil is unstable. Scientific evidence of links between carbon emissions and global warming has led many Governments in developed countries to begin the move away from the burning of fossil fuels and put a price on carbon emissions.

pteg (2010) noted that despite the potential of (electric) trams to help reduce carbon outputs, reduce our reliance on fossil fuels, and improve air quality in urban areas there is no appraisal of such processes. They argued that light rail appraisal processes, where light rail is particularly disadvantaged under the current appraisal scheme compared to other modes of transport, "fail to take into account the full range of benefits trams have to offer, including carbon reduction, regeneration impacts, health benefits and potential to promote modal shift" (pteg 2010, p.21). "Linking local renewable energy generation to tram schemes can make a significant contribution to the energy demands of light rail – there are examples in Canada and Germany where 50% or more of the power needed for local light rail is generated from locally sources [sic] renewables" (pteg 2010, p.18). However appraisal schemes in 2010 did not take into account the increasing importance of carbon reductions. Future availability and price of fossil fuel should increase the benefits of investing in light rail systems (pteg 2010). Light rail should be part of a long term plan to decarbonise road transport.

In the widespread public debate about carbon emissions, less attention has been placed on the impacts of high and increasing global oil prices and the consequences of global Peak Oil output being reached within the next 25 years (Knowles 2012b).

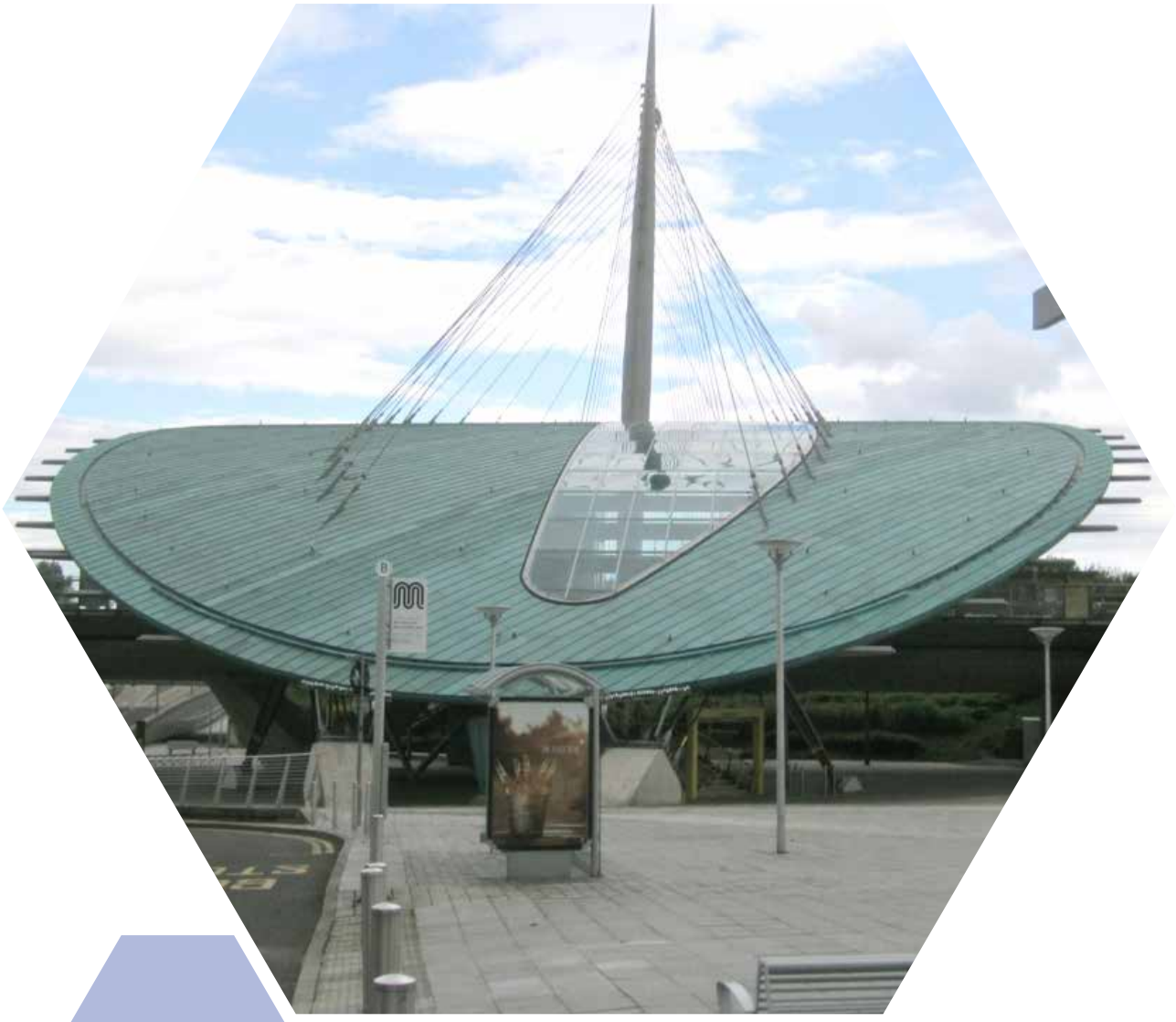
The 20th century was an era of cheap oil and crude oil prices remained between $10 and $25 per barrel in real terms except for brief periods of political turmoil. Since 1999, rising global demand for oil and increasing extraction costs have increased the price of crude oil more than eightfold from $12 to above $100 and it has remained above $100 almost continuously since the 2008/9 global recession with forecasts showing higher future prices. Despite these price increases, UK Government projections since 2000 have underestimated the future price of oil in 2020 despite belatedly revising their projections in 2005, 2008 and 2009 (Table 8.3) (Knowles 2012b, p.9). DECC's most recent central price projection for oil in 2020, is a more realistic $119.7 per barrel (DECC 2013). Consequently, the future demand for private car and air travel, road building and airport expansion have all been overestimated, but for light rail and other public transport investments have been underestimated.

Date	2020 price	UK Government Department
February 2006	$35	Department for Trade and Industry
May 2008	$72	Business Enterprise and Regulatory Reform
July 2009	$80	Department for Energy and Climate Change

Table 8.3

UK Price of Oil in 2020

As the viability of transport investment proposals are measured against these over-optimistic oil price projections for 2020, Government transport investment decisions have discriminated in favour of road building schemes and discriminated against light and heavy rail schemes. Knowles (2007) examples the cancellation of light rail schemes in 2004/5 in Leeds, Liverpool, Manchester and Portsmouth on the Government's assessment of poor value for money. UK Airport expansion policy in 2003 was based on predictions of continuing strong growth in demand and as recently as 2008 Government assumed that aviation fuel would remain at 22 pence per litre until 2080 (Knowles 2012b).



9. CITY IMAGE AND QUALITY

9. CITY IMAGE AND QUALITY

9.1 Boosting city image and quality

The iconic architecture of Manchester's Central Park Metrolink Stop (see previous page), the pedestrianised and landscaped Place Garibaldi in Nice (see Figure 9.5), and the elevated tracks of the DLR, Ørestad Metro and the Vancouver Skytrain (see Figure 2.5) present iconic impacts on the urban landscape (Book et al. 2010; Knowles 1999; 2000; SDG 2005a). Light rail, as an embodiment of modernity and commitment to urban renaissance (SDG 2005a), can boost a city's image and, in the UK "There is clear evidence that all of the schemes implemented to date have had a positive effect on the image of the city" (SDG 2005a, p.4). Furthermore, as an electrified form of public transport, light rail can be linked to lower levels of air pollution, and it emits less noise and vibration than buses (Knowles 1992). These positive factors not only improve the image of a city, but can bring additional benefits to the economy. As Banister and Berechman (2001, p.211) summarised, "image building is key to the revitalisation of central areas and in maintaining strong city centres".

