World Cities Research

Final Report on World Cities

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Summary

In November 2004, the Commission for Integrated Transport (CfIT) charged MVA with investigating the strategies being implemented to manage traffic growth and congestion in a sample of cities. This report covers the 'world cities' and other large comparators, namely: Barcelona; London; Moscow; Madrid; New York; Paris; Singapore; and Tokyo.

The research has been undertaken in three phases comprising a desk study of available documentation, case studies based on interviews with relevant authorities in the cities and an analysis of the impacts of transport strategies. Statistical evidence is limited and the key outcomes have been changes in car modal share, public transport patronage, and traffic levels and speed as proxy measures of congestion.

The work has shown that national economies depend on the contribution of large cities, and while there have been fluctuations associated with world or local events, the city economies have remained strong. Economic development has driven population growth and the resulting competition for land has given rise to a process of suburbanisation that started at different times, but has occurred in all the cities and continues to the present. The increasing need to travel from lower density suburbs to more centralised employment areas or edge of town commercial centres, coupled with increasing household wealth and rising car ownership has fuelled growth in mobility.

Some of this increase has come from higher trip rates, but the main contributor has been the increase in distances travelled. Cities that have sprawled more, or gone further in allowing the separation of people and jobs, now have the longest average journey lengths.

The challenge facing all cities has been how to accommodate this growth in travel demand which is becoming increasingly disparate and more difficult to meet with cost-effective public transport. There is some commonality in the policies that have been implemented. All of the cities have adopted a combination of highway investment (typically ring roads to reduce through traffic in city centres) and public transport improvements. Some have also sought to radically improve conditions for pedestrians and cyclists in the hope that this will attract short-distance car users.

None of the cities has harnessed the full potential of land use policies to contain low-density sprawl, ensure a mix of development types to reduce the need to travel, or increase public transport patronage through transit-oriented development. Greater progress has been made in Barcelona, Singapore and Tokyo where new lines

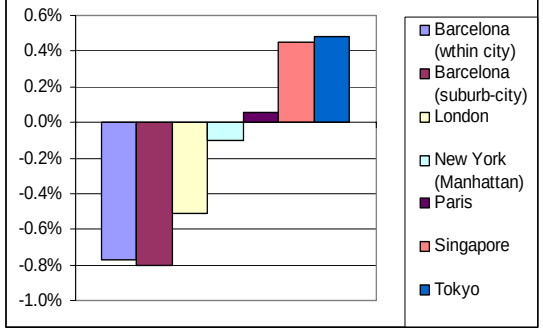
are generally keeping pace with development, and it is these cities that have the lowest reliance on public sector subsidy.

Most of the cities have implemented some form of traffic restraint, but the commitment to reducing car use and the measures used vary. For example, Barcelona has implemented physical restrictions on car access to the historic core and other environmentally-sensitive neighbourhoods and, like Madrid, there has been a major programme to reallocate road space to pedestrians. Parking provision is extremely limited in London and New York, there are high user charges and the authorities are committed to effective enforcement.

There are tolls on strategic inter-urban routes in most cities and on the bridge and tunnel approaches to Manhattan Island. Congestion charging has been implemented in London and Singapore; the London scheme charges drivers a £5 daily fee for driving within the zone, whereas the Electronic Road Pricing Scheme (ERP) in Singapore charges drivers each time they enter the charging zone and the rate varies according to congestion levels (monitored by average vehicle speeds).

Data on changes in modal share are only available for six cities and in varying formats which makes comparison difficult. However, the study has shown that Barcelona and London have been successful in reducing car dependency (Figure 1).

Figure 1 - Annual Average Change in Car Mode Share



Barcelona has seen a fall of 0.8% pa in the proportion of trips made by private transport both within the inner city[1] and between the inner city and the suburbs in the past four years, with a consequent reduction in traffic and rise in average speed. This has been achieved through a combination of investment in public transport, integrated fares and ticketing and restrictions on car use through access controls, removal of car parking and the reallocation of road space to pedestrians. These policies have been assisted by the existing mix of people and jobs, extremely high land use density and good pedestrian facilities in the inner city which have increased the feasibility of using alternative modes.

Barcelona's strategy is expensive; the city typically spends 2% of its GDP on transport, and the 10 Year Infrastructure Plan for 2001-2010 is worth 7.3billion euros (£6bn adjusted for purchasing power

[1] Within the ring road

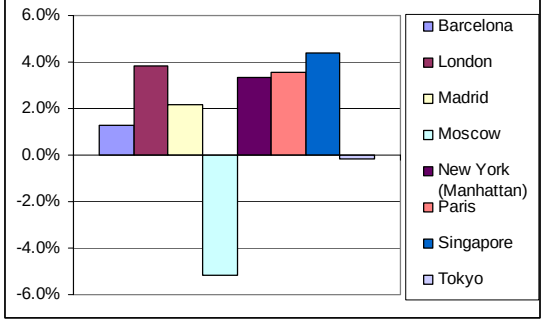
parity); however, this contains a further 251km of new suburban rail and metro.

In London, the car mode share has fallen by 0.5% per annum between 1993 and 2003, and by 0.8% between 1999-2003 to compare with Barcelona. The strategy has comprised investment in public transport (including expanding the bus network, increasing frequencies and better reliability through continued implementation of bus priority measures and operator incentives) and the introduction of congestion charging.

Whilst it has been controversial, the charge has been effective in increasing public transport patronage and reducing traffic and delays in central London, and has not resulted in substantially higher flows on perimeter routes. It has also created a revenue stream (estimated at £1.3bn over 10 years of operation) for further transport improvements. London is now spending nearly 3% of its GDP on transport and the Five Year Investment Programme (2005/06-2009/10) includes £10bn of investment in extending the East London Line, Metropolitan (Underground) Line and new Docklands Light Railway links.

Public transport patronage has also increased substantially in Singapore (Figure 2). The rise is due to the continuing growth in population at accessible locations, and an increase in the public transport trip rate resulting from the combination of rail and bus network extensions and traffic restraint. The transport strategy has sought to balance the supply and demand for road space, rather than reduce car use *per se,* and so the car mode share has increased, but the ERP has been successful in ensuring that as traffic rose, average speeds remained constant. This approach contrasts with Moscow, where there have been no constraints on car use and the public transport trip rate has been falling in parallel with the rapid increase in car ownership which has doubled over the past 10 years.

Figure 2 - Annual Average Change in Public Transport Trip Rate



Amongst the key factors that have assisted the success of policies has been integrated planning, particularly to ensure a 'carrot and stick' approach to providing alternative modes and discouraging car use, and co-ordinating transport and land use policies to reduce sprawl and contribute to an urban structure suitable for walking, cycling and cost-efficient public transport.

Other factors have included the need for long-term political consensus and continuity in the planning and delivery of the strategy. Where policies have been controversial, such as access controls in Barcelona and congestion charging in London and Singapore, these were made more acceptable by being ‘sold’ to the public as part of a package of measures.

1 Introduction

1.1 Introduction

1.1.1 In November 2004, the Commission for Integrated Transport (CfIT) charged MVA with investigating the strategies being implemented to manage traffic growth and address congestion in a sample of cities.

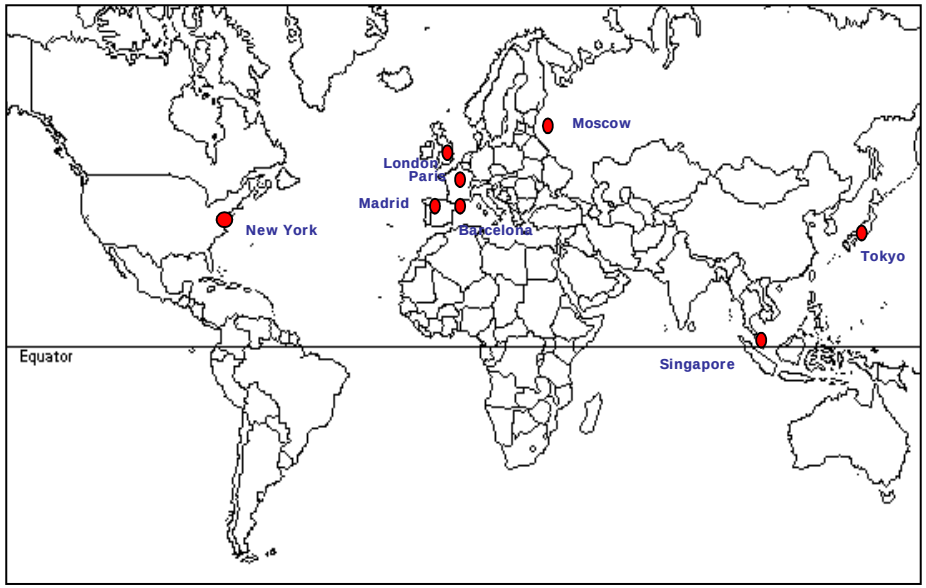
1.1.2 The study included identifying the demographic and socio-economic characteristics, describing transport and land use trends, and benchmarking the performance of the key strategies in terms of modal shares, public transport patronage and traffic/congestion levels. The findings were intended to provide an insight into how successful different strategies had been, inform the transport policy debate and contribute to the promulgation of good practice.

1.1.3 The sample included the four 'world cities' of London, Paris, New York and Tokyo, plus 10 other comparator cities. These have been split into two tranches according to city population to assist in data handling, analysis and presentation.

1.1.4 This report covers:

- Barcelona;
- London;
- Madrid;
- Moscow;
- New York;
- Paris;
- Singapore; and
- Tokyo, as shown in Figure 1.1.

Figure 1.1 – Sample of Metropolitan Cities



1.1.5 The second tranche of the study concerns the strategies being implemented in Dublin, Lyon, Nottingham, Perth, Rome and Zurich.

1.2 Methodology

1.2.1 The research into each tranche of cities has been undertaken in three phases; a desk study of available documentation and statistics, case studies based on interviews with relevant authorities within the cities, and an analysis of the policies and their impacts.

1.2.2 The Internet has been a valuable resource in the desk study phase giving access to information collected by various pan-European initiatives, including previous research funded by the European Commission and networking groups such as POLIS and EMTA. We have also benefited from several articles on transport strategies and their impacts in on-line journals such as *Transport Policy* and *Transport Reviews* which have been supplemented by papers from recent conferences organised by the Association of European Transport (AET) and the OECD.

1.2.3 Much of the contextual data has come from two key sources:

- **Millennium Cities Database** (data for 1995/96) - compiled in 2001 by Dr Jeff Kenworthy and Felix Laube for the International Association of Public Transport (UITP); and
- **An International Sourcebook of Automobile Dependence in Cities 1960–1990** (trend data for every ten years, typically 1961, 1971, 1981, 1991) – compiled in 1999 by Dr Jeff Kenworthy and Felix Laube and published by the University of Colorado Press.

1.2.4 These are the most comprehensive and consistent datasets, but they contain limited time series data to enable an investigation into the impacts of policies.

1.2.5 Hence, we have used data provided by the relevant city authorities to consider issues of effectiveness. Unfortunately monitoring is continuing to receive a low profile and the analysis has been constrained by the availability of suitable indicators and differences in definitions and survey years.

1.2.6 The benchmarking has focused on changes in 2003/04:

- Modal shares;
- Public transport patronage; and
- Congestion – using proxy measures of traffic flows and speeds.

1.2.7 We have sought to compare 'like with like'; the data refer to the metropolitan areas which generally cover the journey to work areas, and financial information has been converted to a common currency and adjusted for purchasing power parity. However, the metropolitan areas covered by Tokyo and New York are significantly larger than Greater London, and data for Paris and Madrid tend to be collected at the regional, rather than the metropolitan area level.

1.2.8 Where possible, we have included data for the central business district (CBD) or the inner city to assist meaningful comparison.

1.3 Structure of this Report

1.3.1 Following this introductory chapter:

- Chapter 2 considers the contextual factors that are influencing the demand for travel and, in particular, levels of car use and congestion.
- Chapter 3 summarises the strategies that are being implemented, drawing on the material in the case studies.
- Chapter 4 links the contextual factors and the strategies and discusses the common issues facing the World Cities and the selected large comparators, and the effectiveness of the various strategies, along with the factors that have contributed to success.
- Chapter 5 provides some interim conclusions for the study.

1.3.2 The case study reports are included in the Appendix.

2 Background and Context

2.1 Motorised Travel

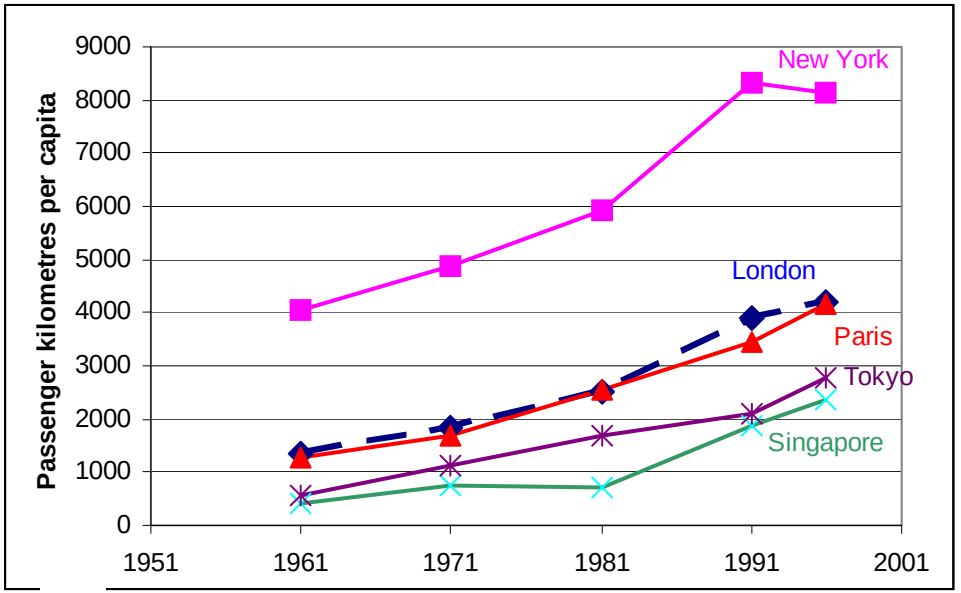
2.1.1 Motorised travel has grown significantly since the 1960s, mainly due to the increase in car, rather than public transport use (Figures 2.1-2.2).

2.1.2 Car use is continuing to rise in all the cities (where data exists), with the exception of New York, where there was some decline through the early 1990s associated with falling car ownership. Recent data suggests that this may have continued, though there has been no fall in traffic in Manhattan.

2.1.3 The rate of growth slowed in London and Singapore during the early 90s; the daily average number of car journeys in London continued to rise slowly through the late 90s and began to decline in 2003[2], and annual car mileage also fell in Singapore after 2002[3].

2.1.4 In contrast, car use increase in Paris and Tokyo rose rapidly in the early 90s. In Paris, this has since tailed off and the

Figure 2.1 – Car Use



Note: Passenger kilometres per capita is a measure of car use, taking no account of occupancy, and a good proxy indicator of congestion, as it reflects the volume of vehicles on the road.
Source: Kenworthy and Laube, 1999 and 2001

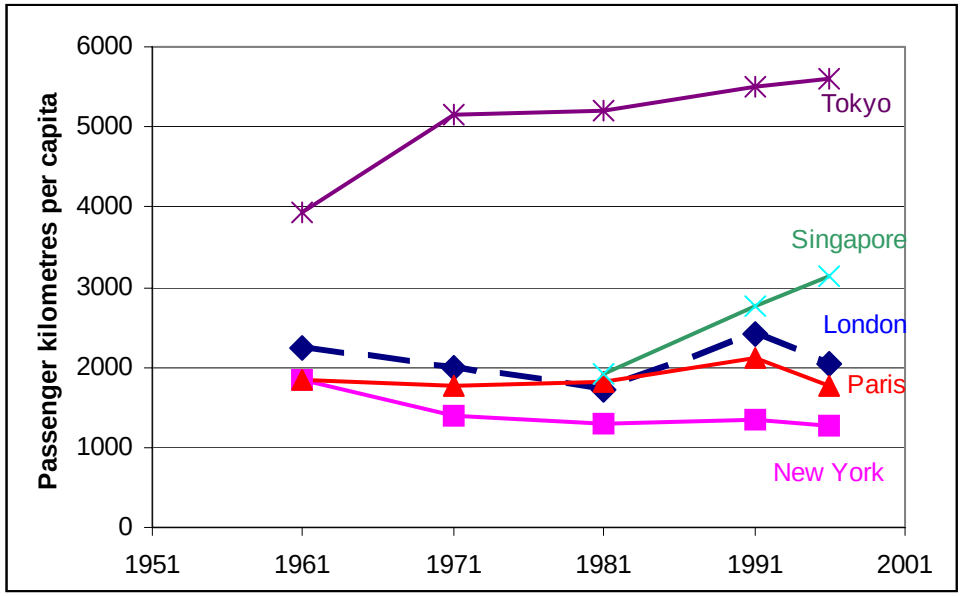
[2] TfL, London Travel Report 2004
[3] Land Transport Authority, Singapore Land Transport Statistics in Brief, 2004

number of car trips per day fell between 1997-2001, though the average journey length has continued to increase[4].

2.1.5 Whilst there has been a clear trend of increasing car use, public transport use has varied largely because of fluctuations in the economy and issues of quality and reliability (discussed later).

2.1.6 In London, the decline in the early 90s has been reversed and total passenger kilometres has risen; bus use has increased 50% between 1998/99 and 2003/04, while Underground use peaked in 2000/01 and has fallen slightly in the last three years. Similar trends of increasing public transport use have occurred recently in the other cities, with the exception of Paris, where the average number of journeys per day has fallen, but the average journey length has remained constant. Substantial increases in public transport patronage (passenger journeys) have been seen in Madrid and Barcelona.

Figure 2.2 – Public Transport Use



Source: Kenworthy and Laube, 1999 and 2001

[4] DRIEF, Les résultants détaillés de l'enquête globale de transport 2001-2002

2.1.7 These changes in car and public transport use have resulted from:

- Changes in the drivers of demand; and
- The strategies that have been adopted to manage traffic growth.

2.1.8 The rest of this chapter considers the key drivers, namely the changes in the demographic structure, land use pattern, economy and travel options, particularly the availability of a car. The strategies and the policies implemented in each city are discussed in Chapter 3.

2.2 Key Drivers of Demand

Demographics

2.2.1 Each of the cities has undergone a period of rapid urbanisation. In London, Paris and New York this took place during the late nineteenth century before the influence of the private car.

2.2.2 The population of the city centre subsequently stabilised or even declined as residents moved out to the suburbs; in London, the railways assisted the relocation of the middle classes, whereas in Paris, the wealthy households stayed in the centre and the poor moved out to areas with little transport provision.

2.2.3 In New York, the rail/subway links opened some surrounding areas to development, but it was the construction of the freeways following the Second World War that allowed the population to continue to grow in low density neighbourhoods that sprawl into the surrounding states of New York, Connecticut and New Jersey.

2.2.4 Meanwhile cities such as Barcelona, Madrid, Tokyo and Moscow were growing fast. The growth was initially focused on the city centre, but monocentric policies in the first three were diluted by market forces and largely unplanned housing developments occurred on the periphery as transport infrastructure was extended.

2.2.5 In Tokyo, the combination of radial rail links and poor housing conditions in the centre encouraged residents to move out to increasingly remote suburbs. Nowadays two-thirds of commuters travel more than an hour to work.

2.2.6 The Asian cities have been booming since the 1970s; Tokyo has continued to grow and the population of Singapore has been rising by 10-15% every 10 years.

2.2.7 All the cities grew in the late 90s, with the exception of Barcelona and Moscow, which saw some decline that has since been reversed. The growth has occurred in the suburbs as city residents continue to decentralise or new residents in-migrate from other regions (Tables 2.1-2.2). This has been accompanied by higher rates of growth in car ownership and car use to provide mobility in areas that have limited public transport options, particularly for orbital movements.

2.2.8 The most dramatic rebalancing of city centre and suburban populations has been in Barcelona, Madrid, Paris and Tokyo (Figure 2.3 overleaf).

2.2.9 For example, between 1970 and 2000, Barcelona grew by 11%; the inner city population fell by 14% (249,000), and the surrounding metropolitan area gained 33% (715,000) mainly in the outermost parts. Similarly in Paris, the Ville de Paris fell by 11% (275,000) and the surrounding Ile de France region grew by 30% (2 million). The exodus of people (and jobs) has tempered policies to restrain car use as much of the traffic in the centre is generated by residents, and there are relatively low levels of commuters and visitors coming in by car.