SDG (2005a, p.45) warned that "The question of how light rail improves the "image" of a city and how this in turn leads to tangible improvements in the use of public transport, the economy and environment, is contentious". The ideal model, according to SDG (2005a, p.45), is the "Grenoble Effect", which recognises how one of the first modern French tram systems was used to revitalise the city centre in an aesthetically and pedestrian-friendly way (see Pitrel 2008).

Shaw and Docherty (2014, p.161) argued that "The positive influence of the tram on French cities... cannot be understated". France has provided a template for the type of urban centres that might be achieved. Since the 1980s, modern tramways in cities such as Nantes, Grenoble, Nice, Lyon, Rouen, Montpellier and Bordeaux have been part of larger urban renewal projects that have transformed city centres into more attractive and pedestrian-friendly public spaces (Hass-Klau et al. 2004; Shaw and Docherty 2014). Pedestrianised streets, landscaping and streetscaping improvements - including fountains and public art spaces - have been accompanied by opportunities to transform car-dominated streets with modern tramways.

Light rail has helped to boost city image and SDG (2005a) stressed how this in turn has led to additional economic benefits, in terms of attracting inward investment, business and tourist visitors and increased expenditure (Figure 9.1) (see Theme 2). Similarly, SACTRA (1999) reported that image enhancement can lead to "significant spin-offs" (p.32) (see also Crocker et al. 2000; Docherty et al. 2004; Hass-Klau et al. 2004). "The confidence that is instilled from a very visible, long-term commitment to public transport and the feeling that this indicates an area is "going places", is a common response in user surveys and focus groups. It is also clear that light rail has a role in the 'branding' of places, which other forms of transport such as bus, rarely achieve (SDG 2005a, p.5).

Figure 9.1

The Bordeaux Tram boosts city image and tourism

Place-making refers to the creation of a distinct 'sense of place', for example, shaping public spaces that appeal to potential residents, visitors and other users as physical and symbolic hubs of a community, and thus towards longer-term sustainable urban forms (Cervero 2010; see also Jacobson and Forsyth 2008). The type of activities and land uses that might become the focal point of community building include parks, plazas (which might be used for events or parades), shops, restaurants and cafes, in largely pedestrianised spaces (CfIT 2001). In particular, CfIT (2001) recognised that pedestrianisation plays a critical role in shaping the quality of urban environments by helping to develop spaces of exchange through an emphasis on generating "person interaction in quality urban space rather than on mobility in car dominated streets" (p.24).

Increasingly, public transport hubs and alignments are at the centre of such place-making strategies (Cervero 2010; ITC 2014b) and relate to increased ridership levels and farebox incomes, particularly as more people are attracted to the area (Cervero 2010). Egis Semaly Ltd and Faber Maunsel (2004) argued that surface-level light rail systems offer an opportunity to redesign streetscapes where walking, cycling and public transport are prioritised. Furthermore, the image of light rail as a modern, clear and quality mode of transport blends easily into this vision to create a high quality environment (clean, safe, modern, green, spacious and pedestrianised) that make cities attractive to a range of users (Docherty et al. 2004).

It is recognised that this has been achieved, to a large extent, in some continental European cities, particularly in France and Germany, where joint transport and planning initiatives have helped to transform cities "from being noisy, polluted places into vibrant, people centred environment as well as facilitating the widespread re-allocation of street space to PT [public transport], cycling and walking" (CfIT 2001, p.24). Adopting an holistic approach to transport infrastructure development, light rail projects have been developed in France as opportunities for revitalisation of public spaces, and this is often given as a significant reason why such projects have often been deemed a success (Hass Klau et al. 2004; SDG 2005a). However, while transport projects may increase the image, quality and prestige of a city, or even a country, van Wee and Rietveld (2013) noted that measuring such benefits is extremely difficult.

In addition, it is understood that high-quality organisation and a long-term planning vision can enhance the quality of the city centre through the development of public transport infrastructure and the revitalisation of city centres progressing together (Priemus and Konings 2001). However, this is not created through transport alone.

9.2 Light rail and city image in the UK

SDG (2005a) argued that the idea that light rail can boost a city's image has been noted as a principal motivation for light rail investment in almost all UK examples. SDG also claimed that "There is clear evidence that all of the schemes implemented to date have had a positive effect on the image of the city in which they were built, even where, initially, public reactions may have been adverse (usually due to disruption during construction)" (SDG 2005a, p.4), such as in Sheffield and Manchester. French examples are said to have influenced UK schemes, particularly in the 1990s "with on-street running and, within the limitations imposed by administrative and operational arrangements, as much integration with other public transport modes as possible. There has also been a noticeable improvement in the care taken to ensure that light rail is sensitively incorporated into the urban fabric" (SDG 2005a, p.4). Many assessments of the possible impacts of rapid rail transit have employed methodologies that seek to learn from experiences elsewhere, particularly France and, to a lesser extent, Germany (Egis Semaly Ltd and Faber Maunsel, 2004; ITC 2014a; 2014b; pteg 2010; SDG 2005a).

9.2.1 Light rail and city image in Greater Manchester

Knowles (1999, 2000) conducted interviews with key stakeholders and found an overwhelming positive response to the idea that LRT can boost a city's image. For example, Metrolink was described in terms of (Knowles 2000, p.11):

- The "Tram is an icon of Manchester"
- "Presence on street adds to its (Metrolink's) attraction"
- "Buzzy, energetic, exciting"

Metrolink's positive image was not always strong in the initial stages of its development. SDG (2005a) explained that there were initial problems fitting the system into the city centre, for example in terms of relocating buried utility services. A rather negative image of Metrolink was initially held by the public, although SDG noted that since then, "Metrolink has developed a very positive image and has become an integral part of the renaissance of Manchester" (p.52).

Law et al. (1996) found that Metrolink enhanced people's perception of the attractiveness of the city centre, and their ideas that the city would thus attract new or relocating office-based activities, particularly in central and southern parts. However, Law et al. (1996) found no firm evidence that such development had occurred. In contrast, 11 years after Metrolink commenced operation, the "extensive and popular tram system" contributed to a positive image of Manchester that is attracting major investment from financial institutions (SDG 2005a, p.53).

Roger Tym & Partners Ltd (2006) referred to the expectation, in 1996, that the Metrolink extension to Salford Quays would help improve both the image and quality of the largely derelict dockside area. High crime levels, perceived lack of spaces to eat, shop and spend time, and a perception that female staff were at risk when walking alone, were anticipated to be overcome with the arrival of Metrolink (Roger Tym & Partners Ltd 2006). The Salford Quays area is now a symbolic model of a post-industrial waterfront with mixed-land use developments, landscaping and pedestrianised areas.

9.2.2 Light rail and city image in Sheffield

Initially, Supertram was perceived in a negative light in Sheffield, influenced by considerable disruption to traffic and pedestrians while the system was under construction (SDG 2005a). However, this negative image shifted to a more positive image over time. For example, Dabinett et al. (1999) demonstrated how, in 1993, Sheffield's urban transport facilities were considered to have negative connotations among local and national stakeholders. In a 1996 survey, however, Supertram was referred to positively, and the only positive intra-urban transport facility in Sheffield. Dabinett et al. (1999, p.128) thus suggested that "SYS was beginning to impact positively on the perceptions of the city held by external investors and agents".

Among visitors, SYS was ranked 6th out of 13 of the most attractive developments in the city, and was noted to be modern and efficient. It has become an important element within the city's visitor and tourism promotions, but was not considered to be a visitor attraction in itself (Crocker et al. 2000). Similarly, Lawless and Gore (1999) argued that it is difficult to identify behavioural changes as a result of an improved city image in Sheffield, but Crocker (1996) noted that 'place image' mattered to firms when they were making decisions on location and specific sites within a region.

9.2.3 Light rail and city image in Croydon

Siraut (2004) confirmed that Tramlink has been used in Croydon to market the town as a place with drive, ambition and a 'can do' philosophy. Transport for London (2002) noted that "people expected Tramlink to be 'high tech', fast and reliable and they have not been disappointed. People believe that Tramlink has been a good thing for Croydon and raised its image by helping to put it on the map" as "The London Borough with the Tram" (p.10). In addition, Oscar Faber (2002, p.65) revealed that most people considered that Tramlink had "helped to create a more modern and European feel".

In a similar way, Colin Buchanan and Partners (2003) found that Tramlink instilled "a new sense of civic pride and belonging to many parts of south London – people are proud of their tram and enjoy using it. Extensions will contribute to a sustainable south London." (p.6).

Colin Buchanan and Partners (2003) emphasised that "Tramlink has not only helped to reduce pollution and congestion, is has also helped to create new green spaces, enabled the planting of more trees and made parks and rivers more accessible" (p.4). In addition, it was noted that "The modern cosmopolitan image of the tram has had a significant effect on the visual appeal of town centres. Streets are more pleasant, less congested and less polluted, making them better places for leisure and relaxation, which in turn helps to attract new investment." (p.5).

SDG (2005a, p.62) reported that "Tramlink helped Croydon achieve a more European feel. Other European cities are known to have a light rail system and Tramlink is seen to symbolise this European sophistication. During the summer, people now take advantage of the paved pedestrian areas and sit outside during lunch hours, with pavement cafes becoming a popular feature."

SDG (2005a, p.61) also included individual comments from local businesses in Croydon:

- "Floating vehicles and all this sort of, you know, crazy space stuff. It's, you know, quite cool and sleek, it's almost a shame that they are spoiling them by putting big adverts on the outside"
- "Also it makes it a very cosmopolitan town...it improves the image of Croydon to be a cutting edge rather than following everything."
- "I'm from Yorkshire, and even people I know up there when you mention Croydon, they go 'ur, they've got trams now.'"
- "I think it's a topical thing, so people do talk about it, you know, especially Croydon people but not only Croydon people, I mean the institutions for example, and we do a lot of business with the like of Legal and General, Axia, and people like that, and its a big talking point actually."

9.2.4 Light rail and city image in Newcastle

Knowles (2000, p.11) demonstrated how individuals perceived that LRT boosts Newcastle's image. For example:

- "(Metro has) equivalent status to the Tyne Bridge"
- "Metro brings credibility to the area"
- "Everyone wants one"
- "Done properly LRT improves people's lives"

According to research undertaken by Newcastle City Council, the Metro's distinctive 'M' logo is recognised by visitors as an iconic symbol of Newcastle (Figure 9.2) (SDG 2005a). It has thus been used as one of a number of iconic symbols to promote the city, and plays a key role in the growing importance of tourism in the North-East economy (SDG 2005a). Art in Transport, a Newcastle art scheme, displays art projects at Metro stations and throughout the transport network, and has been said to help maintain Metro's high profile (SDG 2005a) as well as contributing to an attractive environment.

Figure 9.2

The iconic 'M' logo of the Tyne and Wear Metro

9.2.5 Light rail and city image in London Docklands

According to SDG (2005a), the DLR's image has improved over time: "initially conceived as low cost investment to cater for a demand", "The reliability, capacity and accessibility to Docklands offered by the system have all improved as has its image" (p.51). One of the positive features of the DLR is its high visibility, which has had a positive effect on its image (SDG 2005a).

Knowles (2000, p.11) identified some specific perceptions about the DLR among key transit and planning stakeholders:

- "Build DLR on legs to be visible"
- LRT more visible. Tourism attraction, driverless and elevated"

The high visibility of the DLR was seen to have had a positive effect on its image (Buck Consultants International 2000).

9.2.6 Light rail and city image in the West Midlands

Users of the Midland Metro perceived it as "clean, fast and stylish" compared to the "antiquated, slow, dirty and uncomfortable" bus service (Oscar Faber 2000, in SDG 2005a, p.55).

Public art is used in Metro stations to generate a high quality and aesthetic travelling environment. "The commitment of the promoters to public art and community involvement in its design, choice and sitting has proved popular, has contributed to local pride in the system and has possibly led to lower levels of vandalism that would otherwise have been anticipated" (SDG 2005a, p.56).

9.2.7 Light rail and city image in Nottingham

Initial perceptions of NET suggested that it is very popular with local people and that many perceived the system to give the city a continental atmosphere (SDG 2005a).

9.3 Light rail and city image in the UK and Canada

Knowles (1999, 2000) explored how various stakeholders involved in LRT systems perceived the impact that light rail had had on city image in four Canadian and four English cities (Vancouver, Edmonton, Calgary, Toronto; Manchester, London Docklands, Newcastle and Sheffield). 31 of 33 Canadian respondents, and 17 of 19 British respondents agreed that light rail could boost a city's image, while only two respondents in each country disagreed. Respondents also described light rail in these places as (Knowles 2000, p.11):

- "A status symbol"
- "Progressive, modern, cosmopolitan"
- "Big league look. Small city with a big city image"
- "An integral part of promoting city for visitors and tourists"
- A "tool in attracting employers"
- "Boosterism culture"
- "Sending out right signals"

9.4 Light rail and city image in Vancouver, Canada

In Vancouver, SkyTrain initially received negative reactions from residential areas concerning noise levels. The problem was solved by building noise barriers along the corridor (Babalik 2000). However, perceptions are generally positive, and Knowles (1999) found, for example, that SkyTrain is regarded as "a visual icon" (p.6) and "Something as sexy as SkyTrain puts the city into the senior league" (p.8).

9.5 Light rail and city image in France

The positive influence of investment in LRT in French cities is not separate from urban planning, which has revitalised city centres as pedestrianised areas, and aesthetic streetscapes, as part of a transport and urban revitalisation package: the "Grenoble Effect" (SDG 2005a, p.45). Many French schemes run wholly on-street and have good integration with the mainline rail network. Some of the model examples include Grenoble, Nantes, Nice, Lyon and Bordeaux (Figure 9.3)

Figure 9.3

The landscaped Place Masséna in Nice

9.5.1 Light rail and city image in Grenoble

In Grenoble, the tramway was constructed as part of a larger project of city centre pedestrianisation. Wide boulevards were transformed from car thoroughfares and parking to areas specifically designated for public transport (trams) and pedestrians (Figure 9.4). In this way, Grenoble is described as a very attractive place to visit, shop and sit at outdoor cafes (Walmsley & Perrett 1992).