Table 2.1 - Population of Inner City (000s)

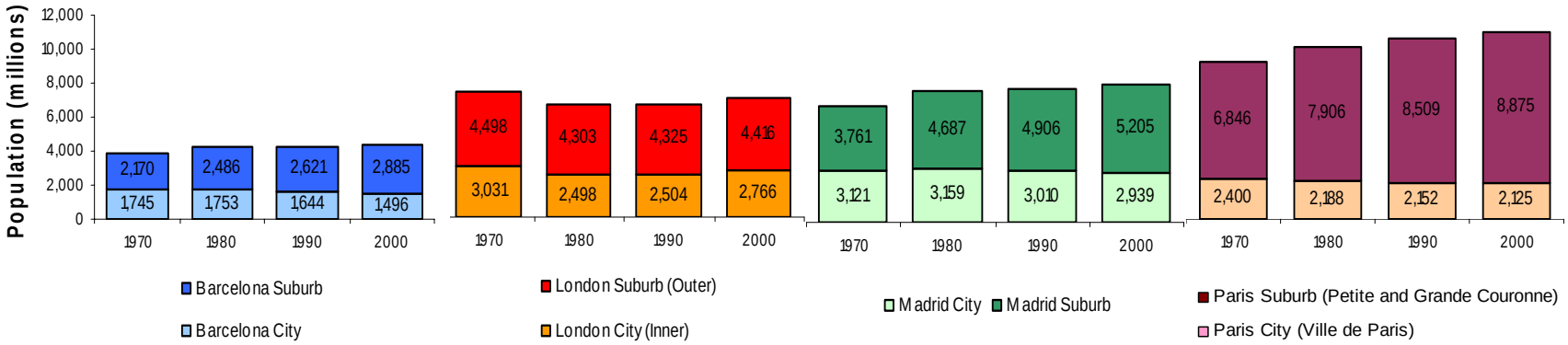
City	1970	1980	1990	1995	2000
Barcelona	1,745	1,753	1,644	1,615	1,496
London (Inner)	3,031	2,498	2,504	2,700	2,766
Madrid	3,121	3,159	3,010	2,867	2,939
New-York (New York City)	7,895	7,071	7,323	n/a	8,008
Paris (Ville de Paris)	2,400	2,188	2,152	2,131	2,125
Tokyo (23 Wards)	8,841	8,352	8,164	7,830	8,130

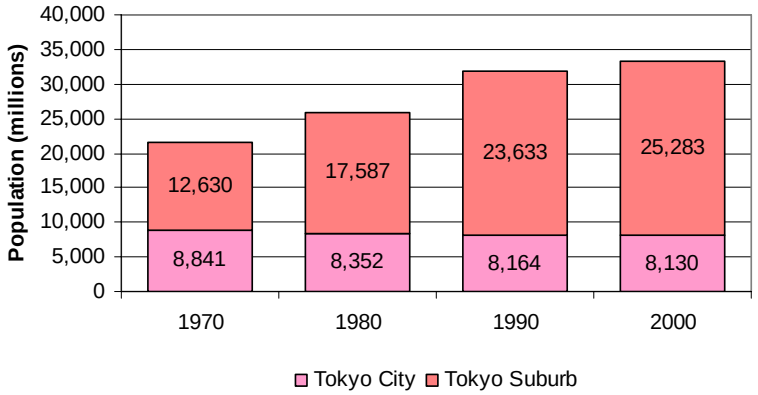
Table 2.2 - Population of Suburbs (000s)

City	1970	1980	1990	1995	2000
Barcelona	2,170	2,486	2,621	2,776	2,885
London (Outer)	4,498	4,303	4,325	4,300	4,416
Madrid	3,761	4,687	4,906	5,182	5,205
Moscow (includes inner city)	7,200	8,100	9,000	8,800	8,297
New York (rest of Tri-state area)	10,836	10,854	11,086	n/a	11,219
Paris (rest of Ile de France)	6,846	7,906	8,509	8,851	8,875
Singapore (includes inner city)	2,074	2,414	2705	2,987	3,263
Tokyo (Saitama, Kanagawa, Chiba)	12,630	17,587	23,633	24,609	25,283

Note: The definitions of Barcelona and Paris vary slightly between datasets. For example, the tables above correspond with the most recent travel data and assume that Barcelona is made up of the city, immediate suburbs beyond the ring road and the extended metropolitan area, whereas Kenworthy and Laube have used the city and the immediate suburbs only. Similarly for Paris, we have assumed the inner city is the Ville de Paris, whereas Kenworthy and Laube have used this plus the surrounding Petite Couronne. Recent population data for the inner city and suburbs is not readily available for Moscow and Singapore. Source: Various City Census plus Kenworthy and Laube, 1999 and 2001 for Singapore.

Figure 2.3 – Changes in Metropolitan Populations (Selected Cities)





2.2.10 Further growth in car use has occurred as the city populations have aged and the average household size has fallen.

2.2.11 London, Singapore and Tokyo have a particularly large proportion of adults in their 30s and 40s (Table 2.3). It is these age cohorts that travel the most and have the highest propensity to drive, as illustrated by the distances travelled in England and Wales from the National Travel Survey (Table 2.4 overleaf).

Table 2.3 – Age Structure of Population and Average Household Size

City	Child	Young adult	Mid adult	Older adult	Over 65
Barcelona[1]	11.6%	11.4%	23.8%	31.7%	21.5%
London[2]	18.9%	13.9%	38%	17.8%	11%
Madrid[3]	17.3%	63.4%			19.3%
Moscow[4]	18.8%	57.8%			23.4%
New York[5]	26%	62%			13%
Paris[6]	18.3%	36%		26.1%	19.6%
Singapore[7]	21.5%	13.0%	36.6%	21.6%	7.2%
Tokyo[8]	11.9%	70.9%			17.1%

Source and age categories: [1]Barcelona Town Council (www.bcn.es), child 0-14, young adult 15-24, mid adult 25-39, older adult 40-64; [2]Office of National Statistics (Mid-2000 estimate), child 0-14, young adult 15-24, mid adult 25-44, older adult 44-64; [3]Madrid Population and Housing Census (2001), child under 19, adult 20-64; [4]http://www.md.mos.ru/eng/pop/t_4.htm 1995, child, working age, older than working age; [5]http://www.statehealthfacts.kff.org (New York City 2004 estimate), child 18 and under, adult, 19-64; [6]Source: http://www.insee.fr/en/recensement/page_accueil_rp.htm, city child 0 to 19, young adult 20 to 39, mid adult 40 to 59, older adult 60 to 74; [7]http://www.singstat.gov.sg/papers/c2000/censuscount.pdf 2000, resident population by age group (2000), age categories as London. [8]http://www.chijihon.metro.tokyo.jp/ english/PROFILE/APPENDIX/appendix2.htm, child under 14, adult 15-64. Percentages may not sum to 100% due to rounding effects.

2.2.12 London and Paris have the smallest households with just 2.4 inhabitants (Figure 2.4). Previous research[5] has shown that smaller households tend to make more frequent journeys and travel further because of a number of factors including the need to travel for social interaction, fewer opportunities for combining journeys and typically higher disposable income per person within the household.

2.2.13 Recently there has been an 'urban renaissance' and since 2000, all of the cities have been growing through a combination of rising inner city *and* suburban populations. There are several theories on the cause of this movement including public reaction to increasing congestion and commuting, desire for greater consumer choice that can only be offered at higher densities, and the increasing availability of housing in the centre (eg Tokyo).

2.2.14 This has positive implications for transport as it should reduce average trip lengths and favour the use of alternative modes. In addition, the ageing population and general decline in travel as working age adults move into retirement, suggests that the demand for car use should fall in the future.

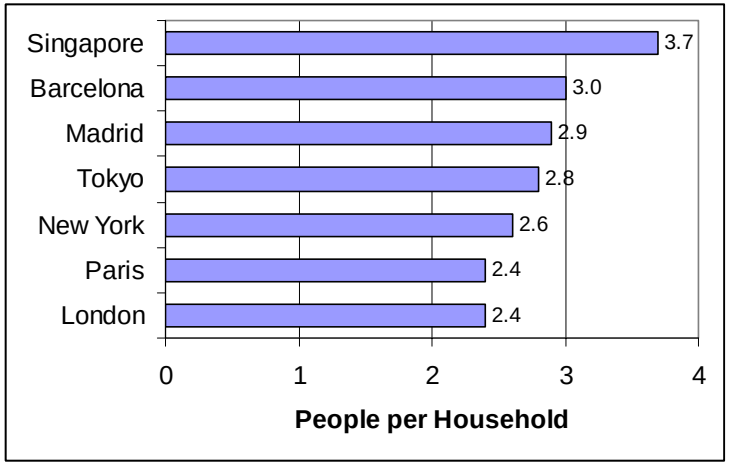
[5] De Jong, G., van de Riet, O., RAND Europe (2004). Drivers of demand for passenger transport worldwide. European Transport Conference, Strasbourg, 2004.

Table 2.4 – Distance Travelled by Age (miles per person 1998/2000)

Distance	<17	17-20	21-29	30-39	40-49	50-59	60-69	70+
All modes	*3,987*	*6,330*	*8,742*	*9,095*	*9,720*	*8,642*	*6,088*	*3,345*
Car driver	-	1,867	4,908	5,913	6,586	5,534	3,247	1,326
Car passenger	3,041	2,472	1,944	1,695	1,665	1,899	1,719	1,114
Walk	188	206	170	152	143	151	168	127
Bus	315	738	387	235	260	287	472	445

Source: National Travel Survey 1998/2000

Figure 2.4 – Average Household Size



Source: Case studies

Land Use Pattern

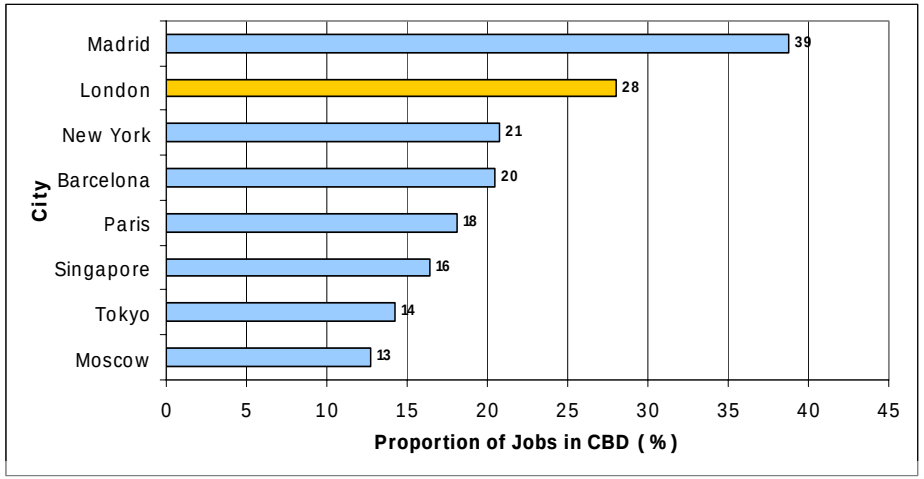
2.2.15 The physical development of the city and the resulting land use pattern affects people's need to travel and their choice of mode; previous research[6] has shown that residents and employees in 'compact cities' tend to travel less, make fewer journeys by car and more trips on foot than those in lower density cities.

2.2.16 In London, the early development of the railways allowed residents to move out of the city centre and so land use density did not rise to the same level as Paris and New York where urban sprawl was constrained for longer (in Paris by the ring of military land surrounding the Ville de Paris, and in New York by the limited land area of Manhattan Island). Whilst the majority of the jobs have stayed in the Central Business District (CBD) (Figure 2.5), multi-centric planning policies have since encouraged further development at lower densities in the suburbs (Table 2.5 overleaf).

2.2.17 In Paris, major suburban centres have been developed just outside the city walls, for example, at Créteil and Bobigny to absorb the growing population, and La Défense to accommodate employment growth. The plans for new towns, for example, in the rural areas of Marne-la-Vallée and Melun, included housing and employment to reduce travel, but they grew into dormitory settlements and contributed to the growth in travel.

2.2.18 In New York, the zoning laws have ensured that the suburban residential areas are interspaced with small pockets of employment and retail centres. Like Paris, this has taken the development pressure off the city centre, but sprawl and disparate travel patterns cannot be served by public transport and there is a high level of car dependency, though New York has by far the lowest car use of all US cities due to its extensive high density inner area and large rail-oriented public transport system.

Figure 2.5: Employment in the CBD



Source: Kenworthy and Laube, 2001

[6] See www.vtpi.org and Kenworthy and Laube, 1999

Table 2.5 – Comparative Land Use Indicators

Land Use Indicators	Barcelona	London	Madrid	Moscow	New York	Paris	Singapore	Tokyo
Area								
metropolitan area (km²)[1]	3,235	1,579 (Inner London 321)	8,028	1,091	22,763 (NY City 785)	12,012 (Ville de Paris 105)	648	12,563
urbanised area (km²)[2]	141	1,186	604	588	10,657	2,311	319	3,689
CBD (km²)	n/a	27	42	19	23	23	8	42
Population Density								
metropolitan area (pop/ km²)	8,387	4,438	645	7,974	845	916	4,612	2,386
urbanised areas (pop/ km²)	19,710	5,907	8,585	14,626	1,804	4,762	9,353	8,768
city centre (pop/ km²)	16,601	6,296	22,377[3]	15,470[4]	22,970	18,227	7,500	6,334

Note: [1]The metropolitan area depends on arbitrary administrative boundaries. In some cases this is very large and incorporates lots of non-urban land (such as Madrid, Paris and New York), whereas in some cases it is very tight around the urban area (such as London). [2] The urbanised area is a better measure of the built-up area ie the metropolitan area without agricultural land, forest, large parks and bodies of water; [3]Refers to the city rather than the CBD; [4]1980 data. Source: Kenworthy and Laube, 2001, plus www.economist.com and consultant's own research.

2.2.19 Political philosophies in the cities that developed rapidly in the mid-20th century supported centralised planning and hence Barcelona, Madrid and Moscow have high density centres and a mix of residential and employment functions in the city centre.

2.2.20 In Barcelona, continuing urban growth has been accommodated by in-fill in the existing urban area and decentralisation to towns on the edge of the metropolitan area. Whilst these are served by rail, there has been an increase in car use as the new sites have generous parking standards.

2.2.21 In Madrid, the General Urban Plan (1946) allowed ribbons of growth out from the city along the main radial corridors (particularly along the north west/south east axes) to satellite settlements. This structure demanded a high level of mobility, especially for commuting journeys, but also meant that Madrid was better suited to public transport use than cities with low density sprawl.

2.2.22 However, the vision has gradually been replaced by more ad-hoc planning decisions that have permitted low density peripheral housing and science parks. With the continuing use of minimum parking standards[7] and development of high capacity roads, this has contributed to greater car use and longer journey lengths.

2.2.23 Whilst the growth in employment in central Tokyo was a considerable draw, the lack of housing prevented densities from rising in the original city (known as the 23 Wards). With the construction of the railways, cities have grown in the metropolitan area that have densities similar to Ville de Paris and Manhattan, however, these were unplanned and are mainly dormitory settlements. The pressure from commercial occupiers and the rise in property prices forced some residents out of the 23 Wards in the 70s and 80s, while tax incentives made areas on the periphery – some 90km from the 23 Wards - more attractive[8], further extending commuting distances and leading to extreme crowding on the road and rail networks.

[7] The General Urban Plan (1997) requires one parking space for each new house or 100m^2 of housing, and each 100m^2 of land developed for industrial use. Rates for offices and recreation vary according to location; one space per 100m^2 of built area inside the city and 1.5 spaces outside the M-30 ring road.

[8] Most Japanese companies bear the full commuting costs of their employees and this has encouraged many workers to live in distant suburbs. Employers can deduct the costs of commuting allowances from their corporate income taxes.

2.2.24 In contrast, the development of Singapore has been planned by the Urban Redevelopment Agency and regulated by Government controls on land sales. New towns and suburban areas have high densities and a mix of functions to reduce the need to travel. Development is well integrated with transport provision; the public housing areas are well-served by the extensive public bus and rail networks, though there is higher car dependency in the private estates.

2.2.25 Singapore's 1991 Revised Concept Plan has been strongly influenced by transport considerations and contains two key land use planning strategies; to decentralize activities to balance rail utilisation, and reduce the need to travel by locating employment opportunities close to residential areas.

2.2.26 The impact of the land use patterns (discussed above) on travel are illustrated in Figure 2.6. Residents in the cities that have spread over a larger urban area (namely Paris, New York, Tokyo) tend to travel more, and a greater proportion of their mileage is by private rather than by public transport (Figure 2.7). The exception is Tokyo where

Figure 2.6 – Urbanised Area and Motorised Travel

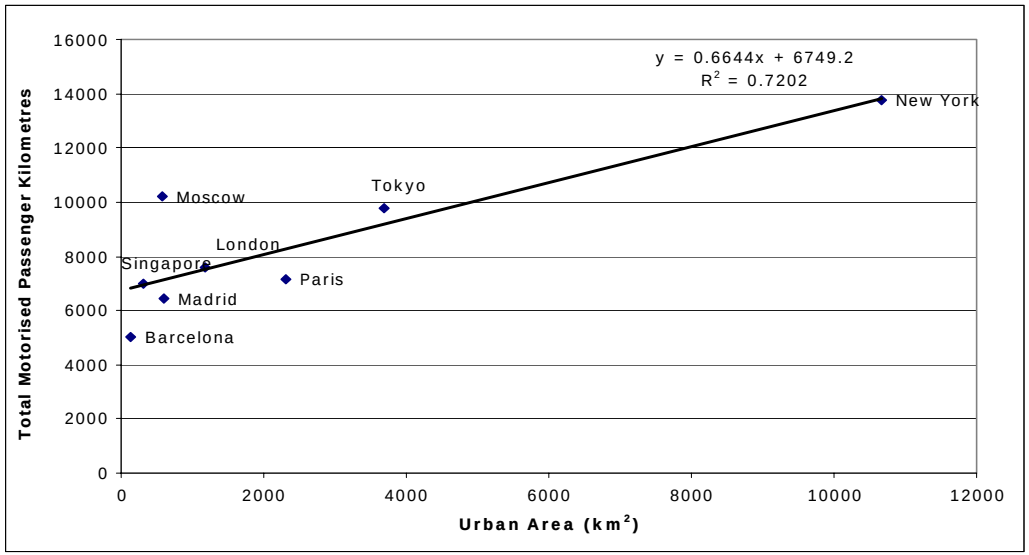
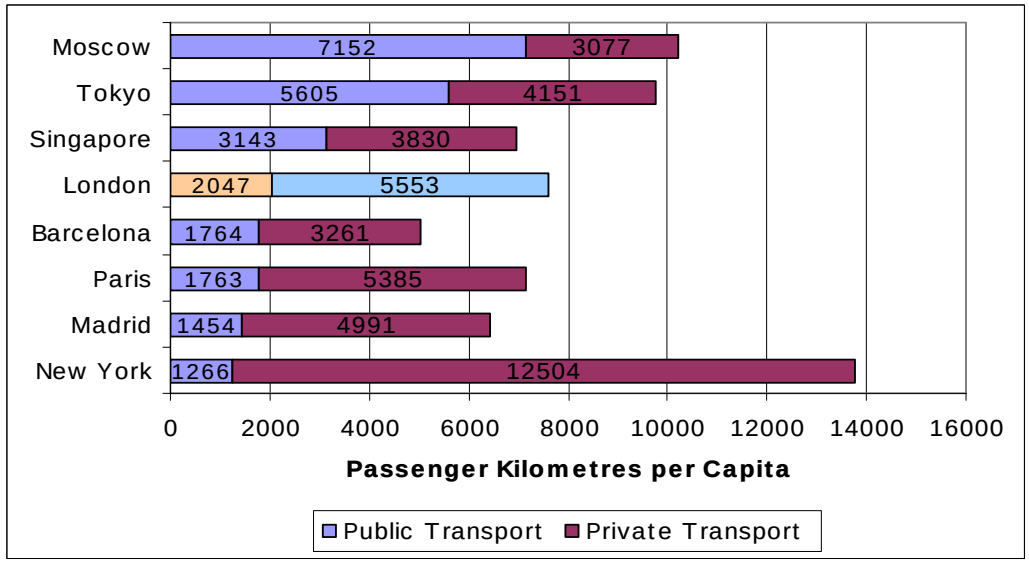


Figure 2.7 – Motorised Travel by Mode



Source: Kenworthy and Laube, 2001

over half of the total distance travelled by motorised modes is by public transport (almost entirely rail).

2.2.27 Part of this increased mobility is due to longer average journey lengths, as shown in Figure 2.8. A typical journey in the 'spread cities' of New York and Tokyo is significantly longer than in smaller cities such as Barcelona and Singapore.

2.2.28 Average journey length is affected by density. Cities that have retained high densities in the city centre and focused additional growth in mixed use suburban centres, tend to have shorter average journey lengths (Figure 2.9). Hence the lowest levels of motorised travel are in compact, high density cities.

Figure 2.8 – Urbanised Area and Average Journey Length

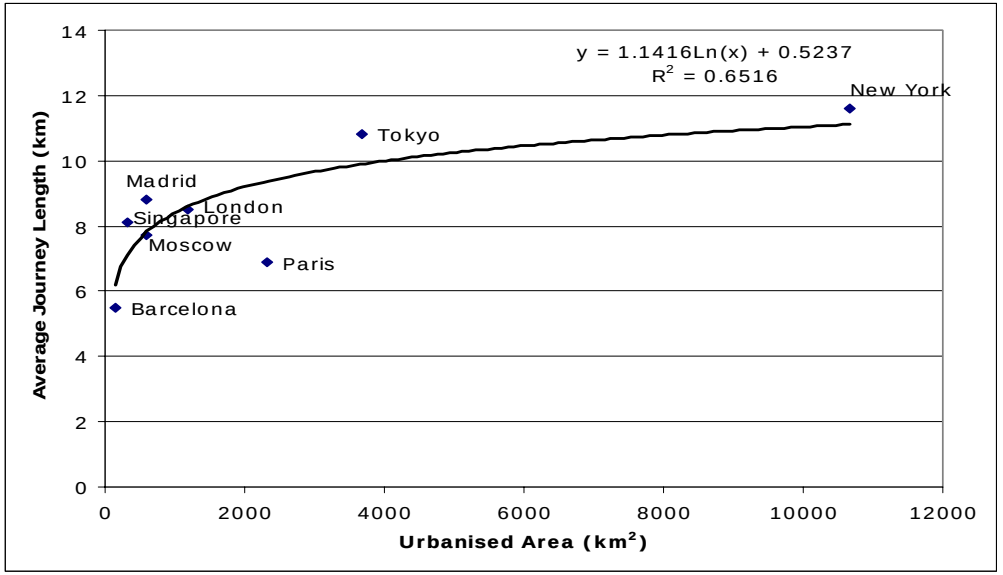
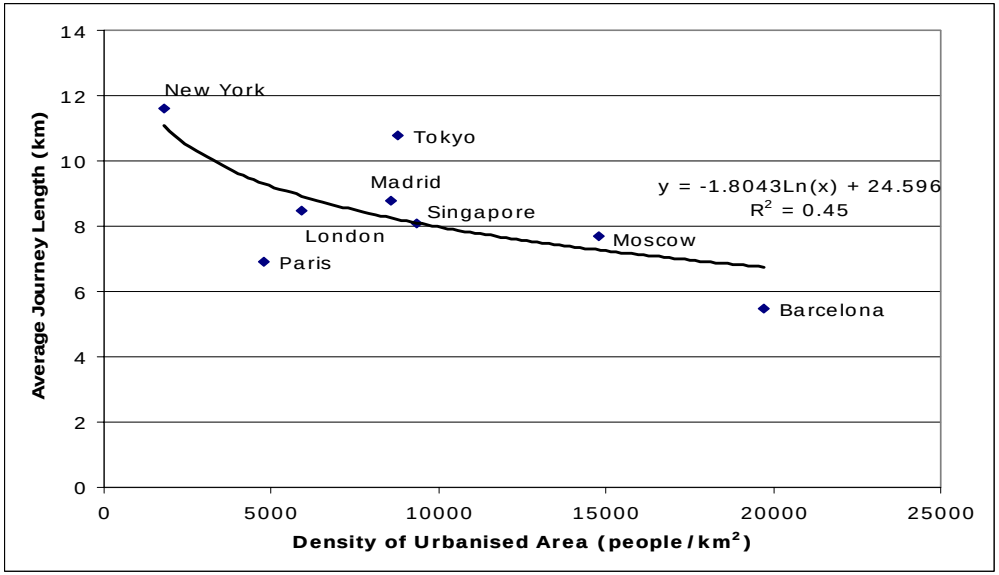


Figure 2.9 – Density and Average Journey Length



Source: Kenworthy and Laube, 2001

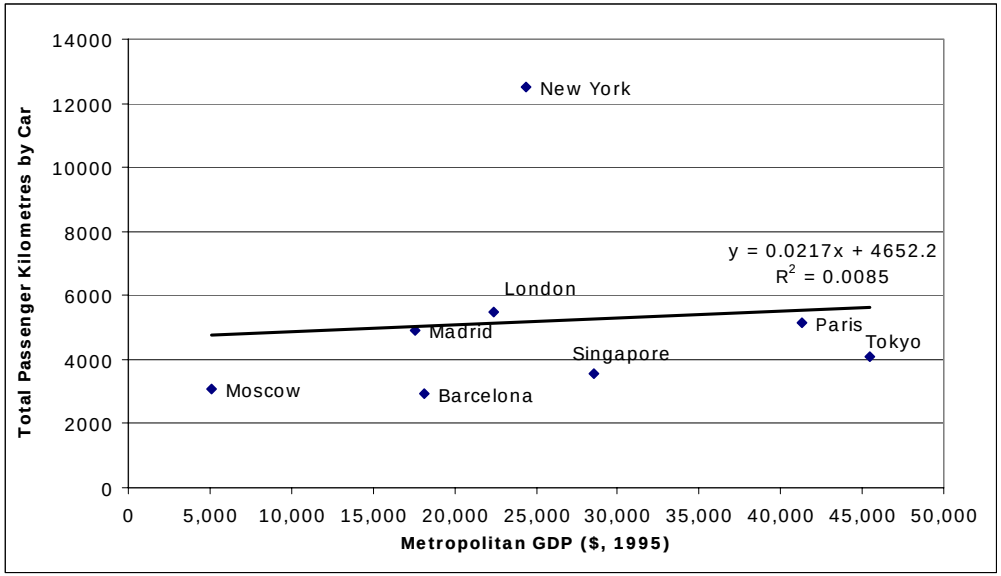
Economic Growth

2.2.29 Measures of the economic wealth of a metropolitan area are sensitive to the location of the boundary of the functional economic region. Where there is cross-border commuting residents take their wealth back to their place of residence, hence London has a considerably lower gross domestic product (GDP) per capita than Paris, as many wealthy commuters live outside Greater London, whereas the Ile de France area is much bigger and contains just about all Parisien workers.