Figure 9.4

The 'Grenoble Effect': Before and After

9.5.2 Light rail and city image in Nantes

Nantes is held up as an influential model of modern tramway development with simultaneous development of pedestrian areas, streetscape enhancements and the 'greening' of public spaces and LRT corridor (SDG 2005a).

SDG (2005b) noted that "Policy makers in the city regard the transformation of Nantes city centre as having hinged on the land use and behavioural changes brought about by the tramway. In particular, they point to the fact the [sic] for every new trip by tram created, an additional unrelated trip on foot is made, which is seen to explain the renewed vitality of retailing and other key city centre activities" (Docherty 2004 in SDG 2005b, p.38).

According to Walmsley and Perrett (1992), Nantes' inhabitants perceived that the tramway had improved the city's image. However, there is little evidence of behaviour change as a result and the authors noted "scanty evidence" of companies moving into the area based on this perception of image alone - "there are usually other factors involved" (p.125).

9.5.3 Light rail and city image in Rouen

Hue (2000, p.41) argued that "As a high-quality investment, [Rouen's] light rail system is striving to make a major contribution to city life and to take on the role of cultural animator - an attempt in some ways to give the light rail system a heart and soul." 84 percent of light rail users in Rouen believe that the system has helped to make the city more modern and improve its image. According to Hue, this is partly due to high-quality architecture associated with the light rail system, a quality urban environment and attractive improvements such as a grassed platform at Petit-Quevilly.

9.5.4 Light rail and city image in Nice

Shaw and Docherty (2014) described the city centre of Nice as unrecognisable in 2014 from how it looked in 2000, and its transformation "is just the latest success for the tramway moderne, the first line of the Niçois version having opened in 2007 as part of a larger project that completely renewed the public realm in the main square and shopping street" (p.161). Place Garibaldi has been transformed from a square in which mopeds and cars were dominant to a pedestrianised space (Figure 9.5).

Figure 9.5

An example of the 'Grenoble Effect': Place Garibaldi in Nice city centre

9.5.5 Light rail, heavy rail and city image in Lille

Euralille, a large complex that includes a rail station (Eurostar, TGV and light metro), financial institutions, offices, apartments, shopping centre, hotel and congress centre, has been an important contributor to improvement of the city image, which has been linked to private investment moving in (ITC 2014b). Euralille is described as having "symbolic value, contributing much to the image and self-confidence of Lille as a modern city" (ITC 2014b, p.12).

9.6 Light rail, heavy rail and city image in Utrecht, the Netherlands

In Utrecht, a 'meaning of place' is part of the basic planning principles to regenerate a quality city centre environment through, for example, green public spaces centred around the main station. Plans include the planting of trees, pedestrianisation and construction of three public squares that will not only connect different parts of the city that have previously been cut off by major road arteries (which are planned to be directed underground via a tunnel), but also give a 'sense of place' as 'the living room of the city' (ITC 2014b). The plans are developed around the main central station, which is an inter-modal transport hub in terms of walking and cycling, as well as bus, light rail and heavy rail transport modes.

9.7 Light rail and city image in Germany

In Germany, "Light rail investment has improved the environmental quality of city centres and they can be used as places for relaxation and cultural activities" (Hass-Klau et al. 2004, p.23).

City quality may be impacted by the type of shops that exist in the city centre. Hass-Klau et al. (2004) considered the role that light rail has played in terms of influencing shops in Germany. Transport corridors have led to increased property and rental prices, which has resulted in some of the more established shops being driven out and replaced by chain stores. This may result in the city centre becoming less visually diverse and interesting, or by those stores that sell higher-quality or fashionable goods, thus turning city centre streets into fashionable avenues, which may improve the quality of the environment.

9.8 Light rail and city image in Copenhagen, Denmark

While light rail can help to create a positive image to a place, this does not exist independently. For example, Knowles (2012a) acknowledged how early development in Ørestad City was slow, and private office developers showed little interest in the area, which led to its initial reputation as a deserted city.

Book et al. (2010) noted that Metro's elevated tracks help to create seamless mobility at ground level by removing barriers to movement, and also to enhance the iconic impact of the Metro on the urban landscape.

In the wider areas of Ørestad New Town, one third of space "is allocated for parks, green areas, lakes and artificial canals whilst large scale leisure space, 'peace and tranquillity' are next door to the west and south in Amager and Kalvebod's nature reserves within West Amager's green wedge" (Knowles 2012a, p.258).

9.9 Light rail and city image in Portland, Oregon, USA

The Head of Planning for Portland, Oregon's Tri-Met Transit Agency, celebrated the city boost that Portland's MAX light rail system has brought to the city's image: "Light rail operates at the surface and offers visibility. Store fronts become billboards for passengers. Light rail penetrates the community and is not separated from it like heavy rail, which is down in a hole or up in the air. Light rail is part of the urban experience - an amenity, a signature for the area. You can put light rail right into the middle of the action... At Portland's Saturday Market, a weekly street fair attended by thousands, the festival literally surrounds the train; it's part of the experience; it's the way to get there" (Bernick and Cervero 1997, p.49).

CONCLUSIONS

CONCLUSIONS

1. Investment in light rail systems can have positive economic impacts on cities. Similar light rail investments in different locations will not necessarily have the same impacts – geography matters. However, light rail investment on its own is unlikely to be a sufficient catalyst for economic change without other supportive policies.

2. Light rail systems can improve economic growth by increasing the attraction of locations for inward investment. However, it is difficult to attribute specific investments in economic activity solely to light rail. To isolate light rail's impacts from other factors and temporal trends, it is important to use similar control areas in Impact Studies.

3. Light rail systems can transform accessibility to previously hard to reach sites such as derelict docklands, brownfield former industrial areas and reclaimed land.

4. By improving accessibility, light rail can provide a trigger to reorganise or rationalise production, distribution and land use.

5. Absence of a well-developed transport system can act as a serious constraint on growth. Transport constraints can be alleviated by increased capacity, better efficiency, new connections and improved accessibility

6. Light rail systems improve accessibility, usually increase land and property values, and enable developer contributions to be made. Increases in land and property value are often not captured.

7. Light rail impacts are enhanced when planning policies are co-ordinated in a transit-oriented development (TOD) to focus investment in housing, employment, activity sites and public services around station sites.

8. Cost Benefit Analysis forecasts the costs and benefits of transport schemes, emphasises time saving and value of time, and has difficulty in valuing environmental, social and wider economic effects even after a New Approach to Appraisal (NATA) was adopted. The UK Government appears to have underestimated the future prices of oil, so demand for light rail and other public transport investments has been underestimated and future demand for private car and air travel has been overestimated.

9. Light rail can boost a city's image and attract inward investment, employers, business and tourist visitors. It can help create a distinct 'sense of place' and have an iconic impact on the urban landscape.

REFERENCES

REFERENCES

***AECOM Transportation, 2012.** Metrolink Business Impacts Study: MediacityUK - Year 1 Report. Transport for Greater Manchester: Manchester

***Airport Watch, 2012. Oil Price (Light Crude – from CNN Money).** [online] Available at:<http://www.airportwatch.org.uk/?p=1689>

Al-Mosaind, M.A., Dueker, K.J., and Strathman, G.J., 1993. Light-rail transit stations and property values: a hedonic price approach. Transportation Research Record, 1400, pp. 90-94

Annema, J.A., 2013. The use of CBA in decision-making on mega-projects: empirical evidence. In: Priemus, H. and van Wee, B. (eds), International Handbook on Mega-Projects, Cheltenham: Edward Elgar, pp. 291-312

Arrington, G.B., 2004. Light rail and the American City: state-of-the-practice for transit-oriented development. Transportation Research Circular E-C058: 9th National Light Rail Transit Conference, pp.189-204

Arrington, G.B., 2009. Portland's TOD evolution: from planning to lifestyle. In: Curtis, C., Renne, J.L. and Bertolini, L. (eds), Transit Oriented Development: making it happen, Farnham, UK and Burlington, Vermont, USA: Ashgate Publishing, pp. 109-124

Atkinson-Palombo, C., 2010. Comparing the capitalisation benefits of light-rail transit and overlay zoning for single-family houses and condos by neighbourhood type in metropolitan phoenix, Arizona. Urban Studies, 47(11), pp. 2409-2426

Atkinson-Palombo, C. and Kuby, M.J., 2011. The geography of advance transit-oriented development in metropolitan Phoenix, Arizona, 2000-2007. Journal of Transport Geography, 19(2), pp. 189-199

Babalik, E., 2000. Urban Rail Systems: a planning framework to increase their success. Thesis submitted to the University of London for the degree of PhD, London

Babalik-Sutcliffe, E., 2002. Urban rail systems: Analysis of the factors behind success. Transport Reviews, 22(4), pp. 415-447

Banister, D., 2005. Unsustainable Transport: City Transport in the New Century. London: Routledge

Banister, D., 2007. Sustainable transport: challenges and opportunities. Transportmetrica, 3(2), pp. 91-106

Banister, D., 2011a. Cities, mobility and climate change. Journal of Transport Geography, 19, pp. 1538-1546

Banister, D., 2011b. The trilogy of distance, speed and time. Journal of Transport Geography, 19, pp. 950-959

Banister, D. and Berechman, Y., 2000. Transport Investment and Economic Development. London: University College Press

Banister, D. and Berechman, J., 2001. Transport investment and the promotion of economic growth. Journal of Transport Geography, 9, pp. 209-218

Banister, D. and Thurstain-Goodwin, M., 2011. Quantification of the non-transport benefits resulting from rail investment. Journal of Transport Geography, 19, pp. 212-223

Bartholomew, K. and Ewin, R., 2011. Hedonic price effects of pedestrian- and transit-designed development. Journal of Planning Literature, 26(1), pp. 18-34

Belzer, D. and Autler, G., 2002. Transit Oriented Development: moving from rhetoric to reality. Washington DC: Brookings Institute Center on Urban and Metropolitan Policy and Great American Station Foundation

Berechman, J. and Paaswell, R., 1983. Rail rapid transit investment and CBD revitalisation: methodology and results. Urban Studies. 20(4), pp. 471-486

Bernick, M. and Cervero, R., 1997. Transit Villages for the 21st Century, New York: McGraw-Hill

Berry, B. J. L., Tennant, R. J., Garner, B. J. and Simmons, J. W., 1963. Commercial structure and commercial blight. Research Paper 85, Chicago: University of Chicago, Department of Geography

Bertolini, L., Curtis, C., and Renne, J.L., 2009. Introduction. In: Curtis, C., Renne, J.L. and Bertolini, L. (eds), Transit Oriented Development: making it happen, Farnham, UK and Burlington, Vermont, USA: Ashgate Publishing, pp.4-12

Binder, A. and Knowles, R., 2013. Transport choice, accessibility and modal shift - constraints on achieving a travel plan target at MediaCityUK, Salford. RGS-IBG Conference presentation, London, August 2013

Boarnet, M.G. and Compin, N.S., 1999. Transit-Oriented development in San Diego county: The incremental implementation of a planning idea. Journal of the American Planning Association, 65(1), pp. 80-95

Book, K., Eskilsson, L., and Khan, J., 2010. Governing the balance between sustainability and competitiveness in urban planning: the case of the Ørestad Model. Environmental Policy and Governance, 20, pp.382–396

Bragado, N.S., 1999. Transit joint development in San Diego: Policies and practices. Transportation Research Record, 1669, pp. 22-29

Bråthen, S., 2001. Do fixed links affect local industry? A Norwegian case study. Journal of Transport Geography, 9, pp.25-38

***Buck Consultants International, 2000.** LiRa: International Network of Light Rail Cities: state of the art. Produced for The European Union, North Western Metropolitan Area, Interreg II C Programme, Nimegen

***Carter, D., 1991.** London Docklands: The DLR's Dash for Growth. Light Rail Review, 2, pp.67-77

***cebr, 2008a.** Assessing the economic impact of the construction of the Wednesbury - Stourbridge extension. London: Centre for Economics and Business Research Ltd

***cebr, 2008b.** Modelling the Midland Metro: Understanding the wider economic benefits of the City Centre extension. A report for Centro: London.

Cervero, R., 1998 The Transit Metropolis: A Global Inquiry, Washington DC: Island Press

Cervero, R., 2009. Public transport and sustainable urbanism: global lessons. In: Curtis, C., Renne, J.L. and Bertolini, L. (eds), Transit Oriented Development: making it happen, Farnham, UK and Burlington, Vermont, USA: Ashgate Publishing, pp.23-38

Cervero, R., 2010. Transit transformations: private financing and sustainable urbanism in Hong Kong and Tokyo. In: Ascher, W. & Krupp, C. (eds), Physical Infrastructure Development: Balancing the Growth, Equity and Environmental Imperatives, New York: Palgrave Macmillan, pp.165-185

***Cervero, R. and Duncan, M., 2001.** Rail transit's value added: effects of proximity to light and commuter rail transit on commercial land values in Santa Clara County, California, California: National Association of Realtors, Urban Land Institute

***Cervero, R. and Duncan, M., 2002a.** Land value impacts of rail transit services in San Diego County, California: National Association of Realtors, Urban Land Institute

Cervero, R. and Duncan, M., 2002b. Transit's value-added: effects of light and commuter rail services on commercial land values. Transportation Research Record, 1805, pp. 8-15

Cervero, R. and Murakami, J., 2009. Rail and property development in Hong Kong: experiences and extensions. Urban Studies, 46(10), pp. 2019-2043

Cervero, R. Ferrell, C. & Murphy, S., 2002. Transit-oriented development and joint development in the United States: a literature review, Research Results Digest 52 Transit Cooperative Development Program: Washington DC pp.39-40

Cervero, R., Arrington, G.B., Smith-Heimer, J.S., Dunphy, R., 2004. Transit-Oriented Development in the United States: Experiences, Challenges and Prospects. Transit Cooperative Research Program, Report 102, Washington, DC.