2.2.30 Using the GDP for the region, there is no apparent link between wealth and total motorised mobility or total travel by car amongst the world cities and the other large comparators (Figure 2.10). The effects of transport policies, congestion and other contextual factors have helped to decouple these.

2.2.31 The case studies highlight several cities that have seen public transport demand fluctuate with economic growth and recession, but there is insufficient trend information on changes in GDP, incomes and travel demand to enable any robust analysis as part of this study.

Figure 2.10 – Car Travel and GDP



Source: Kenworthy and Laube, 2001

Public Transport Fares and Cost Recovery

2.2.32 Cities have simplified fares structures and most have flat or zonal fares, particularly for bus, tram and metro systems. All the cities except Moscow also offer stored value or smartcards to provide integrated fares. Comparing the average revenue per passenger and per passenger-kilometre to overcome differences in average journey lengths (Figures 2.11-2.12), shows that:

- New York and London have the highest **urban rail** fares;
- London has by far the highest **metro** fare; and
- Tokyo, New York, and London have the highest **bus** fares.

2.2.33 London's public transport fares rose by about 20% in January 2005 to help fund a £3bn investment programme in the transport network, although in real terms bus fares have not increased for four years. A pricing strategy has been introduced through the 'Oyster' pre-paid card to reduce the number of cash transactions and to encourage off-peak travel.

Figure 2.11 – Revenue per Passenger

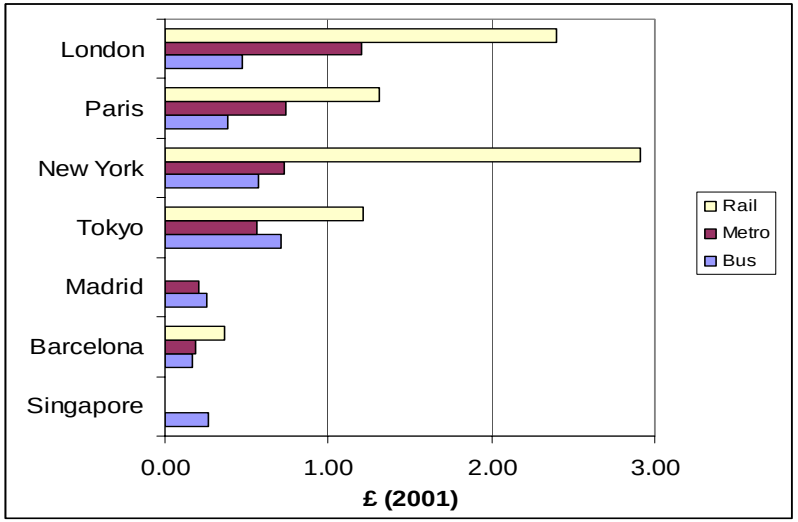
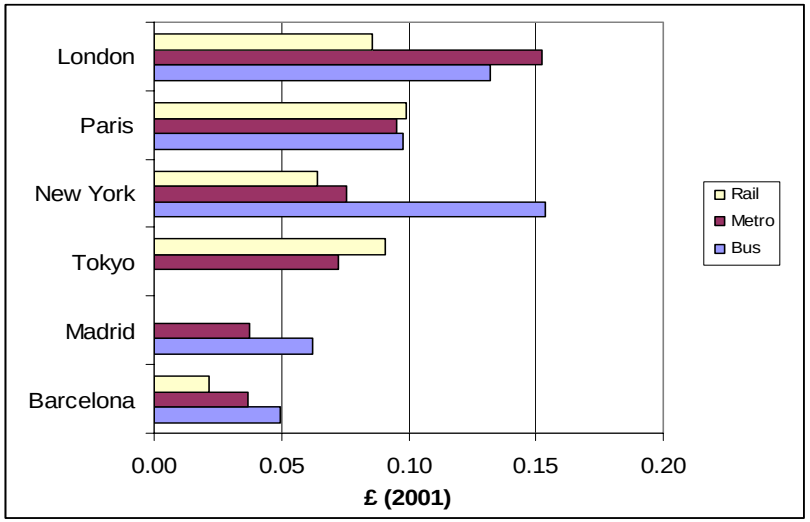


Figure 2.12 – Revenue per Passenger Kilometre



Source: Relevant transport authorities and EMTA (www.emta.com)

2.2.34 Fare levels tend to reflect the philosophy towards public transport, in particular the amount to which fare revenue is expected to cover the operating costs.

2.2.35 Paris has the lowest cost recovery rate (the proportion of public transport operating costs covered by fare revenue), as shown in Table 2.6. The farebox covers just 28% of costs and the remainder is made up through a 'payroll' tax (Versement Transport), government grants, and employer contributions to employee travel costs (through the Carte Orange season ticket). Singapore has the highest cost recovery ratio at over 100%, where fare revenue alone covers more than the operating costs, though this is also true for many of the private operators in Tokyo.

Table 2.6 – Cost Recovery Rate

City	Farebox (%)	Other (%)
London	55%	45% mainly central government grant
Moscow	56%	44% central and city government grant
Barcelona	75%	25% central and city government grant
New York	46%	28% dedicated taxes, 14% toll revenues 7% state and local subsidies, 5% other revenue
Madrid	55%	45% subsidies
Paris	28%	37% 'versement transport' payroll tax 22% central/regional/local government grant 9% employers contribution to carte orange, 4% other
Tokyo	80%	16% subsidies/grants 8% other commercial sources
Singapore	100+%	n/a

Note: Percentages include rounding errors. Source: Case studies and EMTA (www.emta.com). Fare revenue includes concessionary fare reimbursement.

Highways and Roads

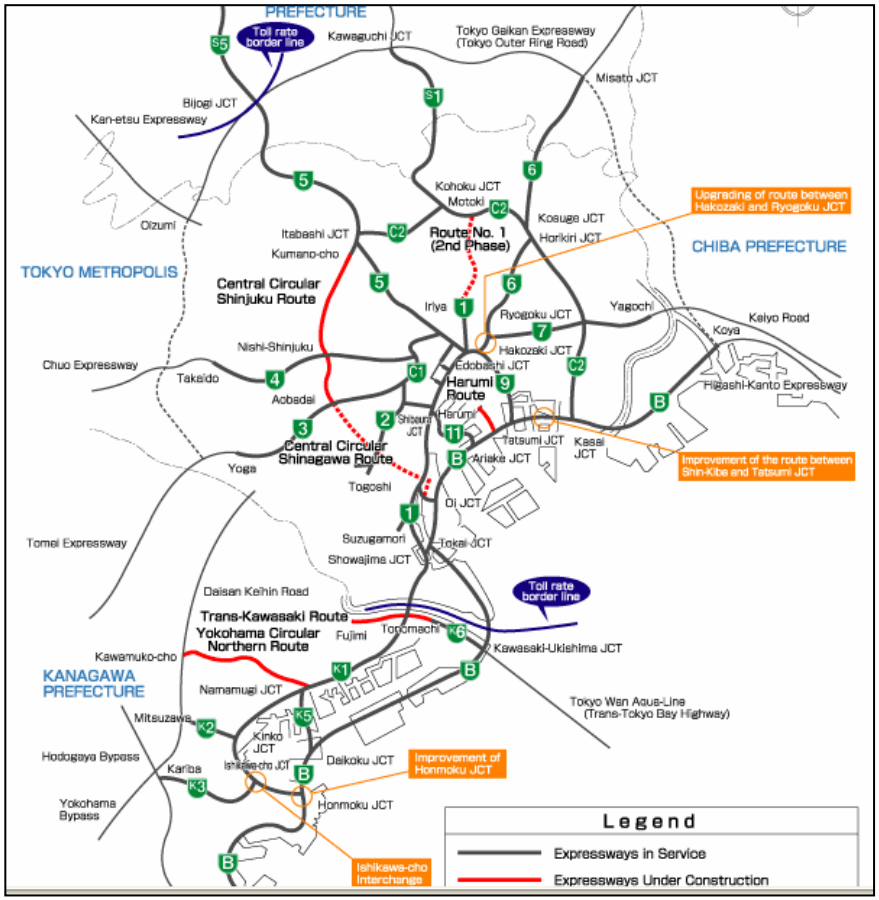
2.2.36 New York is unique in that its strategic links form a grid pattern and access to Manhattan is provided by bridges and tunnels. These provide an effective cap on traffic entering the city centre and varying tolls are being used to manage the level of demand throughout the day.

2.2.37 In the other cities, the highway networks are highly radial. In London, these radials run through suburban centres where local access movements reduce their efficiency. Elsewhere, the major radial roads tend to be tolled and segregated to provide fast access to the city.

2.2.38 The convergence of numerous radial routes has brought problems of through traffic and distribution to the city streets which have been tackled with varying levels of investment and environmental sensitivity.

2.2.39 For example, with rapid growth during the mid 20th century, Tokyo outgrew its network of minor roads. An outer ring road circling the north of the Tokyo prefecture was built and inside eight expressways feeding inner and central ring roads have been carved into the existing urban structure of the 23 Wards (Figure 2.13).

Figure 2.13 – Tokyo Expressways



2.2.40 In Paris, fourteen autoroutes converge on the eight-lane Boulevard Périphérique which was built on unused land circling the Ville de Paris. Within the city limits, the Boulevards Extérieurs provide an inner ring road with grade separated flyovers and under-passes at intersections. Efforts to implement former President Pompidou policies "to adapt Paris to the car" also included the construction of segregated expressways running parallel to the Seine *(left)* that provide a bypass to the CBD.

Figure 2.14 - Roads per 1000 People

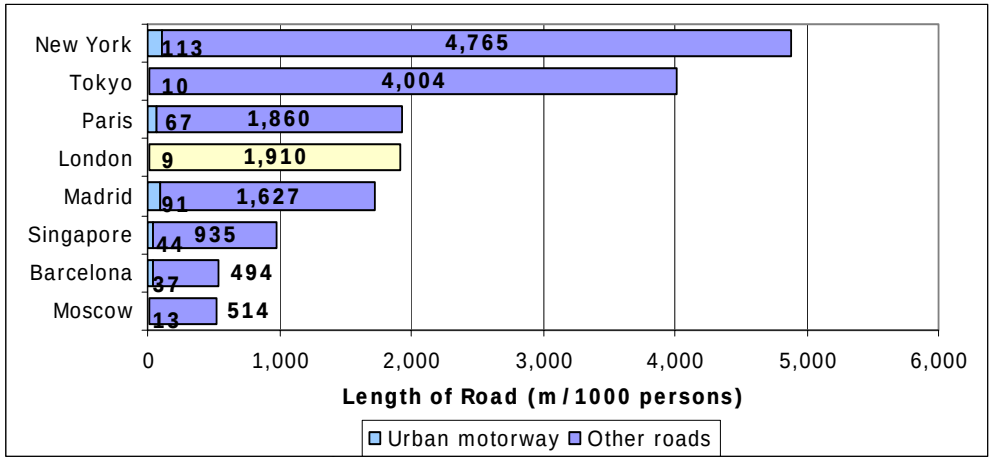
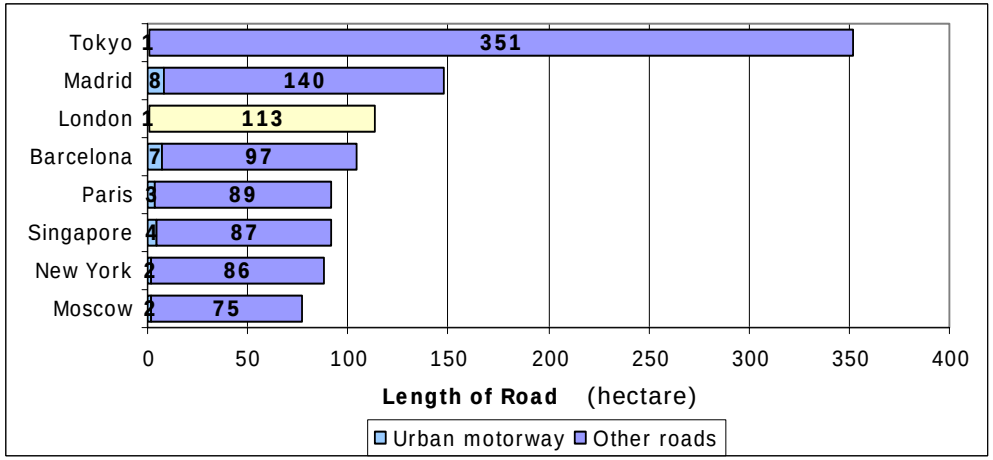


Figure 2.15 - Roads per Urban Hectare



2.2.43 Tokyo and Moscow have plans for significant road building. In Tokyo, these are aimed at alleviating congestion, whereas in Moscow, they aim to address the current under-provision of roads and the city authorities accept that road building will not have much impact on congestion as car ownership is rising so rapidly.

2.2.44 Elsewhere, there is evidence of a change of public and political attitudes towards urban roads. For example, public demands to reclaim public space in Paris led to the Seine Banks being closed during summer 2004 and converted into public 'beaches', and it is likely that they will be downgraded or closed permanently in the future.

2.2.45 Some 99km of Madrid's dual three-lane inner ring road (M30) are currently being reconstructed and 56km will be placed in tunnel at a total cost of €3.7 billion (£3.1 billion adjusted for purchasing power parity). Similarly, 5km of Barcelona's rondas have already been placed in tunnel to reduce noise and pedestrian severance (*below*) and road space along the main distributor (Avenida Diagonal) has been reallocated to tramways.

The Ronda del Mig (right) now runs in a 2km tunnel and the road above has been converted to a rambla lined with trees and public seating.

2.2.46 Within the cities, the differences in the capacity of the road links are important in explaining average speeds and congestion levels. In New York and Paris, for example, the planned networks of multi-lane distributor roads accommodate a higher volume of traffic and hence have a higher average speed than the predominantly single carriageway roads in London[9] and Tokyo that have evolved as the city has grown (Figure 2.16 and 2.17).

2.2.47 Significantly only in Tokyo does the average speed of public transport exceed that of general road traffic.

2.2.48 Roads in the historic core of Barcelona are too narrow to allow unrestrained car use. Areas have been pedestrianised or converted to access only operation with permit schemes and the traffic is channelled onto more appropriate roads. This has increased the traffic intensity, but reduced traffic congestion in the centre.

[9] The Millennium Cities Database contains the most recent consistent data on average speed in each metropolitan area, but this refers to 1995, and precedes the congestion charging scheme in London. More recent data for certain parts of cities, or types of roads, are shown in Chapter 4, but this can only be used for trend analysis within the city concerned.

Figure 2.16 - Traffic Intensity

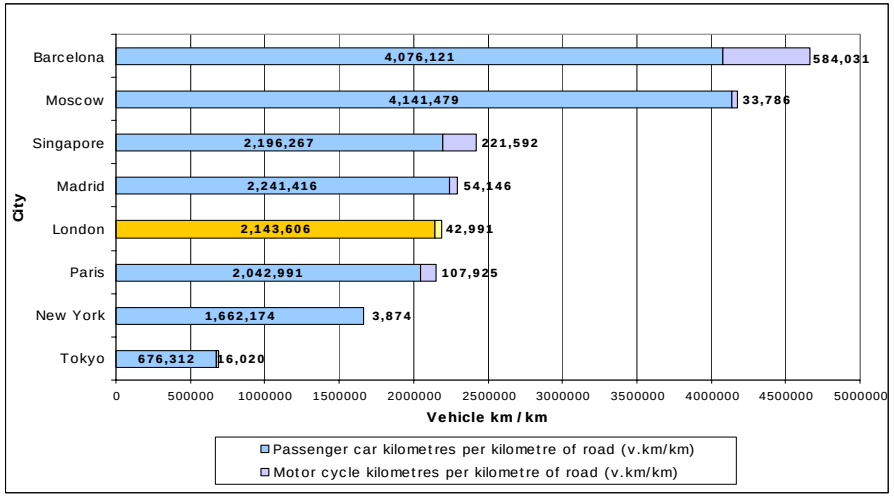
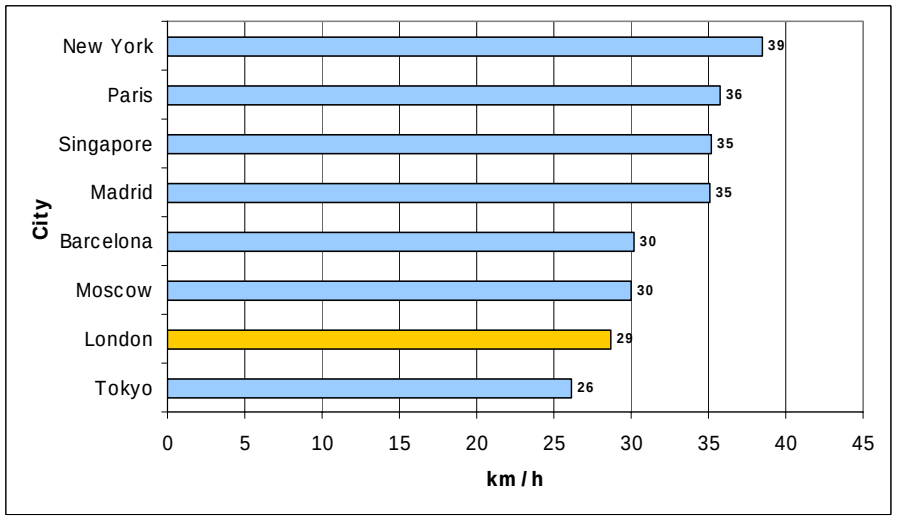


Figure 2.17 - Average Traffic Speed



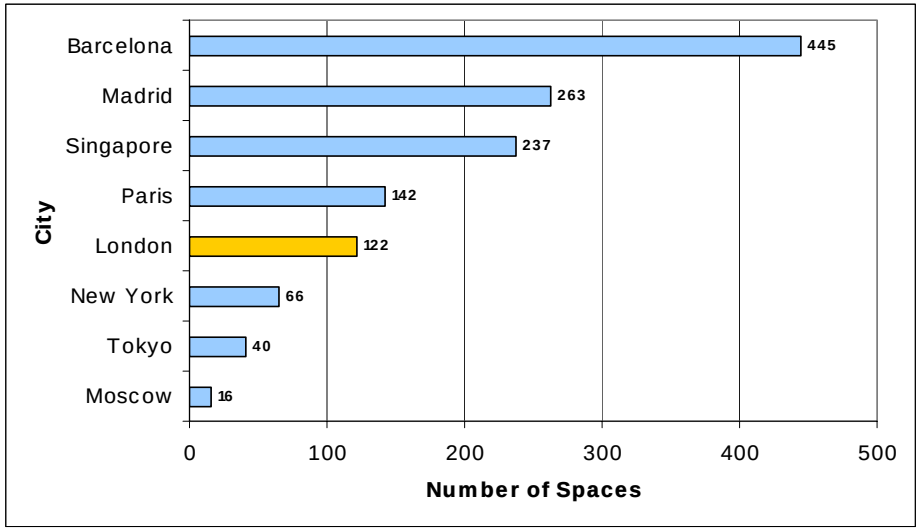
Source: Kenworthy and Laube, 2001

2.2.49 The effects of low road provision and road pricing are evident in the high traffic intensity *yet* above-average speed in Singapore. The charges discourage drivers from travelling in congested conditions and help to manage traffic levels throughout the day.

2.2.50 Parking policies are used to influence traffic demand in all the cities (Figure 2.18), with the exception of:

- Moscow - where there are few formal parking spaces, but the existing legislation does not support stopping and parking restrictions and their enforcement; and
- Tokyo - where the shortage of parking provision and need to provide evidence of an off-street overnight space prior to purchasing a car have restrained both car ownership and car use, however, this is changing as the metropolitan government encourages more car park construction.

Figure 2.18 – Formal Parking Spaces per 1,000 CBD Jobs



Source: Millennium Cities Database

2.2.51 The supply of parking varies according to:

- The need to provide adequate spaces for residents - Barcelona and Madrid have more than half of the metropolitan population living in the city and hence have the highest parking provision; and
- The commitment to parking controls to deter car access - London and New York are the strongest examples of this and have long used parking restrictions and charges to deter car access.

2.2.52 A limited comparison of on-street parking charges in key business and shopping areas show that parking is more expensive and restricted in London and New York than in Paris, for example, where there is a greater proportion of metropolitan residents in the CBD and parking policies have tended to have lower priority than public transport improvements in transport policy (Table 2.7).