***CfIT, 2001.** European best practice in delivering integrated transport. London: Commission for Integrated Transport

Chen, H., Rufolo, A., and Drucker, K., 1998. Measuring the impact of light rail systems on single-family home values: a hedonic approach with geographic information system application. Transportation Research Record, 1617, pp.38-43

Church, A., 1990. Transport and urban regeneration in London Docklands: a victim of success or a failure to plan? Cities,. 7, pp. 289-303

***Colin Buchanan and Partners, 2003.** Economic and regeneration impact of Tramlink. Report for the South London Partnership, funded by the London Development Agency. Transport for London and the London Boroughs of Croydon & Sutton, July 2003

Crocker, S., 1996. Place image marketing and infrastructure investment. Urban Transport Investment Studies, 35, Sheffield: Centre for Regional Economic and Social Research, Sheffield Hallam University

Crocker, S., Dabinett, G., Gore, T., Haywood, R., Hennebury, J., Herrington, A., Kirkpatrick, A., Lawless, P. and Townroe, P., 2000. Monitoring the economic and development impact of South Yorkshire Supertram, Sheffield: Centre for Regional Economic and Social Research, Sheffield Hallam University

***CTOD 2008.** Capturing the Value of Transit. Prepared for United States Department of Transportation Federal Transit Administration by Centre for Transit-Oriented Development

Dabinett, G., 1998. Realising regeneration benefits from urban infrastructure investment. Town Planning Review, 69(2), pp. 171-189

Dabinett, G., Gore, T., Haywood, R. and Lawless, P., 1999. Transport investment and regeneration, Sheffield: 1992-1997. Transport Policy, 6, pp. 123-134

Davoudi, S., Gilliard, A., Healey, P., Pullen, B., Raybould, S., Robinson, F., Silcock, D. and Wymer, C., 1993. The longer term effects of the Tyne and Wear Metro. Transport Research Laboratory, Contractor Report 357

Debrezion, G., Pels, E. and Rietveld, P., 2007. The impact of railway stations on residential and commercial property value: a meta-analysis. Journal of Real Estate Finance and Economics, 35, pp. 161-80

***DECC, 2013.** Fossil Fuel Price Projections. London: Department of Energy and Climate Change. July

***DfT, 2005.** Transport, Wider economic benefits, and Impacts on GDP. Technical Paper, London: Department for Transport

***DfT, 2007.** Transport Analysis Guidance (TAG), Unit 3.13.1, Guidance on Rail Appraisal, London: Department for Transport

***DfT, 2009.** NATA Refresh: Appraisal for a Sustainable Transport System, London: Department for Transport

***Diaz, R.B., 1999.** Impacts of Rail transit on property values. APTA 1999 Rapid Transit Conference Proceedings Paper

Dickens, I., 1992. Transport investment, economic development and strategic planning: the example of light rail transit. Planning Practice & Research, 7(2), pp. 9-12

***Docherty, I., 2004.** Innovative Public Transport and the Urban Renaissance. Unpublished working paper, University of Glasgow

Docherty, I., Shaw, J., Knowles, R. and Mackinnon, D., 2009. Connecting for competitiveness: the future of transport in UK city regions. Public Money and Management, 29(5), pp. 321-328

Dorsey, B. and Mulder, A., 2013. Planning, place-making and building consensus for transit-oriented development: Ogden, Utah case study. Journal of Transport Geography, 32, pp. 65-76

Du, H. and Mulley, C., 2007. The short-term land value impacts of urban rail transit: Quantitative evidence from Sunderland, UK. Land Use Policy, 24(1), pp. 223-233

Dueker, K.J. and Bianco, M.J., 1999. Light-rail-transit impacts in Portland: the first ten years. Transportation Research Record, 1685, pp. 171-180

Duncan, M., 2008. Comparing rail transit capitalization benefits for single-family and condominium units in San Diego, California. Transportation Research Record, 2067, pp. 120-130

Duncan, M., 2011. The synergistic influence of light rail stations and zoning on home prices. Environment and Planning A, 43, pp. 2125-2142

Dwarka, K and Feitelson, R., 2013. The political economy of urban infrastructure. In: Priemus, H. and van Wee, B. (eds), International Handbook on Mega-Projects, Cheltenham: Edward Elgar, pp.158-181

***Eady, S., 2014.** A match (not) made in Heaven: MediaCityUK and the Salford Community. Unpublished dissertation. Oxford: University of Oxford

***Eddington, R., 2006a.** Transport's Role in Sustaining the UK's Productivity and Competitiveness. London: The Stationery Office

***Eddington, R., 2006b.** The Eddington Transport Study: the case for action. Sir Rod Eddington's advice to Government. London: The Stationery Office

***Egis Semaly Ltd and Faber Maunsel, 2004.** Comparative Performance Data from French Tramways Systems. South Yorkshire Passenger Transport Executive

Fan, Y., Guthrie, A. and Levinson, D., 2012. Impact of light-rail implementation on labor market accessibility: a transportation equity perspective. The Journal of Transport and Land Use, 5(3), pp. 28-39

Fitzsimmons, N. and Birch, W., 2004. Hudson-Bergen Light Rail System and Economic Development on the Waterfront. Transportation Research Circular E-C058: 9th National Light Rail Transit Conference, pp.205-214

Forrest, D., Glen, J. and Ward, R., 1996. The Impact of a Light Rail System on the Structure of House Prices: A Hedonic Longitudinal Study. Journal of Transport Economics and Policy, 30(1), pp. 15-29

Fullerton, B. and Knowles, R.D., 1991. Scandinavia, London: Paul Chapman Publishing

Giuliano, G., 1995. Land use impacts of transportation investments: highway and transit. In: Hanson, S. (ed), The Geography of Urban Transportation. New York: Guilford Press, pp.305-341

Goetz, A. 2013. Suburban sprawl or urban centres: tensions and contradictions of smart growth approaches in Denver, Colorado. Urban Studies 50(11): 2178-2195.

Goetz, E.G., Ko, K., Hagar, A., Ton, H. and Matson, J. 2010. The Hiawatha line: impacts on land use and residential housing value (CTS 10-04) Minneapolis, MN: Centre for Transportation Studies.

Gordon, P. and Kolesar, P.E., 2011. A Note on Rail Transit cost-benefit analysis: Do nonuser benefits make a difference? Public Works Management and Policy, 16(2), p.p. 100-110

Graham, D., 2007. Agglomeration, productivity and transport investment. Journal of Transport Economic and Policy, 41(3), pp. 317- 343

Grant, C., 1990. Public transport in London Docklands: The Chicken or The Egg. Journal of the Institute of Highways & Transportation, pp.1-12

Hansen, W. G., 1959. How accessibility shapes land use. Journal of the American Institute of Planners, 25, pp. 73-76

Hass-Klau, C., Crampton, G.R. and Benjari, R., 2004. Economic impacts of light rail: the results for 15 urban areas in France, Germany, UK and North America. Environmental and Transport Planning, UK: Brighton

Haywood, R., 1999. South Yorkshire Supertram: its property impacts and their implications for integrated land use-transportation planning. Planning Practice and Research, 14(3), pp. 277-299

He, J., and Zheng, S., 2004. Can new rail transit raise housing price? Case study of Beijing's City Rail (Line 13). Urban Development, 6, pp.36-38

Hensher, D.A., Truong, P., Mulley, C. and Ellison, R., 2012. Assessing the wider economy impacts of transport infrastructure investment with an illustrative application to the North-West Rail Link project in Sydney. Journal of Transport Geography, 24, pp. 292-305

Heseltine, P.M. and Mulley, C., 1993. Longer-term benefits of the Tyne and Wear Metro. Transportation Planning Systems, 1, pp.47-55

Hess, D.B. and Almeida, T.M., 2007. Impact of proximity to light rail rapid transit on station-area property values in Buffalo, New York. Urban Studies, 44(5-6), pp. 1041-1068

***House of Commons Transport Committee, 2005.** Integrated Transport: the future of light rail and modern trams in the United Kingdom. London: The Stationery Office Limited

Hoyle, B. and Smith, J., 1998. Transport and development: conceptual frameworks. In: Hoyle, B. and Knowles, R. (eds), Modern Transport Geography, 2nd edn, Chichester: Wiley, pp.13-40

***Hue, R., 2000.** Rouen's Light Rail System: factors in its success. Public Transport International, 5, pp. 38-42

Ibeas, A., Cordera, R., dell'Olio, L., Coppola, P. and Dominguez, A., 2012. Modelling transport and real-estate values interactions in urban systems. Journal of Transport Geography, 24, pp. 370-382

***ITC, 2014a.** Capturing the Value of High Speed Rail. Learning from Europe: the Lille Symposium 2014. Summary Report March, London: Independent Transport Commission

***ITC, 2014b.** 'Learning from Europe': field study background information. The Spatial Effect of High Speed Rail, London: Independent Transport Commission

Jacobson, J. and Forsyth, A., 2008. Seven American TODs: good practices for urban design in transit-oriented development projects. The Journal of Transport and Land Use, 1(2), pp. 51-88

***Kandall, P., 1995.** Plan for Mass Transit. Newsweek, 15 May

Kittrell, K., 2012. Impacts of vacant land values Comparison of Metro Light Rail Station Areas in Phoenix, Arizona. Transportation Research Record, 2276, pp. 138-145

Knight, R.L., 1980. The impact of rail transit on land use: evidence and a change of perspective. Transportation, 9, pp. 3-16

Knight, R.L. and Trygg, L.L., 1977. Evidence of land use impacts of Rapid Transit Systems, Transportation, 6, pp. 231-247

Knowles, R.D., 1992. Light rail transport. In: Whitelegg, J. (ed.) Traffic Congestion: is there a way out? Hawes: Leading Edge Press, pp.107-133

Knowles, R.D., 1996. Transport impacts of Greater Manchester's Metrolink light rail system. Journal of Transport Geography, 4(1), pp. 1-14

***Knowles, R.D., 1999.** Impacts of New Light Rail Transit Systems in Canada and Great Britain. Unpublished working paper, University of Salford

Knowles, R.D., 2000. Light rail transit's impacts in British and Canadian cities. Paper presented at the Association of American Geographers Annual Meeting, USA: Pittsburgh, April 6 2000

Knowles, R.D., 2006. Transport shaping space: differential collapse in time-space. Journal of Transport Geography, 13, pp. 407-425

Knowles, R.D., 2007. What future for light rail in the UK after the Ten Year Transport Plan targets are scrapped? Transport Policy, 14, pp. 81-93

Knowles, R.D., 2012a. Transit Oriented Development in Copenhagen, Denmark: from the Finger Plan. Journal of Transport Geography, 22, pp. 251-261

Knowles, R.D., 2012b. Transport shaping space, before and after Peak Oil. Hoyle Lecture in Transport Geography, Royal Geographical Society (with IBG) Conference, Edinburgh 3rd July

Knowles, R. D. and Abrantes, P., 2008. Buses and Light Rail: stalled en route? In: Docherty, I. and Shaw, J, (eds), Traffic Jam: Ten Years of Sustainable Transport in the UK, Bristol: Policy Press, pp. 97-116

Lakshmanan, T.R., 2011. The broader economic consequences of transport infrastructure investments. Journal of Transport Geography, 19, pp. 1-12

Landis, J., Guathakurta, S. and Zhang, M., 1994. Capitalization of transportation investments into single-family home prices. Working Paper 619, Institute of Urban and Regional Development, University of California

Lavery, T.A. and Kanaroglou, P., 2012. Rediscovering light rail: Assessing the potential impacts of a light rail transit line on transit oriented development and transit ridership. Transportation Letters, 4(4), pp. 211-226

Law, C., Knowles, R., Grime, E. and Senior, L., 1996. Metrolink Impact Study. Department of Geography, University of Salford.

Lawless, P., 1999. Transport investment and urban regeneration in a provincial city: Sheffield, 1992-1996. Environment and Planning C: Government and Policy, 17, pp. 211-226

Lawless, P. and Gore, T. 1999. Urban regeneration and transport investment: a case study of Sheffield 1992-96. Urban Studies, 36(3), pp. 527-545

Liang, Q., Kong, L.. and Deng, W., 2007. Impact of urban rail transit on real estate value: the case of Beijing metro Line 13. China Civil Engineering Journal, 40(4), pp.98-103

Loo, B.P.Y., Chen, C. and Chan, E.T.H., 2010. Rail-based transit-oriented development: lessons from New York City and Hong Kong. Landscape and Urban Planning, 97, pp.202-212

Macharis, C. and Nijkamp, P., 2013. Multi-actor and multi-criteria analysis in evaluating mega-projects. In: Priemus, H. and van Wee, B. (eds) International Handbook on Mega-Projects, Cheltenham: Edward Elgar pp. 242-266

Mackett, R. and Sutcliffe, E.B., 2003. New urban rail systems: A policy-based technique to make them more successful. Journal of Transport Geography, 11(2), pp. 151-164

Mackett, R.I. and Edwards, M., 1998. The impact of new urban public transport systems: will the expectations be met? Transportation Research A, 32(4), pp. 231-245

Mackie, P. and Worsley, T., 2013, International Comparisons of Transport Appraisal Practice. Overview Report. Leeds: University of Leeds

Mathur, S. and Smith, A., 2013. Land value capture to fund public transportation infrastructure: examination of joint development projects' revenue yield and stability. Transport Policy, 30, pp. 327-335

Medda, F., 2012. Land value capture finance for transport accessibility: a review. Journal of Transport Geography, 25, pp. 154-161

Mohammad, S.I., Graham, D.J., Melo, P.C. and Anderson, R.J. 2013. A meta-analysis of the impact of rail projects on land and property values. Transportation Research Part A, 50, pp. 158-170

***NAO, 2004.** Improving public transport in England through light rail. Report by the Comptroller and Auditor General HC 518 Session 2003-2004, London: The Stationery Office

O'Sullivan, A., 2003. Urban Economics. McGraw-Hill Higher Education

Ohland, G., 2004. Mockingbird Station and Addison Circle. In: Dittmar, H. and Ohland, G. (eds) The New Transit Town: Best Practices in Transit Oriented Development, Washington DC: Island Press, pp. 155-174

***Ohland, G. and Poticha, S., 2009.** Why streetcars and why now? In: Ohland, G. and Poticha, S. (eds) Street Smart Streetcars and Cities in the 21st Century, Washington DC: American Public Transportation Association and the Community Streetcar Coalition

***Oscar Faber, 2000.** Midland Metro Line 1 Monitoring. Working paper 12 - Focus groups - CENTRO

***Oscar Faber, 2002.** Croydon Tramlink Impact Study: Summary Report, Transport for London

Ovenell, N., 2007. A second hedonic longitudinal study on the effect on house prices of proximity to the Metrolink Light Rail System in Greater Manchester. Unpublished MSc Transport Engineering and Planning Dissertation, University of Salford.