Table 2.7 – Comparison of Parking Charges (2004)

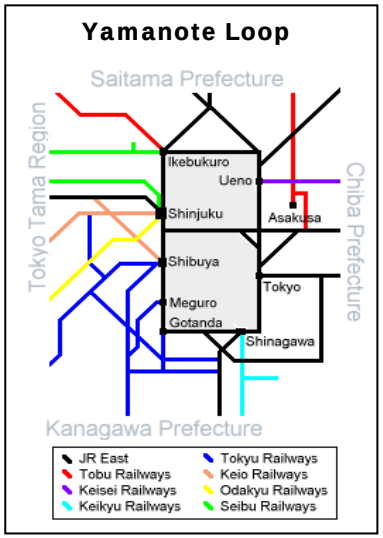
Parking Charges	Paris	London	New York
Shopping area:			
Parking charge (£ per hour)	2	3	2.5
Maximum duration of stay (hours)	2	2	1
Business area:			
Parking charge (£ per hour)	2	4	2
Maximum duration of stay (hours)	2	1	1

Note: Streets selected in the vicinity of Bourse and Grands Magasins, Paris; Oxford Circus and City of London, London; and Fifth Avenue and Wall Street, New York. Prices have been adjusted for purchasing power parity. Source: MVA, 2004.

Public Transport

2.2.53 Rail has been important in allowing cities to expand by providing a fast means of bringing commuters into the city centre. The older surface rail systems in London, Paris and New York provide radial links to the edge of the CBD, whereas the newer systems provide cross-city links that reduce interchange movements and crowding at peripheral stations.

2.2.54 For example, the Tokyo surface rail network serves commuters within a 100km radius of the centre of the CBD. JR East (formerly Japanese National Railways) and most of the private rail operators feed a 30km inner circle (Yamanote Loop). JR East opened an additional 180km Shonan-Shinjuku cross-city line in 2001, linking the suburban cities in the north of the metropolitan area with the southern part of the city centre, and it is currently used by 60,000 passengers per day.



2.2.55 Metro systems link the inner suburbs with the city centre and provide the main means of public transport within the city. The exceptions to this hierarchy of modes are London and Singapore where buses have an important role (Table 2.8).

2.2.56 London has the longest metro system in our sample of cities, though New York covers a larger area and so transit speeds are an issue. There are station bypasses and double-tracking – the total network has 1,065km of track - to allow both express and stopping services and 24-hour operation.

Table 2.8 - Length of Metro

City	Length of Metro (km)	Metro Share of Bus and Metro Trips (%)	No. Bus Routes
London	415	38	700
New York[1]	368	65	235
Tokyo	292	82[2]	n/a
Moscow[3]	265	67	540
Madrid[4]	226	58	188
Paris[5]	212	88	534
Barcelona	111	63	104
Singapore[6]	83	25	244

[1]Data for New York City; [2]Data for 23 Wards; [3]Bus includes trolleybus; [4]Bus data for city; [5]Bus data for Ville de Paris; [6]comprises underground sections of the MRT system. Sources: www.wikipedia.com, Jane's Urban Transport Systems 01-02, American Public Transport Association (2005) and individual operators.

2.2.57 A dual system also operates in Paris; the part-over, part-underground RER provides express links from the suburbs and across the city centre without obliging commuters to interchange at terminus stations. The métro mainly covers the Ville de Paris; its stations are closely spaced so speeds are low and the system is only really appropriate for the short-distance movements that in London are typically made by bus (as illustrated by the modal shares for the city centres in Table 2.9).

Table 2.9 Modal shares for the city centres

Mode	Paris (Arr 1-4)	Central London
Rail / metro	70	71
Bus	4	10
Car / motorcycle	17	12
Walk / cycle	9	6

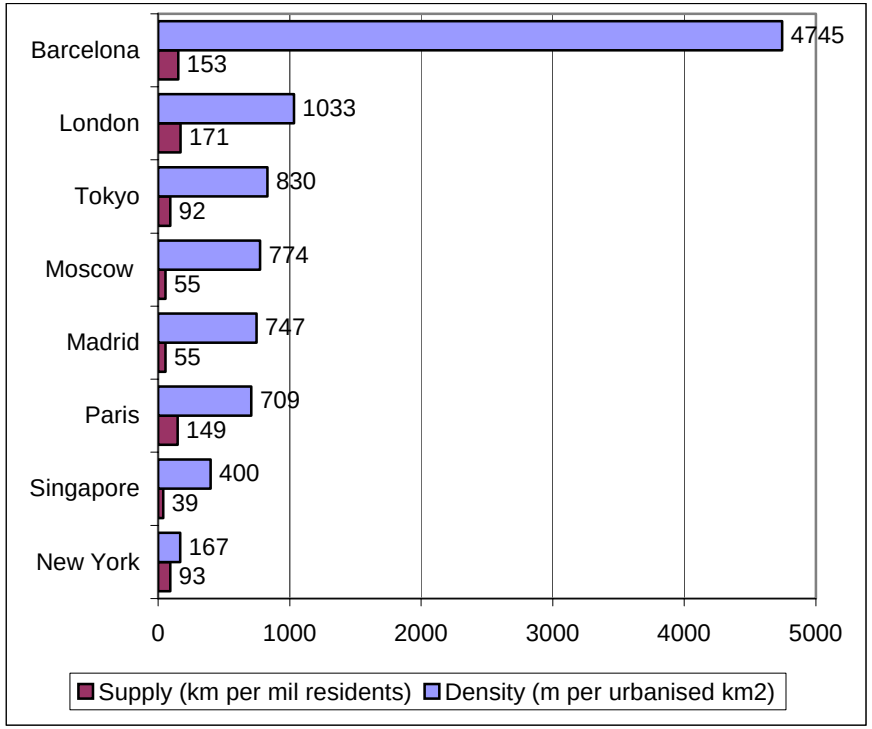
Note: Comparisons between London and Paris are complicated by the different levels at which data are collected. The first four arrondisements have a population of 101,000 and area of 5km^2, compared to Central London which has a population of 170,000 and area of 11km^2. Source: MVA 2004 and TfL 2002.

2.2.58 All the cities except New York have been developing their metro systems by building extensions and new lines. With the exception of London, these are supported by feeder buses in the suburbs. Barcelona and Singapore see investment in metro (and tram) as crucial to encouraging modal switch and this has been possible, in part, because it does not have the heavy maintenance burden of London, Paris and New York which have much older, larger systems.

2.2.59 The total provision of rail (surface and metro lines) is shown in Figure 2.19. London has the largest supply of lines and second highest density in the sample, though the supply is influenced by the relatively low population density of Greater London.

2.2.60 Few operators publish information on crowding but the case studies suggest that the worst problems are in Tokyo, London and New York. In Tokyo, passenger demand is highly peaked with most commuters travelling within a 20-minute period around 08:30 when trains typically having an 'overload percentage' of 250% - two and half times the design capacity. The rail operators employ 'pushers' to keep passengers clear of the doors and allow trains to leave the platform, rather than to pack as many people as possible into the carriage.

Figure 2.19 – Provision of rail (surface and metro lines)



Source: Consultants own research

2.2.61 Bus services have been improving in most of the cities as service levels are increased, fleets are replaced or renovated and varying progress is made with priority measures to improve speeds.

2.2.62 The greatest increase in bus kilometres has been in London, rising by 28% between 1999/2000 and 2004/2005 to 452 million. There has also been a notable improvement in the quality of the vehicles; there are now 7,966 vehicles in the fleet, 93% are low-floor[10] and the average age is 6.7 years (including Routemasters, 4.5 years excluding Routemasters)[11].

In 2003, London began introducing bendy buses. At 18 metres long, these vehicles can carry 140 people, at least 60 more than a double deck.

2.2.63 Alongside the investment in suburban rail and metro extensions, Madrid has also been making significant progress in increasing the bus service offering. The municipal bus fleet comprises 1,958 mainly single deck buses and more than three-quarters are low-floor with the rest being replaced over the next two to three years. Service kilometres has increased by 12% between 1991-2002 to 96 million per year. There are a further 1,494 buses operated under contract in the suburbs and about 150 of these are easy access. The average age is 4.2 years for urban and 4.9 years for the suburban fleet, within the Consorcio de Transportes de Madrid's target range of 4.5-6 years.

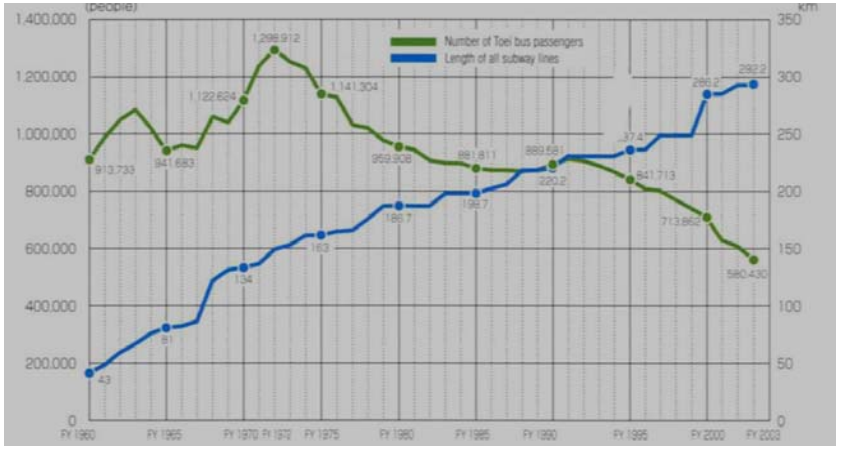
2.2.64 Significant improvements in bus priority have been made in Paris where 350km of bus lanes have been implemented in the Ville de Paris and immediate suburbs, compared to 205km in Greater London and some 120km in Singapore. However, focus groups with residents and local employees have revealed that the low headways (typically 15 minutes on most routes) and delays at junctions mean that buses are still not competitive with the metro or the private car for short journeys[12].

Paris has 171km of segregated bus lanes, 17km of contra-flow lanes and 118km of dual-use bus and cycle lanes.

[10] TfL data for November 2004
[11] TfL data for March 2004
[12] MVA 2004.

2.2.65 Patronage has been increasing in all the cities, except Barcelona, Singapore and Tokyo (see Figure 2.20), where there has been a decline in ridership due to the increase in rail coverage and rising car ownership. Bus speeds are also very low in Barcelona and Tokyo, while in Singapore, speeds are higher because of the 120km of bus lanes and other priority measures, but still not competitive with the car.

Figure 2.20 - Metro Extension in Tokyo



Note: Metro includes systems run by Tokyo Metro and Toei. Bus patronage related to Toei (public sector) services only which carry 40% of passengers in central Tokyo. Source: *Outline of Toei Transportation*, Bureau of Transportation Tokyo Metropolitan Government, 2004

Car Ownership

2.2.66 Previous research[13] has shown strong links between GDP and car ownership at the national level, but this correlation is not clear within the sample of cities for this study where the rate has been rising in some cities and falling in others (Table 2.10 overleaf).

2.2.67 Car ownership has been increasing in Barcelona, Madrid and Paris with the move to the suburbs, in Moscow, because cars have become more widely available under the market economy and average incomes have been rising, and also in Tokyo as more off-street parking is built using metropolitan government grants.

2.2.68 In contrast, car ownership has been declining in Singapore where there are controls on purchases and high taxes (see panel), and to a lesser extent in London and New York because of high insurance costs, congestion and difficulties in finding parking spaces, and the fluctuations in the New York economy.

[13] CfIT, European Best Practice in the Delivery of Integrated Transport, 2001

Singapore Vehicle Quota System

The Singapore Government increased vehicle import duties, registration fees and road tax in 1972 as the first step towards greater control of vehicle ownership and hence vehicle use. When the policy shifted towards road pricing as a more effective lever on use, these charges were reduced slightly, but still amounted to about S$34,000 (£10,000) on a typical 1500cc car with a market value of S$20,000, plus S$1,000 pa in 1999[1].

Despite the charges, vehicle ownership continued to rise by about 7% pa through the late 80s and the Government introduced a vehicle quota system to cap this at 3% pa by controlling the number of vehicles bought each month. Potential purchasers bid for a certificate of entitlement which is valid for 10 years and can be extended for a further 5 or 10 years after which the vehicle has to be scrapped. The bids are closely linked to the economy and are typically about S$30,000 but have reached as much as S$100,000. The bidding process has become more open; 'auctions' are held every fortnight, bidders now know the number of certificates available, and specify a reserve price which can be revised as bids rise.

The charges and quota system have been effective in constraining the growth in vehicle ownership. The total fleet was projected to reach one million by 1990[2], but had only grown to 711,043 (including 380,142 cars) in 2003. However, after paying so much for the vehicle, owners are encouraged to use them more. The average annual car use is 20,171km per car[3], compared to 11,500km in London[4].

[1]May, A.D. (2004) Singapore: *The development of a world class transport system*. Transport Reviews, Vol 24, No 1, 79-101, Jan 2004. [2]Lim, L.G (1970) *Transport planning in Singapore*, Journal of the Institution of Engineer, Singapore. [3]Singapore Land Transport, *Statistics in Brief 2004*. [4]Estimated from total traffic in London (Transport for London, *London Travel Report* 2003) and total vehicle population in London (Office of National Statistics).

2.2.69 Car ownership tends to be lower in the city centre where densities are higher and there are more travel options. For example, just over half of the households in centres of London, Paris and New York do not have access to car (Table 2.11).

2.2.70 The Ville de Paris has retained a relatively low level of car ownership per 1,000 population, compared to the rest of the Ile de France, however, it is still higher than London and New York. With the high population density, many of the streets are dominated by parked cars. The shortage of car parking spaces has had a positive influence on modal choice; residents are reluctant to lose their parking space and so they walk or use public transport for shorter journeys and keep a car for weekly trips to suburban supermarkets and weekends when they drive out of the city. Politicians cannot use parking to control traffic levels as most of the spaces are occupied by residents, and car use amongst commuters and visitors is relatively low.

Table 2.10 – Growth in Car Ownership

Year	Barcelona[1]	Singapore[2]	Paris[3]	Madrid[4]	London[5]	New York[6]	Tokyo[7]	Moscow[8]
1980		64	338	287	284	412	156	20[6]
1990		102	360	366	348	484	225	
1995	370	116	418	431	n/a	444	307	149
2000	452	111	450	536	345	n/a	439	250

Source: [1,4] municipal websites; [2]Statistics Singapore (www.singstat.gov.uk) [3]Kenworthy and Laube (1995 and 1999) and Regional Government estimate for 2000; [5]Transport Statistics for London, TfL (2000); [6]Kenworthy and Laube (1999); [7]Foundation of Tokyo Transport Safety Association (2004); [8] Recent data supplied by case study author.

Table 2.11 - Car Ownership and Availability

Car Ownership	Inner London	Ville de Paris	New York City
No car households	51%	54%	56%
One car households	39%	40%	32%
2+ car households	10%	6%	12%
Cars per 1,000 residents	272	288	255

Source: Transport for London 2004; Office for National Statistics Census 2001; DREIF, Les résultants détaillés de l'enquête globale de transport 2001-2002; US Census 2000

3 Strategies

3.1 Overview

3.1.1 There is evidence of a shift in policy emphasis from road construction to travel demand management[14]. The factors that have influenced these decisions have varied. For example, in London, Paris and New York, there is a shortage of available land to continue building infrastructure, a strong environmental lobby and widespread awareness that increasing capacity will encourage more trips by car.

3.1.2 In Singapore, a high capacity road network has been constructed to ensure the smooth flow of commercial and industrial vehicles[15]. There is a strong recognition that current levels of economic activity and personal wealth would generate significant growth in private vehicles, if car ownership and usage was unchecked, and the congestion would adversely affect the national economy.

3.1.3 In Barcelona and Madrid, the impetus is on improving the quality of life and conserving the architectural heritage to make the cities more attractive to inward investment and tourism.

3.1.4 Only Moscow and Tokyo have significant plans to develop more roads. Moscow arguably has an under-provision of roads and the city authority wants an outer ring road to reduce through traffic and open up land for development, even though it accepts that this will not address the growing problem of congestion caused by the rapid motorisation and lack of investment in alternatives to the car. In Tokyo, additional orbital roads form part of a land use strategy to develop rings of suburban cities that would take the pressure off the 23 Wards. A similar multi-centric plan has been implemented in Paris, and whilst it may have been successful in relieving congestion and crowding in the centre, it has contributed to greater car use in the suburbs (Table 3.1).

[14] Travel demand management is often referred to as mobility management in Europe

[15] Singapore has five times the length of urban motorway per person as London and four times that of Tokyo

Table 3.1 – Evolution in Trip Rates in Paris

	1976	1983	1991	2001	Change 1976-2001
Public Transport:					
Ville de Paris	1.03	1.09	1.15	1.15	11.7%
Petite Couronne	0.66	0.69	0.69	0.71	7.6%
Grande Couronne	0.49	0.46	0.49	0.44	-10.2%
Private car:					
Ville de Paris	0.68	0.72	0.76	0.65	-4.4%
Petite Couronne	1.07	1.28	1.38	1.42	32.7%
Grande Couronne	1.49	1.67	1.98	2.04	36.9%

Note : Trips per person over six years per day. Source: DREIF, Les résultants détaillés de l'enquête globale de transport 2001-2002.

3.1.5 Three main categories of measures have been implemented in the cities to manage traffic demand and reduce congestion:

- Land use strategies;
- Improvements to alternative modes; and
- Road user charging.

3.1.6 It is notable that none of the cities have made a significant effort with 'soft policies' such as travel plans and awareness campaigns, but these figure more in the strategies applied in the small and medium sized cities in the second stage of the study.

3.1.7 Regulating **land use** through the location, type, size and density of development can help to reduce the need to travel, particularly by car. However, the effectiveness of land use strategies has been disputed by some, for example, because people's decisions on where to live are based on a number of factors beyond proximity to their workplace, they change jobs and homes at different times, and land use patterns evolve over a period of years so the impacts are difficult to monitor.

3.1.8 Investing in the quality and coverage of **alternative modes** can encourage modal shift away from the car, particularly if the strategy includes complementary measures such as physical restrictions or reallocation of road space to restrict car use, or congestion provides an effective cap on further traffic growth. Without these, continued investment is likely to generate diminishing returns as the comfort and convenience associated with the car means that it will always be more attractive than public modes.

3.1.9 Taxes on car ownership, fuel duty and parking charges are widely used to influence car use. Various additional forms of **road user charging** have also been applied on strategic routes, but it is only London and Singapore that have congestion charging schemes in the city centre.

3.1.10 The following sections describe the transport strategies being implemented in each of the cities.

3.2 Barcelona

3.2.1 Barcelona has strived to gain identity and independence first within Spain, and then in Europe through regional economic development. Over the last 20 years it has become one of the key business centres and is frequently quoted in the top areas for investment because of its strategic transport links, attractive environment and good quality of life. However, like Madrid, the progressive decentralisation of the population, increase in car ownership and traffic threatened the very factors that contributed to the city's success.

3.2.2 In the late 1990s the focus of the transport policy shifted very much towards public transport to reduce car dependency in the suburbs and complementary land use policies to focus new development in the existing high-density city or at sites served by rail.

3.2.3 The Metropolitan Transport Authority set objectives to increase the use of public transport, maximise the economic and social return, and reduce the car mode share in relation to public transport. Its targets included:

- Extending rail to densely populated areas (>300 inhab/ha) so that no-one is more that 500m from a metro station and 800m from local train station; and

- Matching the supply and demand for public transport, so that buses serve corridors with 2500-4000 passengers per hour, trams are implemented in corridors with 3000-8000 passengers per hour, and metro or rail is provided where there is higher demand.

3.2.4 These targets are echoed in the Public Transport Infrastructure Plan (PDI) for 2001-2010 which stresses that rail-based systems are crucial for the city to function and to ensure international competitiveness, and that sufficient public transport capacity must be provided to "guarantee the effectiveness of government investment", particularly in pump-priming economic growth.

3.2.5 Investment rose dramatically to about 2% of the regional GDP and these high levels of spend have been sustained, as shown in the more recent figures (Table 3.2).

Table 3.2 – Investment & Subsidy (million Euros in 2001)

Investment	Roads[1]	Suburban Rail	Metro & Buses
Investment:			
National Government	191	83	
Regional government	267	31	50
Motorway concessionnaires	26		
Municipalities	37		
Investment and subsidy:			
Metropolitan Transport Authority[2]		74	192
Total	*521*	*188*	*242*

Note: [1]Spend on roads includes demand management measures such as access control, pedestrianisation and relocating roads in tunnels; [2]Cost recovery is reasonably high at 71% for FGC suburban rail and 79% for TMB (metro and urban bus).

3.2.6 The suburban rail and metro systems were extended and now form the backbone of the public transport system, supported by the urban bus network. The fares structure was simplified and the average price of a journey fell by 4.2% between 2000 and 2003. New tickets allow free interchange between rail, metro and buses across the metropolitan area and the number of multi-modal public transport journeys has risen from 8% to 21% in 2003.

3.2.7 Despite the fall in average fares, ticket revenue has risen by more than 10% pa because of the increase in patronage. Further growth followed the opening of two tramways in 2004; the 12km Trambaix connects with the suburbs, and the 4.8km Trambesos (which will be further extended by 1.7km) supports several urban renewal projects.

3.2.8 The €7.3bn PDI includes a further 251km of new suburban rail and metro lines. This includes the new perimeter metro line (L9) to improve access to development sites, and the Can Cuias and Can Ruti 'light metros' with 230 new stations in areas where residents have campaigned for better public transport specifically to tackle traffic growth and pollution.

3.2.9 To balance these 'carrots' to encourage drivers to switch mode, the strategy also contains some policy 'sticks' to reduce car use. Five restricted access zones have been introduced in environmentally sensitive areas. These have access gates that limit entry to authorised vehicles (residents, doctors and emergency vehicles) which are equipped with in-vehicle transponders. Within the zones, the speed limit is just 10kph and priority is given to pedestrians and bicycles.

3.2.10 Surveys conducted in the first zone, La Ribera, show that the traffic entering the zone has fallen by 78% and, despite the lower speed, the average travel time has dropped by 18%. Residents are pleased with the scheme and the impacts on the economy are generally positive, though there has been a change in the types of businesses located in the zone to those that are less dependent on car-based customers.

3.2.11 Some 5km of the main arteries have been placed in tunnel in order to reduce the traffic noise and increase pedestrian space. Other avenues, such as Avenida Meridiana, Arago Street and Gran Via, have been narrowed so that road space could be re-allocated to footways. Across the city, the pedestrianised area has increased from 97ha in 1995 to close to 110ha, and the amount of green space has also risen from about 930ha to 990ha.

3.2.12 The city council has been tightening parking controls and reducing on-street provision to discourage commuters and visitors driving into the city. It has increased the supply of underground residents' spaces to make up for the previous shortfall that led to unnecessary circulatory traffic as drivers searched for a space.

3.2.13 The strategy has been effective in increasing overall public transport use; patronage on rail-based modes has increased, but bus use has been falling despite the 35% increase in network length and investment in new easy access vehicles (Table 3.3).

Table 3.3 – Public Transport Patronage (000s)

Patronage	1992	2004
Suburban rail	116,982	176,680
Metro	272,500	321,365
Bus	200,900	189,800
Total	*590,382*	*687,845*

Source: Transport Indicators, ATM

3.2.14 There is also evidence of modal switch with public transport increasing almost entirely at the expense of the car (Table 3.4). There has been an increase in traffic on the ring road, but traffic levels within the inner city have generally been declining.

Table 3.4 – Modal Share (% of all trips)

	1999	2002
Trips within the inner city:		
Public transport	37.8%	39.5%
Car	26.8%	24.5%
Walk	36.4%	36.0%
Trips between suburbs and inner city:		
Public transport	31.0%	33.5%
Car	65.1%	62.7%
Walk	3.9%	3.7%

Source: Pacte per a la Mobilitat.

Barriers and Levers

– With the abolition of the Metropolitan Corporation of Barcelona in 1987, there is no longer a single authority responsible for transport and land use planning and other urban functions within the metropolitan area. Whilst all the metropolitan cities have undergone a process of suburbanisation, the lack of 'joined up thinking' allowed this to happen rapidly in Barcelona and generate the transport problems that the strategy sought to address.

– Whilst new suburban developments tend to be located on sites served by rail, the potential influence on car ownership and modal choice is undermined by the continued use of generous parking standards.

– Policy-making is complicated because responsibilities for transport are split between the regional government (strategic roads, though the tolled motorways are operated by concessionaires, the FGC suburban railways and inter-urban buses), national rail operator RENFE, Metropolitan Transport Authority (public transport), Metropolitan Entity of Transport (metro and bus), groups of municipalities (distributor roads), and individual municipalities (local roads, traffic management and parking, walking and cycling).

– Funding the increase in public transport supply and integrated fares increased the burden of subsidy. Both public transport authorities borrowed to meet the growing gap between their funding from the national, regional and local governments and system operating costs. They built up debts in excess of €32m which the national Government eventually agreed to pay off.

+ Despite the political tensions between the Socialist city council and the more Conservative regional government, there has been agreement on the need to invest in transport to access the new development sites and ensure the availability of workers to support economic development.

+ Funding for capital investment has been available from the European Union, national Government, public-private partnerships and local taxation (Barcelona has the highest taxes in Spain).

+ Policies and investment decisions were developed through negotiation with the public transport authorities and the municipalities. This process was made easier because the strategy largely contained positive inducements to encourage modal switch, and there was already a culture of walking and public transport use.

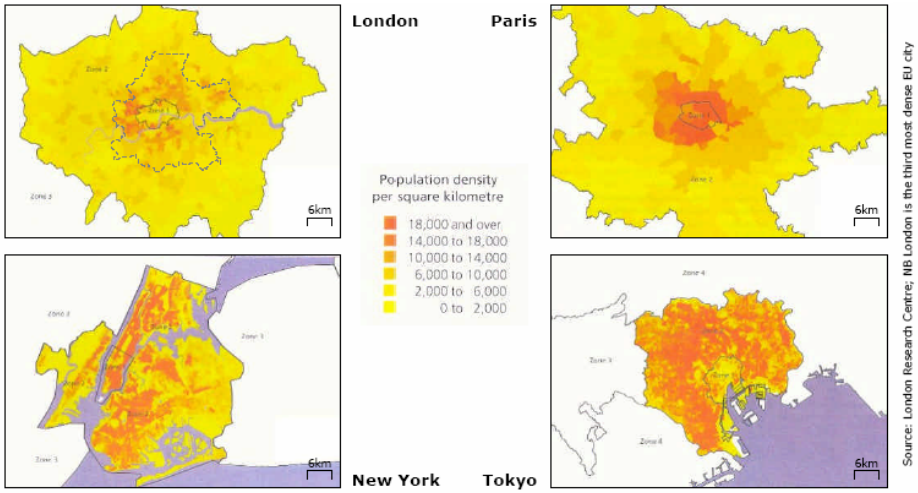
+ However, the public transport bodies are now calling for more restraints on car use to reinforce the effects of the public transport improvements but this is more difficult to reach a consensus on controversial policies.

3.3 London

3.3.1 London was one of the earliest large industrialised cities, and had reached a population of 6.5 million by the end of the 19th Century. The city continued to expand; but active steps were taken to contain sprawl through the establishment of the Green Belt. London's population reached a peak of about 9 million by the beginning of World War 2, but then declined, with active policies to encourage relocation of jobs to other parts of the country. By 1981, the population had fallen to 6.8 million, but this trend has been reversed and it is now steadily increasing through a combination of urban in-fill and edge of town development.

3.3.2 London's history has given it a unique set of spatial characteristics. It has grown as a relatively low-density, open city compared to other World Cities. Two-thirds of its land area and the majority of its population are in the suburbs (Figure 3.1), whilst jobs are still concentrated in the city centre, so there is strong commuter flow. There are a number of distinct suburban centres, many of which date back to the original settlements that have become subsumed within the conurbation, but these have been weakened by out-of-centre shopping and leisure developments, which has increased demand for both longer-distance and orbital travel.

Figure 3.1 – Comparative Population Density Patterns



3.3.3 The economy is dominated by the service sector, including finance and business services which have increased rapidly over the past decade and now account for 35% of London's Gross Value Added (GVA) and a third of all employee jobs. Much of the growth has taken place through redevelopment and densification in the City of London, and there has been significant employment (and population) growth in the Docklands, which has led to reorientation of the city eastwards.

3.3.4 A key stimulus to this transformation was the construction of the Docklands Light Railway (DLR), which provided a rapid and frequent link between the City, the Isle of Dogs and Stratford. Commercial developments quickly followed Government commitment to the construction of the DLR, and then a virtuous circle was established which saw extensions to Bank station, in the heart of the City, to Beckton, and subsequently south of the river to Lewisham. Subsequently, a very much higher capacity link to the Docklands has been created by the creation of the Jubilee Line Underground extension, opened in 2000.

3.3.5 Car ownership continued steadily between 1971 and 1991, but slowed through the 1990s in contrast to other English metropolitan areas (Table 3.5). This is likely to be associated with the rising cost of fuel and insurance, and the high cost and limited availability of parking.

Table 3.5: Car Ownership

	1971	1981	1991	1996	2002
Households without car/van (%)	52	46	41	39	38
Household with 1 car or van (%)	40	41	39	44	42
Household with 2 or more cars/vans (%)	8	13	20	17	20
Passenger cars/1000 population (London)	223	284	325	337	345
Passenger cars/1000 population (all English metropolitan areas)	-	230	305	345	415

Source: TfL, DfT

3.3.6 Responsibility for planning and transport has undergone considerable change in the last 30 years. The Greater London Council was established in 1974 as a strategic authority; it was abolished in 1986, and the Greater London Authority (GLA), with an elected Mayor, was established in 2000. Throughout this period, other organisations, including the London Boroughs, London Transport (now part of Transport for London) and central Government in different forms, have all had varying roles in steering transport strategy and developing transport projects. The London Planning Advisory Committee (LPAC) promoted strategic thinking and the need for demand management, investment in public transport and walking/cycling, and integrated land use policies, but it had no delivery mechanism.

3.3.7 Given added impetus by terrorist activity in 1992-3, the Corporation of London implemented a key traffic restraint measure in the City (the business and financial district). Physical restrictions on access to the Traffic and Environment Zone were intended to reduce through-traffic. Within the 4km^2 'Ring of Steel' road space was been re-allocated and signal settings adjusted to favour pedestrians, cyclists and buses. Following implementation in 1993, the number of vehicles entering the zone fell by 25%, pedestrian accidents reduced by 39%, and air pollution fell by 10%. The scheme has been popular with businesses who have recently contributed to a westward extension.

3.3.8 The establishment of Transport for London (TfL) and creation of a single body responsible for public transport and the 580km network of main roads and all of London's 4,600 traffic lights provided an opportunity for addressing transport problems and implementing further restraint, in cooperation with the Boroughs who are responsible for local road schemes, walking and cycling improvements, and other initiatives. TfL has some influence on local policy through its funding powers and between 2000-2004, TfL spent £450m on Borough-led projects including road renewal, safety improvements, and bus priority measures.

3.3.9 Transport issues have fed into the development of the London Plan, a spatial strategy that envisages significant growth in population and jobs with a focus on the regeneration of the east of London and existing suburban centres. However, local planning decisions, local roads and parking policies are the responsibility of the 32 Boroughs and the Corporation of London (in the City of London). Each Council is controlled by elected councillors representing wards within the borough who make decisions on policies and funding using income from central government, TfL and Council Tax on residents.

3.3.10 Over the past 10 years there have been extensions to the Underground, investment in light rail and two tramways. Since 2000, the Mayor's Transport Strategy has delivered significant improvements in buses, including new routes, new vehicles, higher frequencies and better reliability, as illustrated by the 34% rise in service-kilometres operated in Table 3.6. In addition, fares have been lowered and simplified, new types of tickets have been introduced, including the Oyster Card, a pre-paid smart card that can be used on buses and Underground, and cashless operation has been implemented in central London which has improved boarding times.

3.3.11 Service kilometres on the Underground have also increased (by 22%), but there are still concerns about crowding and issues about reliability on Underground and mainline rail services. For example:

- Underground - scheduled kilometers operated has fallen from 95% in 1990/91 to 93.1 in 2003/04[16] (Figure 3.2); and
- Rail – trains arriving on time (ie within 10 minutes of their timetabled arrival time at the final destination) has fallen from 89.6% in 1997/98 to 80.5% in 2003/04[17].

3.3.12 The Underground has been part-privatised through an innovative Public Private Partnership (PPP) with three private sector companies which will see an important injection of funding into maintenance and renewal of the assets amounting to £16bn in the first 15 years, while TfL retains responsibility for managing and operating train services.

3.3.13 There have been further restrictions on stopping and parking along main roads (red routes) and increases in parking charges and residents' only parking provision across London. These measures have helped to free up road capacity, facilitate the implementation of 250km of bus lanes and deter car use amongst commuters and visitors. However, the roads are still heavily congested and traffic speeds were falling, prior to the introduction of the congestion charging zone (Table 3.7).

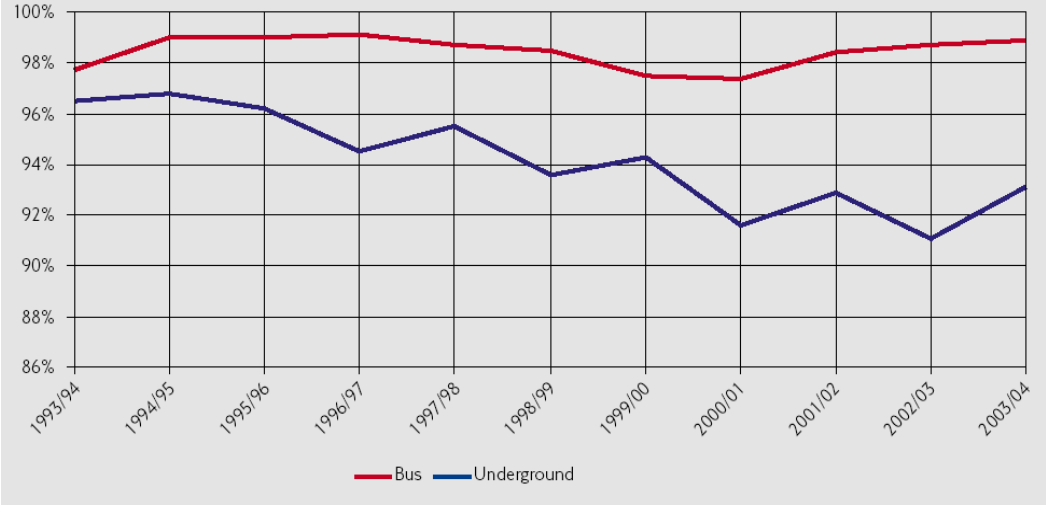
[16] TfL London Travel Report 2004
[17] SRA National Rail Trends 2004/05 Q2. Data for all services run by London and South East operators.

Table 3.6 - Bus and Underground Statistics

Year	Underground			Bus		
	Passenger kms (m)	Passenger journeys (m)	Train kms (m)	Passenger kms (m)	Passenger journeys (m)	Bus kms operated (m)
1971	5,158	654	50	4,678	1,480	314
1981	4,088	541	50	4,039	1,080	275
91/92	5,895	751	53	3,996	1,149	296
95/96	6,337	784	57	4,018	1198	326
01/02	7,451	953	65	5,128	1,430	373
03/04	7,340	948	68	6,431	1,702	437

Source: TfL, 2004

Figure 3.2 – Proportion of Scheduled Kilometres Operated



Source: TfL, London Travel Report 2004

Morning Peak Period	Central Area	Rest of Inner Area	Outer Area
1977-1982	12.2	14.1	19.2
1983-1990	11.7	12.7	18.6
1990-1997	10.6	13.3	17.2
1997-2000	10.0	12.0	18.2
2000-2002	9.9	11.6	16.9
2003-2004	10.6	11.7	n/a

Source: TfL London Travel Trends 2004

Table 3.7 – Morning Peak Average Traffic Speeds (mph)

3.3.14 Throughout the 1990s ideas for road user charging were researched and developed, but with little tangible commitment to implementation. However, in 1998 the newly elected Labour Government set in place changes to the legislation that would allow charging and the Mayor implemented the congestion scheme covering most of Central London in February 2003. It was important that the benefits be visible in the first term of office and so the Mayor's Transport Strategy was rapidly developed to provide a strategic rationale for the scheme, in the absence of powers over the Underground or rail services. The strategy held Underground fares at inflation and froze bus fares (so they reduced in real terms) to encourage modal shift and the quality of bus provision and scope was improved, with some improvements in provision for walking and cycling.

3.3.15 The scheme has been successful in reducing traffic by 15% and delays by around 30% inside the zone. This has led to a 20% fall in traffic-related CO_2 emissions and 20% less fuel consumption.

3.3.16 Some 50-60% of the former car users have transferred to public transport. There has been some switching between mainline rail, Underground and bus to accommodate the increased demand, but there is crowding on the rail-based modes in the peak periods. 20-30% continue to drive but divert around the zone, though there has been little or no adverse effect on the roads immediately outside the zone. The remaining 15-25% have adapted their travel patterns, for example, by changing the time of travel.

3.3.17 The charging scheme, along with bus priority measures, additional policing of bus lanes and introduction of Quality Incentive Contracts that reward operators for good performance have increased bus service levels and reliability. Scheduled kilometers operated has risen from 97.3% in 1990/91 to 98.9% in 2003/04, the average wait for high frequency services has reduced and the proportion of

low frequency service arriving on time has increased from 62.9% to 74.6% over the same period. As a result, London Buses now carry 1.7billion passengers – the highest number since 1968. In light of these benefits, there has been a public consultation into proposals to extend the zone westwards, to embrace adjacent congested areas such as Knightsbridge and Kensington.

3.3.18 There have also been notable results from work with the Boroughs; for example, the London Cycling Action Plan has included a range of measures to improve conditions for cyclists, such as cycle parking at stations, at schools and free training, and cycling has subsequently increased by 23% in just a year (May/June 2003 to same time 2004).

Barriers and Levers:

- For a long time there was no long-term integrated transport and land use strategy in London and, until recently, there has been no single authority responsible for delivering improvements in an integrated context.

- Major projects were conceived and implemented by London Transport, including the Jubilee Line extension, DLR extensions and Croydon Tramlink, and whilst there has been some integrated land use development, these policies were not placed in a broader, multi-modal context, particularly with regard to wider issues of managing the demand for road space[18].

- Through the 80s and particularly the 90s, funding of the Underground was not sufficient to renew and maintain its infrastructure to acceptable standards, and bus service quality has steadily deteriorated as traffic congestion eroded reliability.

- TfL, SRA and the relevant Train Operating Companies have been attempting to simplify service patterns and make other changes that will enable the south London rail network to be presented as a 'metro-style' service, but institutional, funding and infrastructure constraints have hampered progress.

- Fares are high; they rose particularly steeply during the early 1990s, as the then Government shifted more of the costs of public transport from Government to passengers. The relative rise in the cost of using different modes created a powerful economic mechanism favouring car use over public transport.

- London is unusual amongst other cities in that a high proportion of local government spending is raised and determined nationally rather than locally. For example, TfL's total budget at the start of 2003/04 was £4,354 million of which passenger revenue is 51%, Government grants 48% and other local revenue is 1%.

[18] With the exception of Docklands development, which because of access problems was always predicated on the need to establish and maintain very high public transport mode shares for work journeys.

+ The election of a mayor with strong views on the need to manage traffic and the creation of TfL to deliver his strategy have given London a powerful, integrated institutional structure.

+ One of the first moves of the newly elected Mayor was to reduce bus fares; this was partly to facilitate other measures intended to facilitate fares simplification and hence improve operational efficiency, but was also a response to the perception that bus fares had become too high.

+ The congestion charge has been effective in reducing car use and encouraging a switch to public transport, and appears to have had no adverse effect on the economy, though analysis has been complicated by other parallel influences such as the Iraq war and Central Line disruptions.

+ The bus network has been substantially expanded and London now has the world's largest fleet of accessible buses – more than 93% of London's 8,000 buses are modern, low floor and wheelchair-accessible. Service levels are higher than at any time since 1957 and 90% of all London's households are now within 400 metres of a bus service. More people are now choosing to travel by bus than at any time since 1968.

+ Ticketing improvements have made using public transport more attractive, convenient and affordable. The Oyster Card combined season ticket and pre-paid pay-as-you-go ticket is now the largest smartcard programme in Europe and take-up is increasing daily. It is speeding up Tube and bus journeys by making ticket purchase easier and reducing time spent boarding buses.

3.4 Madrid

3.4.1 Historic planning policies have generated a high population density and mixed land use pattern in the centre of Madrid and focused new development along the main radial corridors (particularly along the north west/south east axes) that are well-served by public transport. However, between 1970 and 1985, both the population and the supply of public transport were increasing, but total patronage fell by about 20%, mainly because of poor co-ordination between the rail, metro and bus systems, lack of investment in new fleets and interchange penalties. The development of low density housing and science parks in the suburbs and continuing use of minimum parking standards[19] contributed to further increases in car ownership, car use and congestion that threatened continued economic growth.

[19] The General Urban Plan (1997) requires one parking space for each new house or 100m^2 of housing, and each 100m^2 of land developed for industrial use. Rates for offices and recreational developments vary according to location; one space per 100m^2 of built area inside the city and 1.5 spaces outside the M-30 ring road.

3.4.2 The regional government adopted 'maintaining public transport patronage' and 'controlling suburbanisation' as key objectives and developed a transport strategy with the national Government and municipal authorities, including the City Council. Following the completion of three dual carriageway ring roads, policies have focused on increasing public transport provision to offer motorists a greater choice of travel with some efforts to manage traffic demand through tolls on the radial and orbital autoroutes, two sections of HOV lanes and traffic restraint within the city. These include parking restrictions, pedestrianisation and other improvements to walking and cycling facilities to maintain the cultural and architectural heritage and support the growing tourist industry.

3.4.3 Through the 90s, the national Government invested in the electrification of the 12 radial cercanias (suburban) lines and rolling stock renewal that have improved punctuality (the proportion of trains arriving within 5 minutes of their scheduled time) from 92% to 99%. Park and ride sites have been built at suburban rail stations[20].

3.4.4 The regional government extended the metro system; 115km have been added in the last 10 years at a cost of €3.7 bn (£3.1 bn) and a further 73km is planned for completion by 2007. Trains have been replaced and the average age is just 10.9 years, and about half of the 236 stations have been retro-fitted with lifts to improve access to the platforms. The complementary urban bus network, run by the municipal operator, has also been extended by more than 10%, stops have been upgraded and most of the fleet is now low-floor with an average age of less than five years.

3.4.5 The typical annual spend on metro and urban bus is shown in Table 3.8. This approximates to £180 per head[21].

Table 3.8 - Spend on Metro and Urban Bus (€million/year)

Body	Investment	Subsidy	Subsidy/ operating cost
MINTRA – all modes	592.1[1]		
Consorcio Metro and urban bus	159.6[2]	335.8[3]	45%

Note: [1]Average spend 2000-2003; [2]Average spend 1997-2002; [3]Support in 2002. Source: Urban Mobility Observatory, Ministry of Environment (2004) and Consorcio de Transportes (2003).

3.4.6 The region set up the Consorcio de Transportes de Madrid to plan and manage public transport. The Consorcio devised a zonal fare system in 1987, lowered metro fares to create a common tariff within the city (a single is about €1) and introduced the Abono Transportes, an unlimited monthly or yearly travel pass that permits interchange between cercanias, metro and buses. These

[20] There is capacity for over 17,000 cars, with 300-500 spaces at each site

[21] Using the population of the city plus the surrounding metropolitan ring in 2002.

measures made public transport easier to use and much cheaper for increasingly disparate journeys in the suburbs and successfully reversed the trend of declining public transport use. Patronage has since increased by 61% (Table 3.9).

Table 3.9 – Public Transport Demand (millions)

	Trips		Pass-kms	
Year	**1986**	**2002**	**1986**	**2002**
Metro	329.0	565.0	1,875.3	3,162.0
Urban buses	387.3	412.0	1,755.0	1,674.4
Cercanias	59.7	193.3	890.2	3,450.4
Regional buses	116.5	266.1	1,125.4	4,445.6
Total	*892.5*	*1,436.4*	*5,645.9*	*12,732.4*
% increase		*61%*		*125%*

Source: Consorcio de Madrid

3.4.7 Traffic levels have fluctuated; generally declining in the inner city, but rising in the suburbs where ad-hoc decisions are still being made on development proposals, though the municipalities are now negotiating for contributions to transport improvements.

3.4.8 In the city centre, the main commercial and tourist areas have been pedestrianised and the City Council has launched an ambitious Accessibility Plan to reclaim more space for walking – including a 1.5km link between the Royal Palace and the Prado Gallery. There are also traffic calming schemes in inner city neighbourhoods where pavements are being widened, and on-street parking is being converted to residents-only use and re-located underground.

Barriers and Levers

- The investment in public transport has helped to off-set the full impacts of the demographic and economic trends, but it is difficult to see how this level of spend can be sustained in the absence of more effective forms of restraint either on suburbanisation or car use.

- The regional government has a spatial planning strategy, but little has been done to contain sprawl, particularly through the late 80s and 90s when economic prosperity intensified the pressure for development.

- The rail extensions have improved travel choices in existing suburban areas, but the investment could have been more effective if new developments had been focused around stations, rather than in low density housing estates and science parks.

- Travel patterns are becoming increasingly complex and difficult to accommodate with conventional public transport.

+ Progressive decentralisation has given the regional government legislative and executive powers over planning, transport, health, etc. It also has the resource - human and financial – to develop and implement strategic transport policies.