Pacheco-Raguz, J.F., 2010. Assessing the impacts of light rail transit on urban land in Manila. The Journal of Transport and Land Use, 3(1), pp. 113-138
Pan, Q., 2013. The impacts of an urban light rail system on residential property values: A case study of the Houston METRORail transit line. Transportation Planning and Technology, 36(2), pp. 145-169

Parkinson, W., 1981. The Effect of Road Investment on Economic Development in the UK, Government Economic Service Working Paper No. 43, London: Department for Transport

***Pitrel, J., 2008.** LRT boom, its effect on modal shift and environment: the case of France and Grenoble. 9th UITP Light Rail Conference, June 2008, Istanbul

Pooley, C.G., Turnbull, J., and Adams, M., 2005. A Mobile Century? Changes in Everyday Mobility in Britain in the Twentieth Century, Aldershot: Ashgate Publishing

Priemus, H. and Konings, R. 2001. Light rail in urban regions: What Dutch policymakers could learn from experiences in France, Germany and Japan. Journal of Transport Geography, 9(3), pp. 187-198

***pteg, 2010.** Light Rail and the City Regions Inquiry. Final Report. All Party Parliamentary Light Rail Group/ pteg

Ratner, K. A. and Goetz, A.R., 2013. The reshaping of land use and urban form in Denver through transit-oriented development. Cities, 30, pp. 31-36

Renne, J.L., 2009. Measuring the success of transit oriented development. In: Curtis, C., Renne, J.L. and Bertolini, L. (eds), Transit Oriented Development: making it happen, Farnham, UK and Burlington, Vermont, USA: Ashgate Publishing, pp.241-255

***RICS, 2004.** Land Value and Public Transport Stage Two: testing the methodology on the Croydon Tramlink. London: Office of the Deputy Prime Minister and Department for Tranport

Rietveld, P., 1994. Spatial economic impacts of transport infrastructure supply. Transportation Research A, 28(4), pp. 329-341

***Riley, D., 2001,** Taken for a Ride: Trains, Taxpayers and the Treasury, Centre for Land Policy Studies

Roberts, J., 1985. Light rail: what relevance for Docklands, London? In , Williams, A.F. (ed) Rapid Transit Systems in the UK: problems and prospects. Transport Study Group, Institute of British Geographers, pp.98-137

Robinson, J.F.F. and Stokes, G., 1987. Rapid Transit and Land Use: the effects of the Tyne and Wear Metro. DP-88, Newcastle: Centre for Urban and Regional Development Studies, University of Newcastle upon Tyne

***Roger Tym & Partners Ltd, 1996.** Forecast Employment at 1998 and 2013 in the Pomona/Cornbrook, Exchange Quay, Salford Quays and Eccles Development Areas. In association with Greater Manchester PTE, Manchester

Roukouni, A. and Medda, F., 2012. Evaluation of value capture mechanisms as a funding source for urban transport: the case of London's Crossrail. Procedia: Social and Behavioural Sciences, 48, pp. 2393-2404

Ryan, S., 1999. Property values and transportation facilities: Finding the transportation-land use connection. Journal of Planning Literature, 13(4), pp. 412-427

***SACTRA, 1999.** Transport and the Economy. London: The Stationery Office

***SDG, 2005a.** What Light Rail can do for Cities: a review of the evidence. Final Report, London: Steer Davies Gleave

***SDG, 2005b.** What Light Rail can do for Cities: a review of the evidence. Final Report: Appendices, London: Steer Davies Gleave

Senior, M. L., 2009. Impacts on travel behaviour of Greater Manchester's light rail investment (Metrolink Phase 1): evidence from household surveys and Census data. Journal of Transport Geography, 17, pp. 187-197

Shaw, J. and Docherty, I., 2014. The Transport Debate, Bristol: Policy Press

***Siraut, J., 2004.** Economic and regeneration impacts of Croydon Tramlink. In: Brebbia, C.A. and Wadhwa, L.C. (eds), Urban Transport X, Southampton: WIT Press, pp. 873-882

***TCRP, 2004.** Transit-oriented development in the United States: experiences, challenges, and prospects. In: Research Results Digest, Washington DC: Transit-Cooperative Research Program

Tian, L., 2006. Impacts of transport projects on residential property values in China: evidence from two projects in Guangzhou. Journal of Property Research, 23(4), pp.347-365

Townroe, P. and Dabinett, G., 1995. The evaluation of public transport investments within cities. Annals of Regional Science, 29, pp. 175-188

TRRL, 1986. The Metro Report - The Impact of Metro and Public Transport Integration. Crowthorne: Tyne and Wear Metro, Monitoring and Development Study, University of Newcastle upon Tyne, Tyne and Wear County Council, Tyne and Wear PTE

***Truelove, P., 1997.** Funding and extending the Docklands Light Railway. Proceedings of the International Conference on Automated People Movers, p.183

Turton, B. and Knowles, R., 1998. Urban transport problems and solutions. In: Hoyle, B. and Knowles, R. (eds), Modern Transport Geography, 2nd edn, Chichester: Wiley, pp.135-157

van Wee, B. and Rietveld, P., 2013. CBA: ex ante evaluation of mega-projects. In: Priemus, H. and van Wee, B. (eds), International Handbook on Mega-Projects, Cheltenham: Edward Elgar pp.269-290

Venables, A.J. 2007. Evaluating urban transport improvements: cost benefit analysis in the presence of agglomeration and income tax, Journal of Transport Economics and Policy, 41(2): 173-188

Vickerman, R., 2008. Transit investment and economic development. Research in Transportation Economics, 23, pp. 107-115

Vickerman, R., 2013. The wider economic impacts of mega-projects in transport. In: Priemus, H. and van Wee, B. (eds), International Handbook on Mega-Projects, Cheltenham: Edward Elgar pp.381-397

***Volterra Consulting 2008.** Economic Benefits of the Metrolink Extension. Manchester Enterprises in association with Colin Buchanan: Manchester

Walmsley, D. and Perrett, K., 1992. The effects of rapid transit on public transport and urban development, London: The Stationery Office

Walton, W. and Shaw, J., 2003. Applying the new appraisal approach to transport policy at the local level in the UK. Journal of Transport Geography, 11,pp.1-12

Wang, X., Zhu, D., and Zhang, M., 2004. Impacts or urban rail transit on land and housing prices: case study of Beijing's light rail transit Line 13. Urban Issues, 6, pp.39-42

Weinberger, R., 2001. Light rail proximity: benefit or detriment in the case of Santa Clara County, California? Transportation Research Record, 1747, pp. 104-113

Weinstein, B. and Clower, T., 1999. The initial economic impacts of the DART LRT system. Denton, Texas: University of North Texas, Center for Economic Development and Research report prepared for the Dallas Area Rapid Transit District.

Williams, A.F., (ed.) 1985. Rapid Transit Systems in the UK: problems and prospects. Transport Study Group, Institute of British Geographers.

Yan, S., Delmelle, E. and Duncan, M., 2012. The impact of a new light rail system on single-family property values in Charlotte, North Carolina. Journal of Transport and Land Use, 5(2), pp. 60-67

Zhang, M. and Wang, L., 2013. The impacts of mass transit on land development in China: the case of Beijing. Research in Transportation Economics, 40, pp. 124-133

Zhang, H., Ma, J., and Zhu, H., 2007. Price influence of urban mass transit on housing projects along the line. Journal of Beijing Jiaotong University, 31(3), pp.10-13

***Non-peer reviewed; not verified independently and anonymously by experts in the particular type of research.**

Professor Richard Knowles
Professor of Transport Geography - University of Salford, Manchester
r.d.knowles@salford.ac.uk

Dr Fiona Ferbrache
Senior College Lecturer (Human Geography) – Keble College, University of Oxford
Associate of the Transport Studies Unit, Oxford University
Editor of Geography Directions
Fiona.ferbrache@keble.ox.ac.uk

UK Tram Limited
Centro
Centro House
16 Summer Lane
Birmingham
B19 3SD
Email uktram@centro.org.uk

MAR14051