+ The regional government takes the place of a metropolitan authority for the city and so there is one less body involved in decision-making, compared to other Spanish cities. Through its funding powers, the region also has a large influence in local policies on traffic and town planning.

+ There is a good level of co-operation between the national, regional and municipal tiers, partly because they belong to the same political party. The Popular Party has led the city since 1991 and region since 1995 so there has been stability in policies and funding.

+ The regional and municipal governments have shown considerable strategic leadership. For example, the current president of the region has a clear vision to transform Madrid into the capital of the South of Europe and has promoted major infrastructure projects.

+ Good transport is widely considered essential to economic development and so there has been good buy-in from various stakeholders, including the private sector, employers' organisations, trade unions and pressure groups.

3.5 Moscow

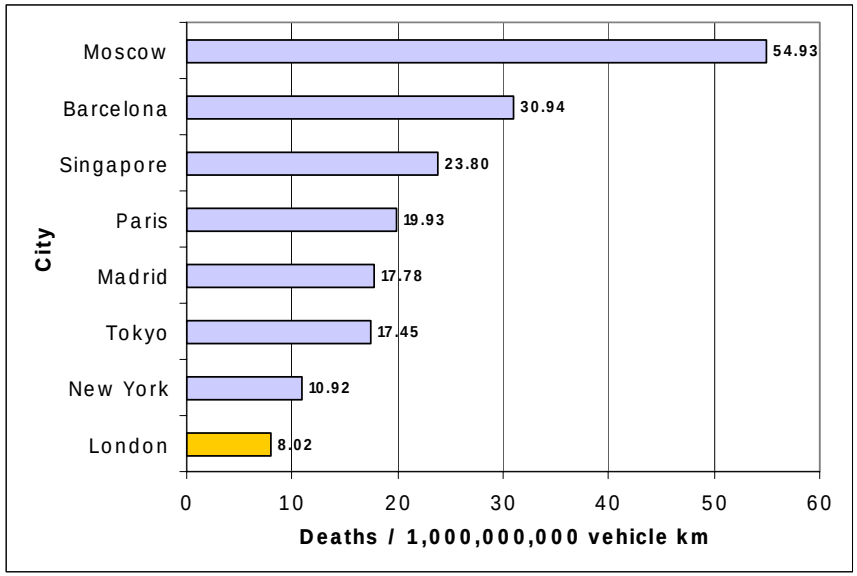
3.5.1 Moscow city limits have been expanding but land use densities have remained high as the population has been growing, mainly through in-migration. However, Soviet-era planning policies separated residential and industrial use so there is a large demand for travel which is being exacerbated by large-scale house building on the edge of the urban area.

3.5.2 Car ownership has been rising rapidly (at more 7% pa for the last five years) to 250 cars per 1,000 population. Whilst this is still low compared to the other metropolitan cities, it has led to rapid growth in traffic. There is no reliable data on flows but estimates suggest that traffic on the main highways entering the city has increased by 70-80% between 1987 and 1999, and traffic on city streets has increased by 50-200%.

3.5.3 This has generated severe congestion as the city was planned assuming that car ownership would be about two-thirds the current level. The average traffic speed is 15kph in the city centre and only 30kph across the metropolitan area, and the cost of lost time and excess fuel consumption is equivalent to 9% of the city's gross regional product.

3.5.4 There is also very poor air quality because of take-up of older imported cars and a worsening safety record because of poor driver training and inadequate traffic management (Figure 3.3). The number of deaths per 100,000 people is 1.5 times higher than the next highest city in our sample, New York.

Figure 3.3 - Comparative Road Safety



Source: Kenworthy and Laube, 2001

3.5.5 The road network comprises 12 main radials and three ring roads; an inner ring around the city centre, a middle (Third Ring), and an outer ring road just inside the edge of the metropolitan area. The 36km Third Ring, which has just been completed, was intended to relieve the inner ring road and the city centre of congestion, but as sections opened, they quickly became congested too.

3.5.6 Until the mid-1990s, public transport was considered the main form of urban transport and the growth in the private car fleet was restrained by high prices for domestically-produced motor vehicles and a ban on imports. The State also provided a high level of support for public transport which allowed continuous renovation of fleets and further development of infrastructure. By 2005, public transport was expected to be used for 85-90% of all motorised journeys, but it actually accounts for 76% and its share is declining as car ownership increases and service quality falls because of the shortage of funding for operation and maintenance. Though this is a worrying situation, no other city in the sample has this level of public transport use.

3.5.7 The transport strategy up to the present day has been to build a way out of the congestion problem with more roads and rail links. In addition to the Third Ring, there is a new light rail line connecting the large residential areas outside the outer ring road with the metro, a monorail is nearing completion, and two other light rail lines are underway, but have been delayed by lack of funding. There has also been an extension to the metro, and other improvements to increase speeds (average operating speed is 35kph) and reduce headways to 1½-3 minutes.

3.5.8 About a third of all journeys are made by metro and patronage grew as the economy improved through the 90s and passengers switched from the buses, trolleybuses and trams which were increasingly affected by the traffic congestion. More recently, the purchase of new trolleybuses and trams have led to greater use of these modes (Table 3.10).

Table 3.10 – Patronage on City-Owned Public Transport (mil)

Mode	2000	2001	2002	2003
Bus	2906	2479	2635	2601
Trolleybus	844	888	1171	921
Tram	444	635	960	704
Metro	3202	3200	3200	3201
Total	*9396*	*9202*	*9968*	*9430*

3.5.9 Traffic management measures have sought to create additional capacity to accommodate the growing traffic levels and there are no plans to re-allocate this to bus lanes. Measures have included a centralised control system that co-ordinates signal settings (START) at 122 key intersections, which has increased road capacity by about 12% and a permit scheme to restrict HGVs entering the city during the day. A further 15% capacity gain is expected from the conversion of the inner ring road and other key routes to a one-way operation, which is currently underway.

3.5.10 There are plans for a 3km tunnel link from the Third Ring to the city centre and a fourth ring road to start construction in 2007. However, there is an increasing awareness that this approach will not succeed, and that more attention must be directed to reducing the demand through traffic restraint measures and better utilisation of existing resources with traffic management schemes and surface transit priority measures. Among the many problems in this approach is the lack of legislation for parking enforcement in the centre.

Barriers and Levers

– Policy is largely the responsibility of the city government, but transport is covered by the Transport and Communications Department, planning falls under the Department of City-Planning Policy, Reconstruction and Development, air quality under the Department of Natural Resources and Environment, while traffic management and safety are covered by the Moscow Division of the State Traffic Safety Inspection. As a result there is no integrated strategy; infrastructure, public transport improvements and traffic management are considered in isolation and detailed in separate policy documents.

– After the collapse of the USSR in 1991, the State transferred responsibility for urban public transport to local authorities. With the economic problems, Moscow's heavily subsidised public transport systems received insufficient funding for operation and maintenance.

– Fares have increased to make up for some of the deficit, but quality and service levels on surface modes have declined. Many people qualified for fares exemptions (as a privilege or a form of social services support) and with ineffective fare collection methods, only 38% of passengers pay for a ticket. New legislation introduced this year has now reduced the number of exemptions.

– The metro has improved and a light rail line has opened and is well used but they have made little impact on traffic levels. Restrictions on cars access to the city centre are a highly controversial topic and would require changes to be made to the State legislation which are extremely difficult in the current political climate.

– There has been some increase in road capacity through traffic management, but there is potential for making significant improvements in circulation and influencing travel demand through parking policies. Currently drivers can park on-street at no charge and the legislation does not allow vehicles to be removed.

+ There is a culture of public transport use and whilst the public transport modal share is falling, it is still high compared to other metropolitan cities. The economic constraints have prevented large-scale road building and there is a growing awareness of Western experience in tackling congestion and an acknowledgement of the importance of managing traffic demand.

3.6 New York

3.6.1 Whilst some of the metropolitan cities have needed to invest in public transport to meet the needs of their expanding built-up areas, New York City already had the necessary infrastructure in place, but years of neglect had led to a gradual decline in reliability and service quality. By the 1980s it was clear that the capacity of the tunnels and bridges approaching Manhattan and the congestion on the city's streets effectively limited further traffic growth, and the only way the economy could continue to grow would be by increasing access to jobs using public transport.

3.6.2 In 1982, the metropolitan authorities developed a consensus to "save public transport" by restoring the decrepit track, rolling stock and much of the behind the scenes infrastructure such as signals and the power system. Over the last 10 years, this restoration work has continued and there has been more 'visible' investment in replacing fleets, increasing capacity, modernizing stations and introducing the MetroCard in 1996. This is a 1, 7 or 30-day multi-

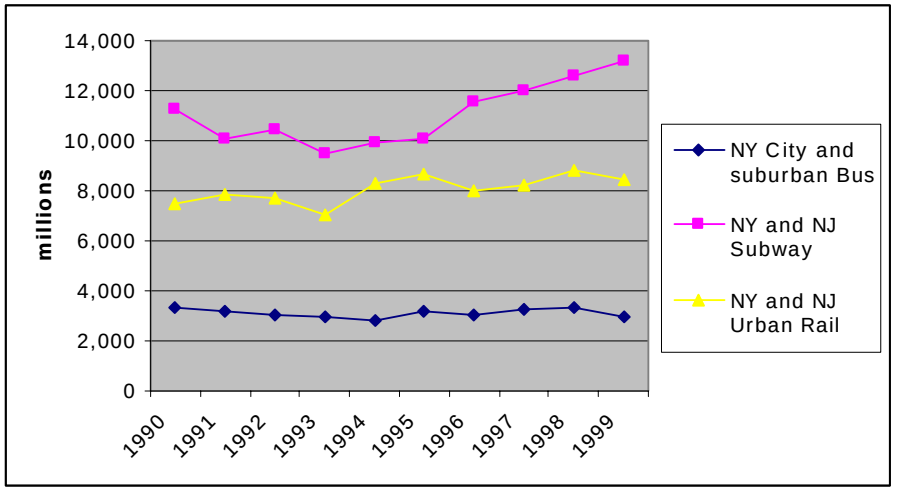
ride ticket, similar to the Oyster card in London, which allows free interchange between bus and subway services within two hours[22].

3.6.3 In all the Metropolitan Transport Authority has invested US$48 billion (£25 bn) in capital funds in restoring and upgrading the public transport, including refurbishing 356 railroad and subway stations and modernising/replacing train and bus fleets which also contributed to a decline in crime, along with the zero-tolerance approach to graffiti which has increased people's sense of security on the system and contributed to patronage growth. On-time performance has increased from 85% to 93.1% on the Long Island Rail Road and from 80.5% to 97.5% on the Metro-North Railroad. The mean distance between failures on the subway has increased continuously, from 7,000 to nearly 140,000 miles.

3.6.4 The investment has been successful in increasing the use of the public transport systems and supporting economic growth; an extra 400,000 jobs have been created in the CBD. Between 1992-2000, railroad patronage grew by 28% and bus and subway patronage by 44%[23] and there is now severe crowding in the peaks.

3.6.5 Subway passenger kilometers increased sharply after 1996 on the strength of the economic boom and the introduction of the MetroCard (Figure 3.4).

Figure 3.4 - Passenger Kilometres Per Annum by Public Transport



Note: Figures for the New York Metropolitan Transportation Council area, which covers 2,440 square miles ie 11 of the 19 million people that live in the metropolitan area, provide the best comparator for Greater London

[22] Interchange penalties apply to cash fares

[23] Scanlon and Seeley (2004) *At Capacity: The Need for More Rail Access to the Manhattan CBD;* Rudin Center for Transportation Policy and Management

3.6.8 In 2001, the Port Authority of New York and New Jersey (PANYNJ) introduced 'value pricing' on the two tunnels and four bridges between New York and New Jersey. The scheme aimed to reduce congestion by encouraging public transport use and greater take-up of the E-ZPass (electronic payment system) that would speed up toll collection.

3.6.9 The tolls varied according to the crossing and time of day; crossings with worst congestion and most public transport options were more expensive than those with spare capacity and few alternate modes, and discounts were available for off-peak (9:00am-4:00pm, 7:00pm-midnight) and night-time (midnight-6:00am) use. The typical toll for a passenger car, for example, was increased from $4.00 cash ($3.40 with E-ZPass) to $7.00, but there was significant public opposition and so this was reduced to $6.00 cash ($5.00 in the peak and $4.00 off-peak with E-ZPass). An additional $1.00 discount on E-ZPass trips is available for car-poolers with 3 or more occupants.

3.6.10 The morning peak period has been spreading, and the initial data suggests that the differential tolls have been successful in encouraging some further shift from peak to off-peak periods. Coupled with the take-up of E-ZPass, the shift has improved journey times as the typical queue into Manhattan Island has dropped from 3 minutes (in 1996) to only 20 seconds, despite a 13% increase in traffic.

3.6.11 However, neither the public transport improvements nor the value pricing have had any real impact on modal shares. Some 11% of journeys to work in Manhattan are made by car and 59% by public transport (Table 3.11), compared to 13% and 79% into Central London

Table 3.11 - Mode Share for Journeys to Work in Manhattan

Mode	1990	2000
Drive Alone	8%	8%
Car Pool	4%	3%
Public Transport	58%	59%
Walk	23%	22%
Other Means	2%	2%
Worked at Home	5%	6%

Source: New York Transportation Statistics 2000

3.6.12 The reactions to the increases in public transport fares and tolls originally proposed for value pricing suggest that New Yorkers would be responsive to congestion charging policies. However, there is limited potential for accommodating more passengers on public transport in the short-term and there is no lead politician to implement a balanced transport strategy to reduce car use across the city and its immediate environs. Instead, less controversial

traffic management measures have had positive local impacts and are being pursued further.

Barriers and Levers:

– The New York Metropolitan Transportation Council (NYMTC) provides a collaborative planning forum to address transportation issues and makes decisions on the use of federal funds, but it only covers 2,440 square miles ie 11 of the 19 million people that live in the metropolitan area.

– The area covered by the Council is the least car dependent urban area in the US largely because of the high land use density. Outside the Council area, the low density 'spread city' cannot be cost-effectively served by public transport and distances are too long to walk or cycle.

– The Metropolitan Transport Authority has responsibility for public transport and toll bridges and tunnels serving New York City. The managing board comprises members nominated by the State Governor and mayor of New York City and representatives from union and passenger bodies with no clear leader or political clout.

– The policies have been implemented in isolation; the fare and toll increases faced massive public resistance, unlike Singapore, for example, where congestion charges were accepted because they were sold as a part of package of measures.

– There has been little feedback on changes to proposed policies and the impacts of the transport improvements. The groups that had opposed the value pricing have taken this to mean that their concerns will never be addressed.

+ The MTA receives funding from the State and is able to shield the operating companies from public or political debates about the benefits of subways over buses or transport over other city functions such as police and fire services.

+ Key stakeholders were involved early in the planning of the value pricing initiative which helped to fine-tune the proposal and engender support which was important because of the public adversity.

3.7 Paris

3.7.1 The population of the Ile-de-France has been stable for the past two decades, but there has been a continuous decentralisation of people and jobs to the outer parts of the region (Table 3.12). Car ownership in the Ville de Paris (inside the Périphérique) was already high at about 288 cars per 1,000 population (compared to Inner London 272 and New York City 255) and this has remained constant, whilst car ownership in the suburbs has grown.

Table 3.12 – Ile de France Population

	1982	1990	1999	Change 1982-1999	Change 1990-1999
Ville de Paris	2,176,243	2,152,423	2,125,246	-2.3%	-1.3%
Petite Couronne	3,909,995	3,988,393	4,038,992	+3.3%	+1.3%
Grande Couronne	3,991,821	4,519,738	4,787,773	+19.9%	+5.9%
Ile-de-France	10,073,059	10,660,554	10,952,011	+8.7%	+2.7%

Source: DREIF, Les résultants détaillés de l'enquête globale de transport 2001-2002.

3.7.2 These factors have contributed to a decline in trips and hence traffic in the Ville de Paris which has been reinforced by certain policy measures. These have tended to concern traffic calming to improve the quality of the local environment and encourage residents to stay, rather than charging or restrictions on car use which could be unpopular and hasten further decentralisation. The latest monitoring data shows that total vehicle flows fell by 3% between 2001 and 2002, and this is likely to continue with proposals to restrict through traffic using traffic management and access controls which are being developed by the Mayor.

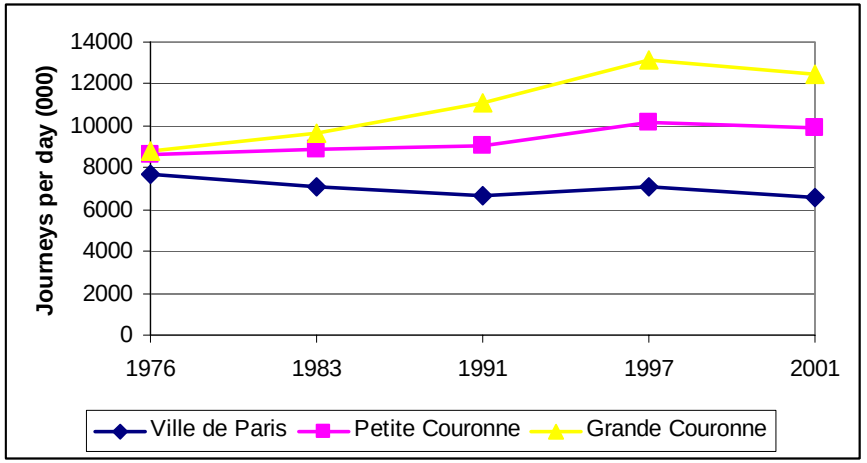
3.7.3 There has been a corresponding rise in traffic in the surrounding suburbs (Petite Couronne) and a significant rise on the outskirts (Grande Couronne), as shown in Figure 3.5 (overleaf). This has shifted the focus of policies and spending to reflect the concerns about the growing problem in the suburbs which has led to tensions between the bodies responsible for transport. STIF, the Government-led public transport authority, will become a regional body in July 2005 and this is expected to further tip the balance towards transport improvements in the suburbs.

3.7.4 The key policies that have been implemented in the past 10 years have been the construction of two major ring roads to allow orbital movement in the suburbs and support the continued development of the regional centres (Table 3.13). The 80km A86 forms an outer ring to the Périphérique linking the important sub-centres including Versailles and Créteil. It is almost finished with the completion of the final 10km underway which will be mainly in tunnel and tolled (2-6 euros for a car, depending on the time of day). The Francilienne is the outermost ring and about half (90km) is currently operational connecting the New Towns of Evry and Marne-la-Vallée to the east of Paris.

3.7.5 The public transport network has also been extended to existing urban areas through the construction of the fifth RER line to the north east of Paris and the progressive development of the Orbitale, a circular line running just outside the Périphérique. This is currently made up of two tramways (T1 Saint-Denis - Bobigny and T2 Val de Seine) and a bus link running in segregated bus lane (Trans Val de Marne).

3.7.6 There have also been some improvements to public transport within the city; the 14th metro line (Météor) running north-south across the centre opened in the late 90s and a tramway on the south part of the Boulevards des Maréchaux, a circular route inside the Périphérique, is under construction.

Figure 3.5 – Journeys by All Modes in Ile de France



Source: DREIF, Les résultants détaillés de l'enquête globale de transport 2001-2002.

Table 3.13 - Length of Roads in Ile de France

Km	Petite Couronne	Grande Couronne	Total
1991	127.4	441.2	568.6
1995	144.2	523.6	667.8
2000	170.8	547.9	718.7

Note: The suburbs surrounding the Ville de Paris are split into two main areas - the Petite Couronne, is an inner ring of 3 départements and the Grande Couronne, an outer ring comprising four départements. Source: STIF

3.7.7 There has been a massive reorganisation of bus services to create a 'trunk network' across the Ile de France region made up of 70 strategic routes that complement the rail and tram services. Timetables have been revised on the second tier of routes that feed the rail stations. In total over 730km of routes have been improved with a variety of measures including bus priority, re-allocation of road space to create bus lanes, higher frequencies and real time information. The priority measures have helped to improve bus speeds and there has been an increase in patronage, particularly in the suburbs (Table 3.14).

Table 3.14 - Passenger Kilometres (millions) by Mode

Year	Regional Trains	Metro	Trams	Bus - Paris	Bus - Suburbs	Total
1990	13,780	5,883	-	751	-	-
1995	11,779	4,960	39	724	2,583	20,085
2000	13,699	6,011	125	846	3,075	23,756
2001	13,870	6,081	129	832	-	-

Source: STIF (2002) Les transports en Ile de France, édition 2001. Memento de statistiques pg.17

3.7.8 Further increases in patronage have been achieved through the changes in ticketing including the introduction of the Carte Orange (monthly ticket) in 1991 and a single ticket allowing travel on metro, suburban rail and RER in 1995. The Carte Orange has significantly reduced the cost of commuting as employers pay half the cost of the ticket for their employees. The ticket will soon be converted to a Navigo pass, which is similar to an Oyster Pass in London.

3.7.9 Employers also contribute to the financing of public transport through the 'Versement transport'. This is a tax levied on public and private sector organisations with more than 9 employees which varies according to the size of the city[24] and the salaries paid. The Versement transport makes up over a third of the STIF's income and goes towards operating costs and investment (Tables 3.15 & 3.16).

[24] Maximum rates for the VT are defined by law; the applied rates are then determined by the local authorities. In the Ile-de-France, the rates are 2.6% in Paris and Hauts-de-Seine, 1.7% in Seine-Saint-Denis and Val-de-Marne and 1.4% in the Grande Couronne.

Table 3.15 - Financing Public Transport (Ile-de-France, 2002)

Financing of operation costs	Billion Euros	%
Passengers	1.73	27.9
Employers (Carte Orange)	0.58	9.4
'Versement transport'	2.26	36.6
Government	0.66	10.6
Region Ile-de-France	0.23	3.8
Départements of Ile-de-France	0.47	7.5
Others (STIF, municipalities, etc.)	0.26	4.2
Total	*6.20*	*100.0*

Table 3.16 - Public Transport Investments (Ile-de-France, 2002)

Financing of investment	Billion Euros	%
Government	0.01	0.8%
Region Ile-de-France	0.33	27.3%
Départements of Ile-de-France	0.06	5.0%
Transport companies	0.76	62.8%
STIF	0.05	4.1%
Total	*1.21*	*100.0%*

Note: Some of the operating costs include investment and so the total spend on public transport is €6.73 bn in 2002. Source: STIF, 2004

3.7.10 Inside Paris, several major streets have been 'civilised' under the 'Espaces civilisés' programme which includes re-allocating road space to segregated bus and cycle lanes and wider footpaths. There has also been an extensive 'Quartiers Verts' programme which has seen neighbourhoods treated with various traffic calming measures including road narrowings, lower speed limits (down to 30kph from 50kph) and road humps to reduce through traffic.

The Boulevards de Clichy and de Rochechouart have been 'civilised' by re-allocating road space to buses, walking, cycling and rollerblading.

3.7.11 These programmes are intended to "reclaim the public realm"; a common phrase in the Mairie de Paris (Mayor's Office/City Hall) which reflects a complete change in strategy from the road building policies that attempted to adapt Paris to the car that were in place just 10 years ago.

Neighbourhoods across a third of the Ville de Paris have been calmed to reduce traffic, noise and encourage more walking.

3.7.12 Car modal share has been rising, but the proportion of trips by public transport has remained at about 20% over the past 25 years. Over this time, the average distance travelled per person has increased from 6.2km to 9.9km by car and 5.4km to 5.9km for public transport (Table 3.17). There has been some decline in walking, but levels are still higher than most metropolitan cities.

Table 3.17 - Trip Rate by Mode (Ile-de-France)

Millions per day	Public Transport	Car	Motorcycle	Walking	Other
1976	5.9	9.8	1.6	12.6	0.4
1983	6.2	11.8	0.9	12.0	0.3
1991	6.7	14.4	0.6	11.2	0.3
1997	6.8	16.6	0.8	12.4	0.2
2001	6.8	15.5	0.7	12.0	0.2
% in 1976	*19%*	*32%*	*5%*	*42%*	*1%*
% in 2001	*20%*	*38%*	*3%*	*38%*	*1%*

Sources: INSEE, DREIF, enquêtes globales de transport

Barrier and Levers

– Parking policies have not been exploited because about half of the supply in the city centre is in private ownership. There is also a reluctance to introduce controversial policies in case it hastens the decline of the resident population.

– Employers contribute to funding public transport and feel that they are already doing enough to reduce traffic hence there has been little progress with travel plans.

– The availability of funding may have contributed to some inefficiencies, for example, there is a high level of fare evasion on the metro and RER.

\+ All the main stakeholders are involved in financing transport investment and subsidising operating costs and so there is a degree of realism in which schemes are affordable and should be progressed, after construction of concurrent public transport schemes over-committed the authorities in the 90s.

\+ Employers play an important role in supporting public transport. Their contributions to the Versement transport and Carte Orange amounts to over 40% of the global (subsidy and investment) costs which has helped to keep fares at a reasonable level and allowed significant improvements in supply.

\+ The Schéma Directeur and the Plan de Déplacements Urbain (PDU) provide clear frameworks for transport planning in the Paris area for the medium and long-term and demonstrate a commitment to public transport schemes.

3.8 Singapore

3.8.1 Singapore's transport strategy has its roots in the 1972 State and City Planning Project which recommended developing a network of expressways, comprehensive traffic management and restraint on cars in the CBD, and improvements to public transport. While responsibilities for transport and development have shifted between Government departments, there has been an unswerving commitment to implementing these measures and providing a high quality, integrated and efficient transport system (Table 3.18).

Table 3.18 - Infrastructure Development

	1972[1]	1999[2]	2003[3]
Road (km)	1000	3,100	3,165
Including expressways	-	149	150
Rail (km)	-	83	128
Buses	3,730	3,300	3,211
Bus lanes (km)	-	n/a	120

Source: [1,2]May, A.D. (2004) Singapore: The development of a world class transport system. Transport Reviews, Vol. 24, No. 1, 79-101, January 2004; [3]Land Transport Authority, Statistics in Brief, 2004.

3.8.2 The key feature of the strategy is the use of various charges to influence both vehicle ownership and use. The Vehicle Quota System (described earlier) limits the growth in vehicles to 3% pa by requiring potential owners to bid (typically S$30,000) for a Certificate of Entitlement. The quota works in parallel with the congestion charging scheme which deters driving in congested conditions and its effectiveness is partly demonstrated by the fact that car ownership and use are substantially lower than London (Table 3.19), for example, even though its GDP is higher.

Table 3.19 – Car Ownership and Car Use

	1980	1990	1999/2000
Cars per 1,000 population			
Singapore	64	102	111
London	284	348	345
Private vehicle kms per capita[1]			
Singapore	770	1864	2150
London	2529	3892	4114

Note: [1]Data refers to 1995/96. Source: Kenworthy and Laube, 1999 and 2001

3.8.3 The charging scheme was introduced as an Area Licence in 1975 and drivers were required to purchase a permit from roadside booths, post offices, and various other outlets to drive in the CBD in the peak. The initial S$3 per day charge was immediately successful in reducing traffic entering the CBD by 40% and increasing the average speeds from 23 kph to 30 kph[25]. The

[25] Holland, E.P. and Watson, P.L. (1978) Traffic restraint in Singapore, *Traffic Engineering and Control*, 19(1), pp. 14-22.

charging zone was subsequently enlarged to include the surrounding expressways and the controls extended to all-day operation.

3.8.4 The Area Licence was replaced in 1998 by an Electronic Road Pricing (ERP) scheme that allows greater flexibility in setting charges and deducting payments. Drivers are now charged each time they enter the charging zone and charges are adjusted if speeds fall outside the accepted 20-30kph range in the CBD and 45-65kph on the expressways. Payment is made from a stored value card located in an in-car unit as the vehicle passes under an overhead gantry.

3.8.5 Whilst the ERP charge is typically lower than the permit, the switch to pay per entry has led to a further 15% drop in entry flows. This has caused a 23% fall in revenue (from S$115 million to S$88 million), which is partly off-set by the cheaper operating cost (S$10 million compared to S$19 million previously).

3.8.6 With much of the infrastructure and management controls in place, and the construction of two more LRT lines and a circle line currently underway, there has been a move to make best possible use of the road and rail links and ensure 'value for money'. The land use strategy has sought to decentralise development to high density regional and sub-regional centres with mass rapid transit (MRT) stations and ensure a mix of development types to reduce the need to travel and redistribute passenger demand so services are busy in two directions. Singapore has been well placed to deliver these changes as the Concept Plan and more detailed Development Guide Plans specify exactly how land is to be used and avoids ad-hoc decision-making that has undermined transport strategies in other metropolitan cities (see Madrid).

3.8.7 Part of Singapore's success is also due to the ruling People's Action Party (PAP) being able to maintain strong political control. It has been in its political interest to invest in high density housing linked to rail stations to control unbridled car use.

3.8.8 Further efficiencies have been gained through the development of an Integrated Transport Management System that brings together data on junction operations and traffic speeds and relays real-time travel information and ERP charges to a website to inform pre-trip planning. The data are also used to adjust traffic signal settings and enable faster recovery from incidents.

3.8.9 There has also been on-going investment in public transport; after rejecting World Bank funding for a busway in the early 1980s, the Government has met the cost of all rail schemes, rolling stock,

rolling stock replacement, a park and ride facility and good pedestrian links to stations. It has also built 120km of bus lanes and measures that allow buses to leave stops, but there is no bus priority at signals.

3.8.10 Buses continue to be the main form of public transport with 25 million journeys pa, compared to 2.3 million by rail, but patronage is falling slowly in line with rail expansion and transit-oriented development. Services are operated by two private companies that cover different parts of the city and so there is no competition. Fares and service levels are specified by Government, but are regulated by the Public Transport Council, an independent body made up of a cross-section of society, that helps to ensure that service patterns are responsive to changing needs. New services have been introduced that specifically appeal to car users; the PlusBus is an executive minibus, and the RapidBus is a cross-island express that has reduced journey times by about 20 minutes.

3.8.11 Whilst the controls on car ownership and use, and the investment in public transport have been successful in managing demand and tackling congestion, car modal share has continued to rise and now represents about 35% of all journeys in the CBD, compared to 15% in central London (Table 3.20). Singapore is therefore constantly adapting its charging system for car purchase and use to keep an effective cap on motorisation.

Table 3.20 – Share of Motorised Journeys

	Daily		AM Peak	
	Public	**Private**	**Public**	**Private**
Island wide	55%	45%	60%	40%
CBD	65%	35%	70%	30%

Barriers and Levers:

– The lack of availability of land has reinforced the need to make good use of infrastructure as there are limited possibilities for constructing more surface transport without incurring significant social and environmental costs.

– It has also reinforced the high density approach to land use planning which has, to date, produced a functional city with a relatively high quality of life.

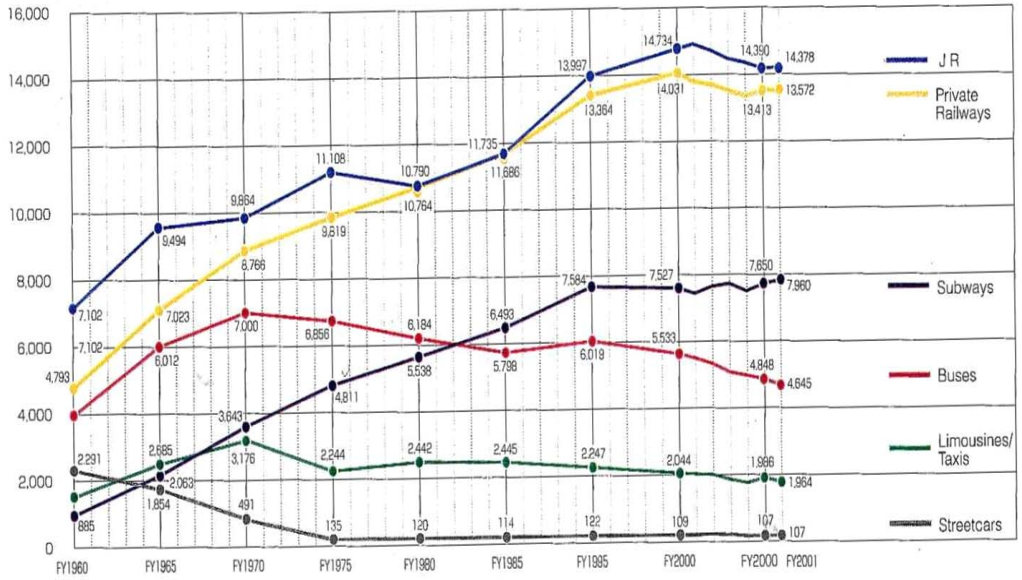
\+ Finance has not hindered the delivery of the strategy; the revenue from the area licence always exceeded spend on transport, but the cost of implementing the ERP technology and lower revenue means that the charging scheme is likely to be revenue neutral for eight years.

+ Singapore has benefitted from its independent-minded approach to transport and land use planning through the early rejection of World Bank funding which would have left the city with only a busway system.

+ In addition, the commitment to the original strategy has provided a consistent framework for more detailed investment plans which are updated on a five-year basis.

+ Charging was accepted by the public as it was 'sold' as part of an integrated transport strategy that included high quality public transport and land use development integrated around rail stations which gives the city an effective urban structure around which to operate.

Figure 3.6 - Daily Average Passengers (000s)



Source: *Outline of Toei Transportation*, Bureau of Transportation, Tokyo Metropolitan Government 2004.

3.9 Tokyo

3.9.1 For the past two decades planning policies have favoured polycentric development through the growth of suburban cities and sub-centres across the metropolitan area to take the pressure off the original city of Tokyo (23 Wards). These policies have been assisted by a shortage of housing and high land prices in the 23 Wards, the on-going construction of transport infrastructure, and the availability of commuting allowances[26].

3.9.2 Over 30 million people now live in the Tokyo metropolitan area. Just over 8 million of these live in the 23 Wards where the majority of jobs are still concentrated. Commuting distances are long; the average is 17km, compared to 7km in London[27], and two-thirds of commuters travel for more than an hour to get to work.

3.9.3 Approximately 2,600km of suburban rail lines have been built by the public sector and private operators often using finance from increased land values around stations. There are also over 300km of metro and 350km of grade-separated expressways, but these

[26] Most Japanese companies bear the full commuting costs of their employees. As a consequence, distant suburbs are more attractive than they should be and commuting distances are long. A tax incentive is an important element in this mechanism; employers may deduct the costs of commuting allowances from their corporate income taxes.

[27] Kenworthy and Laube, 2001. Data for Greater London only and so does not include commuters living in other areas

have always lagged behind the ever-increasing demand for travel, particularly in the morning peak as the economy has picked up through the 90s.

3.9.4 Currently there is traffic congestion throughout the day, the average speed has fallen from 26kph in the mid-90s to 21kph, and trains arrive 50% over capacity in the morning peak hour.

3.9.5 About 30% of all trips are made by public transport, but the share is falling because of increasing car use. About 90% of public transport trips are made by rail; the suburban systems of JR East (former national operator) and the private railways account for about 32% each, with the remainder by the metro[28], which is continuing to attract passengers from the bus services, despite the introduction of new bus services, real-time information at stops and on the Internet, and an integrated bus pass which can be used on all operators (Figure 3.6).

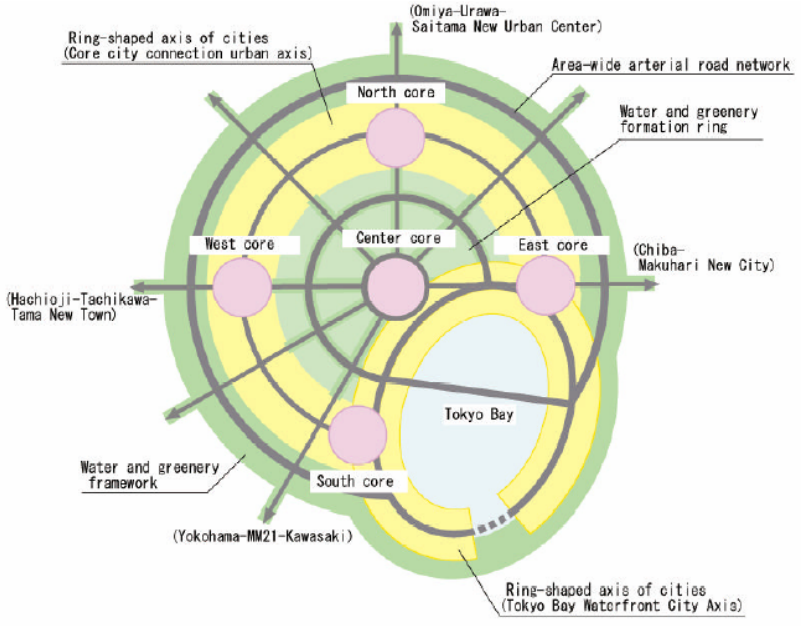
3.9.6 As the focus has always been building new infrastructure to support the spatial plan, there has been no coherent strategy to manage travel demand. There are high taxes on car ownership and tolls on the expressways, but these are used to raise funds for road construction and maintenance, rather than influence traffic levels. Drivers have to have an off-street parking space to park their car overnight. Spaces are limited and therefore expensive and this has helped to deter people from buying cars, but the metropolitan government is now offering grants for the private sector to build more car parks. The rail operators have refused to increase the capacity of existing rail links because the worst crowding occurs for about 20 minutes around 8:30am and demand falls off significantly outside the peak hour, but there have been no efforts between the government, employers and operators to introduce more flexible working and encourage peak spreading.

3.9.7 The national and metropolitan governments see the solution in the continued development of the suburban centres. The 'vision' for the future of Tokyo is a series of concentric road and rail links that serve larger sub-centres (Figure 3.7). The key difference is that these will contain a mix of residential, employment and other functions to ensure that they are more self-sufficient and generate less travel demand[29].

[28] Jane's Urban Transport Systems 2001-02 (JUTS 01-02)

[29] There is a great deal of literature that shows that transit-oriented development is a good basis for managing travel demand, and indeed Singapore, discussed later, is a good example of how mixed use sub-centres linked to rail can help to manage growth in car travel.

Figure 3.7 – The Vision for the future of Tokyo



Source: Toei 2004

3.9.8 The vision includes additional expressways, metro extensions and some 530km of new rail links within 50km of central Tokyo to serve expanding sub-centres at Shibuya, Shinjuku and Ibebukuro, and new centres at Ueno-Asakusa, Kinshicho-Kameido, and Ohsaki. These centres will have high densities and good provision for walking and cycling.

3.9.9 There is also investment in traffic management initiatives to address the congestion. There has been an increase in enforcement to crack down on illegal parking, a programme of improvements at 100 junctions and 'enlightenment campaigns' to raise awareness of the importance of the stopping and parking restrictions.

Barriers and Levers:

– Responsibility for transport is split between a number of national, metropolitan and local government bodies, and several private and public sector operators which results in a lack of joined up thinking. For example, the metropolitan government has been promoting cycling and many commuters cycle to the rail station but there is a chronic shortage of parking and the police confiscate bikes left unattended.

– The metro is run by Tokyo Metro (8 lines) and the Metropolitan Bureau of Transportation Toei (4 lines). The split administration is unique and causes frustration for users. For example, fares are low, equivalent to just over a euro for a single ticket, but there is a charge of just under a euro for interchanging between networks. There are different maps at stations, on trains and on customer information boards, focussing on the company's own lines, making interchange difficult.

– There have been continuous extensions to the metro and patronage has been growing but this has been at the expense of the local bus services.

+ Responsibility for planning is shared between the metropolitan government and the relevant city or town councils. Plans are ratified by the Minister of Land, Infrastructure and Transport in the central Government and so there are strong controls to ensure that development takes place in areas served by rail.

+ The strong regulatory framework protects rail operators from excessive competition to ensure a stable operating environment.

+ The suburban rail network has expanded rapidly, helped by investment by the private sector.

+ Existing legislation allows rail operators with affiliated bus companies to provide feeder buses to stations.

3.9.10 Table 3.21 overleaf provides a summary of the key elements of the transport issues and policies in the sample of eight cities. Their effectiveness is considered in more detail in Chapter 4.

Table 3.21 - Summary of Transport Strategies and Effectiveness

	London	Moscow	Barcelona	New York
Problem	• Traffic congestion • Historic underinvestment in transport • Public transport unreliability, crowding • Increasing travel demand from economic and demographic growth	• Traffic congestion • Deterioration public transport system • Environmental impacts • Traffic safety	• Traffic congestion • Poor integration of public transport	• Traffic congestion • Overcrowding on public transport • Road safety
Transport Strategy	***Managing demand and improving public transport system*** • Tackling traffic congestion • Providing additional public transport (largely bus) capacity and reliability • Providing transport links to underpin population and job growth	***Currently lacking integrated transport strategy*** • Previous focus on road construction • Increasing awareness of need for traffic restraint and better utilisation of existing resources, eg surface transit priority measures.	***Supporting strong economic vision*** • Construction of ring roads to reduce through traffic in inner city • Focusing new development in urban areas and sites served by rail • Matching public transport demand and supply • Improvements to quality of urban realm	***Improving public transport to increase travel choice*** • Series of capital and financial plans to improve public transport • Traffic/demand management initiatives • Increased funding for walking/cycling projects
Policies Implemented	• Congestion charging • More bus services, priority measures • Parking restraint and higher enforcement • Walking and cycling strategies • Underground and light rail extensions to the east of the city	• Road building • Promotion of public transport • Traffic management • Parking policy • Moscow Urban Transport Project • Metro developments	• Public transport modernisation and extensions • Integrated fares and ticketing • Pedestrianisation, more green space • Park and ride • Access controls in sensitive neighbourhoods	• Upgrading of existing bus and metro system • Fares freeze and integrated ticketing • 'Thru Streets' traffic management • Variable tolls on bridges and tunnels • Traffic calming initiatives
Institutional	TfL established in 2000	City government coordinates transport network and services	AMT (public transport) set up in 1997,	MTA (public transport) only covers part of metropolitan area
Effectiveness	• Reduced traffic delays in central London by 30% • More buses and greater reliability • Urban realm improvements, eg 'World Squares' project	• Lack of integrated policy means no major impacts • Mode share remains high due to relatively low car ownership	• Increased traffic on ring road, decrease elsewhere • Increased ridership on rail, but decrease on bus • Increased walking and cycling, and improved air quality	• Public transport use increasing (3.1% in 2001), but so is traffic • No significant change in mode share • Improvement in road network speeds • Peak spreading of bridge and tunnel traffic

Table 3.21 (cont) – Summary of Transport Strategies and Effectiveness

	Madrid	Paris	Tokyo	Singapore
Problem	• Traffic congestion • Poor coordination of public transport networks and services • Suburbanisation, decentralisation, leading to higher car use	• Traffic congestion • Effects of congestion on public transport • Lower level of public transport quality in suburbs	• Rapid development has led to extreme congestion and crowding • High property prices and commuting subsidies led to long-distance commuting	• Growth in vehicular traffic
Transport Strategy	***Improving public transport to increase travel choice*** • Maintaining public transport patronage and controlling suburbanisation • Issues of transport efficiency, environmental impacts and safety subsidiary in decision-making • Some efforts to manage car use	***Improving public transport to increase travel choice*** • Investment in public transport to improve travel choice • Promoting walking and cycling	***Supporting spatial strategy*** • High charges on car ownership to raise funds for roads • Investment in extending rail networks • Encouragement of growth at major sub-centres to alleviate pressure on city centre	***Managing demand and improving public transport system*** • Integrated land use planning • Demand for car ownership balanced with the number of vehicles using the roads • Improvement and expansion of public transport network
Policies Implemented	• Public transport extensions • Integrated fares and ticketing • Construction of four toll motorways • High occupancy vehicle lanes • Removal of car parking spaces	• Construction and improvement of orbital roads • Extension of the public transport network • Ticketing integration • Extensive traffic calming	• Construction of grade-separated expressways • Promotion of additional ring road construction • Extension of the rail network • Enforcement of parking etc. to reduce congestion	• Vehicle quota system • Road pricing • Improvement to bus network, eg bus priority measures • Expansion of rail (suburban/ metro/ light rail) systems
Institu-tional	CTM manages public transport	STIF organises public transport	Split of responsibilities	LTA established 1995
Effective-ness	• Reversed declining public transport patronage and generated 60% increase, mainly on metro • HOV lanes improved efficiency of A-6 corridor	• No significant change in public transport mode share • Increased car ownership and use in the suburbs	• Overall public patronage rising • But public transport mode share declining as car use increases • Some improvement in air quality due to vehicle restrictions	• Control on car ownership growth through VTS Management of car use • Dominant public transport mode share

4 Outcomes

4.1 Evolution of Policy

4.1.1 National economies have long depended on the contribution of the major cities. There have been fluctuations associated with world or local events, but the metropolitan economies have remained strong, adapted to changing markets and grown faster than the national economy.

4.1.2 Economic development has driven population growth and the resulting competition for land has given rise to a process of suburbanisation that started at different times, but has occurred in all the cities and continues to the present. The increasing need to travel from lower density suburbs to more centralised employment areas or edge of town commercial centres, coupled with increasing household wealth and rising car ownership has fuelled further growth in mobility.

4.1.3 Some of this increase in mobility has come from higher trip rates, but the main contributor has been the increase in distances travelled. Cities that have sprawled more, or gone further in allowing the separation of people and jobs, now have the longest average journey lengths.

4.1.4 The challenge facing all cities has been how to accommodate this growth in travel demand which is becoming increasingly disparate and more difficult to meet with cost-effective public transport. In the meantime, more households have found their own solution in further increasing car dependency and contributing to a larger problem of congestion, which has more widespread impacts on economic efficiency, public transport operations, and people's health and safety. Those without access to a car feel the effects of the congestion plus elements of social exclusion from not being able to reach jobs, training, healthcare, etc.

4.1.5 So, which policies have been implemented to address the growth in travel demand and congestion? All of the cities have adopted a combination of highway investment, land use policies and public transport improvements – either to meet their continued growth aspirations or as part of strategies to reduce traffic. Some have also sought to radically improve conditions for pedestrians and cyclists in the hope that this will attract short-distance car users.

Attitudes to Road Building

4.1.6 With the exception of Tokyo[30], all cities have come to view continued spending on highways is no longer feasible because of a number of factors including the lack of available land, unacceptable environmental impacts, and recognition that increasing capacity generates additional demand. Their last significant outlay has been in ring roads designed to meet the more complex orbital movements in the suburbs and reduce through traffic in the city centre. Some of these have been built in tunnel (Barcelona and Madrid) or tolled (Madrid and Paris) to 'manage' the environmental concerns and induced traffic effects.

Integrating Transport and Land Use

4.1.7 None of the cities have harnessed the full potential of land use policies to contain low-density sprawl, ensure a mix of development types to reduce the need to travel, or increase public transport patronage through transit-oriented development. Greater progress has been made in Barcelona, Singapore and Tokyo where new lines are generally keeping pace with development, and it is these cities that have the lowest reliance on public sector subsidy. In contrast, the other cities appear to be trying to catch up with changes in land uses after car-dominated travel patterns have evolved (for example, metro investment in Madrid has been led by previous market-led development in the suburbs, and RER, metro and tram investment in Paris has sought to better link the planned sub-centres with the Ville de Paris).

[30] Whilst Tokyo has a high supply of roads per capita and per unit area, it has the lowest provision of urban motorways after London, which has influenced policies on road building.

Public Transport Policies

4.1.8 None of the cities have met their perceived need for improvements in the supply and quality of public transport. Barcelona, Madrid and Singapore have invested significantly in new rail-based lines, whereas London and New York have been making up for the maintenance backlog on existing systems while there is a growing need for new lines to meet evolving travel needs, especially for orbital travel. Further plans tend to be constrained by affordability at a time when public authorities are expected to be reducing expenditure, and in some cities, a lack of public sector funding has been offset by private sector contributions (for example, in redeveloping stations in Madrid, constructing lines and stations in Barcelona and Tokyo, and asset renewal on the London Underground).

4.1.9 There have been general improvements in bus services, with all cities refreshing their fleets, most cities investing in new simplified ticketing and better real-time information, and some cities (London, Paris and Singapore) introducing priority measures. Views on the

role of the bus in the public transport hierarchy remained polarised, with London, Singapore and to a lesser extent Madrid seeing buses as an important mode in urban areas, whilst the others tend to consider them as feeder services for rail. Where rail-based modes have been extended and replaced bus routes (Barcelona, Singapore, Tokyo), there has been an increase in rail patronage that has exceeded the decline in bus patronage.

4.1.10 There is a general recognition that whilst improvements in the supply and quality of public transport have attracted some modal shift (Barcelona, Madrid and Paris), continuing investment will not be enough to encourage larger-scale transfer and address traffic congestion. The car will always offer high levels of comfort and convenience and so traffic restraint measures are necessary to influence the attractiveness of public transport.

"A vision of public transport is a necessary, but not a sufficient condition for achieving sustainable mobility. Measures must be implemented to dissuade car use." Pelayo Martínez Bauluz, Manager, Barcelona Metropolitan Entity of Transport (EMT)

4.1.11 The exception here is Tokyo which sees further investment in public transport as essential to its land use strategy, and active traffic restraint is viewed as unnecessary because it believes that the further dispersal of activities will facilitate continued economic growth and address congestion/crowding. This will only work, however, if the strategy is successful in decentralising employment and creating self-sustaining cities which has not been possible in Paris, where the previous multi-centric policies have generated dormitory settlements and increased the overall demand for travel.

Demand Management

4.1.12 There are taxes on car ownership in all the cities; these have been particularly effective in Singapore where the duties and a certificate of entitlement are typically three times the market value of an average car. With the exception of Moscow, there are also various forms of control on car use using physical restrictions, parking policies and pricing.

4.1.13 For example, Barcelona has implemented physical restrictions on car access to the historic core and other environmentally-sensitive neighbourhoods, and like Madrid, there has been a major programme to reallocate road space to pedestrians. Parking provision is extremely limited in London and New York, there are high user charges and the authorities are committed to effective enforcement.

4.1.14 There are tolls on strategic inter-urban routes in most cities and on the bridge and tunnel approaches to Manhattan Island. Congestion charging has been implemented in London and Singapore; the London scheme charges drivers a £5 daily fee for driving within the zone, whereas the ERP scheme in Singapore charges drivers each time they enter the charging zone and the rate varies according to congestion levels (monitored by average vehicle speeds).

4.1.15 There is also evidence that congestion itself has been a deterrent to further car use; for example, traffic levels in London and New York have been stable since the mid-90s, and in New York, the congestion was sufficient to encourage drivers back onto rail, once the subway system had been made acceptable to users.

4.2 Effectiveness

4.2.1 Data on changes in modal share are only available for six of the cities and in varying formats which makes comparison difficult. Table 4.1 (overleaf) shows that Barcelona and London have been successful in reducing car dependency.

4.2.2 Barcelona has seen a fall of 0.8% per annum in the proportion of trips made by private transport (cars and powered two-wheelers) both within the inner city[31] and between the inner city and the suburbs in the past four years.

4.2.3 This has been achieved through a combination of:

- Investment in public transport (modernising suburban rail, 5km extension to the metro and two new tramways and a 20% increase in bus kilometres);
- Integrated fares and ticketing which has led to a three-fold increase in public transport journeys involving two or more modes/services; and
- Restrictions on car use through access controls, removal of car parking and the reallocation of road space to pedestrians.

4.2.4 These policies have been assisted by the existing mix of people and jobs, extremely high land use density and good pedestrian facilities in the inner city which have increased the feasibility of using alternative modes. As the population has decentralised, new housing has been focused on sites served by rail. Proximity to a sufficiently large number of potential users has helped to improve the financial viability of public transport and the cost recovery of suburban rail is 71% and metro/urban bus 79%, compared to

[31] Within the ring road

about 50% for most European cities. However, there has been a rise in car ownership (to 452 per 1,000, compared to 345 per 1,000 in London) and car use though the additional traffic has tended to be accommodated by the ring roads and there has been some decline in the city.

4.2.5 Barcelona's strategy is expensive; the city spends 2% of its GDP on transport, and the 10 Year Infrastructure Plan for 2001-2010 is worth 7.3billion euros (equivalent to £6bn adjusted for purchasing power parity), however, this contains a further 251km of new suburban rail and metro.

4.2.6 In London, the car mode share has fallen by 0.5% per annum between 1993 and 2003, and by 0.8% between 1999-2003 to compare with Barcelona. The strategy has comprised investment in public transport (including expanding the Underground and bus network, increasing frequencies and better reliability on buses through continued implementation of bus priority measures and Quality Incentive Contracts that provide operators with a financial incentive to run reliable services), though the largest single contribution to reducing car use has come from the introduction of congestion charging.

4.2.7 Whilst it has been controversial, the charge has been effective in reducing traffic and delays in central London, and has not resulted in substantially higher flows on perimeter routes. It has also created a revenue stream (estimated at £1.3bn over 10 years of operation) for further investment and support for transport

Table 4.1 – Changes in Car Modal Share (% of all trips)

	Barcelona (within city)[1]	Barcelona (city-suburb)[1]	London	New York (Manhattan)	Paris	Singapore[2]	Tokyo
1993 or earlier			47.0	12.0[3]	43.4[4]	16.1[3]	17.0[5]
1997			46.0		45.1		
1999	26.8	65.1	45.1			20.2	32.5[6]
2000			44.0	11.0	44.0[7]		
2003	24.5[8]	62.7[8]	42.0				
Annual change	***-0.8%***	***-0.8%***	***-0.5%***	***-0.1%***	***0.1%***	***0.4%***	***0.5%***

Note: The table shows that annual average change between the two extreme data points [1]Private transport includes motorcycles and scooters; Share of all motorised trips; [3]1990; [4]1991; [5]1968; [6]1998; [7]2001; [8]2002. Source: Barcelona *Pacte per a la Mobilitat*; TfL, *London Travel Report 2004*; New York City *Transportation Statistics 2000*; DREIF, *Enquêtes Globales de Transport 2001-02*; May, A.D. (2004) Singapore: The development of a world class transport system. *Transport Reviews*, Vol. 24, No. 1, 79-101, January 2004; Singapore Land Transport Authority, *Statistics in Brief 2004;* Bureau of Transportation Tokyo Metropolitan Government, *Outline of Toei Transportation 2004*.

improvements in London.

4.2.8 Spending on transport in London has risen from 1.75% of GDP in the mid 90s to close to 3% and the Five Year Investment Programme (2005/06-2009/10) is worth £10bn.

4.2.9 In both Barcelona and London, the switch from the car has tended to benefit public transport and the general trend of decline in walking has continued, with the exception of Paris (Table 4.2).

4.2.10 Paris has historically had a high proportion of trips made by foot, largely because of high density, mixed land uses in the inner city and difficulties associated with finding available car parking. There has been an extensive programme of traffic calming in the more residential neighbourhoods and key shopping areas within the Ville de Paris. This has sought to reduce traffic speed (with a blanket speed limit of 30kph), widen footpaths and improve pedestrian safety and appears to have been successful in encouraging a little more walking.

Table 4.2 – Changes in Public Transport and Walk Modal Shares (% of all trips)

Mode	Year	Barcelona (within city)	Barcelona (city-suburb)	London	New York (Manhattan)	Paris	Tokyo (MTA)
Public Transport	1993 or earlier			27.1	58.0[1]	20.2[2]	32.0[3]
	1997			29.5		18.5	
	1999	37.8	31.0	30.1			28.0
	2000			30.9	59.0	19.3[4]	
	2003	39.5[5]	33.5[5]	33.5			
	Annual change	***0.6%***	***0.8%***	***0.6%***	***4.7%***	***1.8%***	***-0.1%***
Walking	1993 or earlier			23.1	23.0[1]	33.7[2]	43.0[3]
	1997			22.4		33.7	
	1999	36.4	3.9	22.0			24.0
	2000			22.0	22.0	34.1[4]	
	2003	36.0[5]	3.7[5]	21.5			
	Annual change	***-0.1%***	***-0.1%***	***-0.2%***	***-0.1%***	***0.0%***	***-0.7%***

Note: [1]1990; [2]1991; [3]1968; [4]2001; [5]2002. Source: Barcelona *Pacte per a la Mobilitat*; TfL, *London Travel Report 2004*; New York City *Transportation Statistics 2000*; DREIF, *Enquêtes Globales de Transport 2001-02*; Bureau of Transportation Tokyo Metropolitan Government, *Outline of Toei Transportation 2004* .

4.2.11 The changes in modal shares for commuting further illustrate the progress that has been made in London (Table 4.3), compared to New York and Paris, where there have been no additional restrictions on car use to complement the improvements in alternative modes. In New York, $48billion has been spent on restoring and upgrading the decrepit public transport systems over the past 20 years, and patronage has increased (Table 4.4), but not at the expense of car use.

4.2.12 Public transport patronage has also increased substantially in Singapore and London. In Singapore, the rise is due to the continuing growth in population at accessible locations, and an increase in the public transport trip rate resulting from the combination of rail and bus network extensions and traffic restraint. The transport strategy has sought to balance the supply and demand for road space, rather than reduce car use *per se,* and so the car mode share has increased (Table 4.3), but the ERP has been successful in ensuring that as traffic rose, average speeds remained constant (Tables 4.5-4.6).

Table 4.3 –Modal Shares for Commuting (% of all trips)

Mode	Year	London	New York (Manhattan)	Paris	Singapore
Car	1997 or earlier	47	12.3[1]	50	18.1
	2000	43	11.7	49[2]	23.7
	2003	42			
	Annual change	***-0.9%***	***-0.1%***	***-0.3%***	***0.5%***
Public Transport	1997 or earlier	40	61.7[1]	30	55.0
	2000	43	63	36[2]	52.4
	2003	45			
	Annual change	***0.8%***	***0.1%***	***1.5%***	***-0.3%***
Walking	1997 or earlier	8	24.3[1]	17	8.0
	2000	9	23.2	11[2]	6.1
	2003	9			
	Annual change	***0.2%***	***-0.1%***	***-1.5%***	***-0.2%***

Note: [1]1990; [2]2001. Source: TfL, *London Travel Report 2004*; New York City *Transportation Statistics 2000*; DREIF, *Enquêtes Globales de Transport 2001-02*; Singapore Department of Statistics, Census of Population 2000.

Table 4.4 – Public Transport Patronage (passenger journeys, millions)

Mode	Year	Barcelona	London	Madrid	Moscow	New York[1]	Paris	Singapore	Tokyo
All Modes	1992 or earlier	590.4		892.5[2]		1615.1			13035[3]
	1995/96		2440				2850.5		10426
	2000/01		2816		9396.3	2295.2	3398		14803
	2002/03		2981	1436.4				1534.1	
	2003/04	687.8	3356	1543.9	9430.2			1629.7	
	Annual change	***1.3%***	***4.1%***	***2.9%***	***0.1%***	***4.5%***	***3.6%***	***6.2%***	***0.9%***
Bus	1992 or earlier	200.9		503.8[2]					2116[3]
	1995/96		1198				995.3		2020
	2000/01						1170.3		1695
	2002/03		1534	678.1				1139.9	
	2003/04	189.8	1702	747.5				1184.8	
	Annual change	***-0.5%***	***4.5%***	***2.2%***			***4.7%***	***3.9%***	***-1.4%***
	Annual change in PT trip rate	***1.3%***	***3.8%***	***2.1%***	***-5.2%***	***3.3%***	***3.5%***	***4.4%***	***-0.2%***

Note: [1]Data refers to New York city and suburban buses, New York and New Jersey subway and urban rail; [2]1986; [3]1985. Source: ATM 2005; TfL *London Travel Report 2004*; Consorcio de Transportes de Madrid, 2003; Research Institute of Road Transport (NIIAT), 2005; US Statistics Transit Fact Book; STIF, *Les Transportes en Ile de France 2001*; Singapore Land Transport Authority, *2004;* Bureau of Transportation Tokyo Metropolitan Government, *Outline of Toei Transportation 2004*.

4.2.13 In London, most of the growth in patronage has come from the increase in the public transport trip rate, again resulting from a combination of public transport improvements and traffic restraint. TfL research shows that just 18% of Londoners do not use the bus, compared to 24% in 2002/03[32].

4.2.14 Traffic levels have generally been falling in Barcelona, London and inside Madrid, but not in the suburbs. Barcelona and London have also seen a parallel increase in the average speed (Table 4.6 overleaf).

4.2.15 Madrid has also seen a rise in public transport patronage and trip rate (Table 4.4) which suggests that it too has been able to reduce the car modal share. However, the latest travel survey was completed in 1996 and so it will not be possible to confirm this until more recent data is collected.

Table 4.5 – Traffic Levels (vehicles per day)

Year	Barcelona		London			Madrid			New York	Singapore
	Roads into city	Ring roads	Boundary cordon	Inner Cordon	Central Cordon	1st inner ring road	Betw 1st and 2nd ring road	2nd Outer ring road	NYC cordon	Entering CDB
1991	1,159,266	264,051	2,430	2,173	1,644					
2001	1,200,484	283,914	2,566		1,512	626,913	890,653	1,014,717	2,189,588	
2002				2,129	1,442	597,416	867,831	922,917	2,275,923	245,000
2003	1,140,490	288,314		2,078	1,310	577,039	887,955	949,256	2,310,174	244,000

Source: Ajuntament de Barcelona, 2004; Tfl, 2005; Madrid Region Statistical Yearbook 2004; NYC Department of Transportation 2004; Singapore Land Transport Authority 2004.

[32] TfL Annual Report, 2004

4.2.16 Other sources report that traffic in the Ville de Paris fell 3% in 2001/02, largely because of the centralisation and traffic calming which has forced some re-routeing and contributed to the rise in traffic in the suburbs[33].

[33] DREIF 2004

Table 4.6 – Average Speed (kph)

Year	Barcelona		London AM Peak Only		Paris		Singapore	
	Ring roads	Within City	Outer	Central	Radials in Inner suburbs	Radials in Outer Suburbs	Expressway	Within City
1999	59.8	19.9	29.3[1]	16.1				
2002	58.9	20.2	27.2[2]	15.9	62.5	60	66.7	24.8
2003	56.5	21.6	n/a	17.1[3]	61.7	57.1	65.4	24.3

Note: Data for [1]1997-2000; [2]2000-2002; [3]2003-2004. Source: Generalitat de Catalunya, 2004; TfL London Travel Report 2004; DREIF 2004; Singapore Land Transport Authority

Influences on Transport Policy

4.2.17 The key factors that have assisted the development, implementation and success of the demand management policies have been:

- Integrated planning – The cities that have had greater success in reducing car dependency have adopted a combination of public transport, land use and traffic restraint policies. In Barcelona and Madrid, the focus has been more on public transport, and in London and Singapore, it has been more on restraint, but all cases have been assisted by past and present land use policies that have reduced sprawl and contributed to an urban structure that can be served by public transport.
- Long-term planning and continuity – Barcelona, Madrid and Singapore have followed their strategies for more than 20 years and this has allowed time for the benefits, particularly the effect of the land use policies, to come to fruition. Congestion charging has been implemented more recently in London, but has followed a period of sustained application of parking restraint, development control and

integrated transport and land use planning to the east of the city.

- Consensus – Whilst the integrated institutional structure and common political aspirations of the transport and planning authorities in Madrid and Singapore have helped to streamline policy-making, this is not a pre-condition for success. Responsibilities are split between national, regional and local bodies in Barcelona, and yet they have been able to agree a consensus because they are firmly committed to the economic development strategy which depends on an efficient transport system. Similarly in New York, there is no clear lead authority on transport issues, but the various players have successfully worked together to reverse the trend of decline in subway use because they were united in their common desire to 'save public transport'.

- Availability of funding – All the cities have had access to high levels of funding from national, regional and local sources, but the declining availability of future funds or greater pressure to reduce spend, has helped to raise the importance of demand management and deterred further investment in infrastructure. The recent economic situation has reduced spend on transport in Moscow, in particular, but in the absence of a coherent strategy, there would have been diminishing benefits to the planned spend on public transport as car ownership continued to rise.

- Acceptability – London and Singapore are the only two cities that have implemented more punitive policies which have been made publicly acceptable because they were introduced as part of a package that included improvements to public transport.

4.3 Successful initiatives

4.3.1 The World Cities and the large comparators have tended to adopt conventional policies to address their transport problems. There have been some examples of successful innovation; as journeys become more complex, integrated ticketing has given public transport patronage a boost by allowing free interchange between modes and smartcard technology has made services easier to use. Modern communications technology has also been essential in supporting the successful congestion charging scheme and value pricing in New York, though the latter would have been more effective if the Port Authority had not succumbed to public opposition and kept to the higher charges that were originally proposed.

5 Conclusions

5.1 Conclusions

5.1.1 The study has highlighted the different approaches to managing traffic growth in the cities. There has been some commonality in their attitudes towards discontinuing road building and their desire to invest in public transport and better conditions for walking and cycling. However, there are notable differences in their commitment to reducing traffic and implementing specific restraint measures.

5.1.2 The improvements in public transport have been successful in increasing public transport patronage, and in most cases, the public transport trip rate, but this has not necessarily resulted in a decline in car use. In addition to increasing coverage, the key drivers have been simplified fares systems, integrated ticketing and improvement in reliability.

5.1.3 The better pedestrian facilities in the European cities appear to reduce the general decline in walking, but only Paris has been able to increase the walk mode share slightly through extensive traffic calming. Further analysis has been hampered by a lack of data on non-motorised travel.

5.1.4 The effects on both public transport and walking have been most noticeable in cities that have supportive land uses (ie high density, mixed land use patterns arising from past of present policies) and/or have implemented some form of deterrent to car use.

5.1.5 All the cities, except Moscow, have parking restrictions, but it is London and New York that have the most limited supply, highest charges and strictest enforcement. Barcelona and Madrid have gone some way with physical restrictions (Barcelona with access controls and pedestrianisation, and Madrid with reallocating road space to walking). Only London and Singapore have implemented congestion charging as a punitive measure to manage car use.

5.1.6 The analysis demonstrates that Barcelona and London have been most successful in bringing about a fall in the proportion of trips by car, in both cases by encouraging a switch to public transport. The strategies applied in these cities have been quite different; Barcelona has invested heavily in rail-based public transport, used land use policies to retain a compact existing city and focus new development on rail hubs, reduced car parking provision for non-residents and restricted access to the central area. London has invested less in public transport and the focus has been on buses

and traffic management measures which have provided additional capacity to accommodate the modal switch and the limited re-routeing of vehicles around the zone.

5.1.7 The network extensions in Barcelona have increased the burden of subsidy on the city and regional authorities, though the high densities in the inner city and suburban developments have helped to maintain the cost recovery rate. The congestion charging scheme has generated a revenue stream that will be used to support further improvements in local transport in London.

5.1.8 Singapore did not set out to reduce car use, rather to balance the supply and demand for road space, which it has achieved with the ERP. The public transport network extensions and integrated land use development have ensured that accessibility has not declined for those without access to a car.

5.2 Lessons for UK Cities

5.2.1 The key lessons arising from the research into the World Cities and large comparators are the need to:

- Retain inner city populations so walking and cycling are viable modes for many people, and there is less pressure on radial transport links;
- Resist urban sprawl to slow the trend in rising journey lengths and development in areas that are not served by public transport as these factors lead to increased car use;
- Ensure high population densities to provide a sufficient threshold for cost-effective mass transit;
- Balance investment in new transport provision with restraints on car use – charging and access controls are the most effective, but strict parking policies are also powerful;
- Invest in traffic calming and other improvements in walking and cycling to slow the general declining trend in non-motorised travel;
- Make public transport use easy to use with simplified fares, integrated ticketing and passenger information and ensure high levels of reliability to increase patronage.

5.2.2 Several cities have benefited from private sector contributions to public transport investment and operations. There is potential for UK cities to make more of this through opportunities for land value capture around new stations.

5.3 Recommendations for Future Research

5.3.1 Despite the increasing attention on monitoring and the efforts that have gone into benchmarking transport, particularly by European

Commission-funded programmes, there has been no improvement in the availability of suitable indicators for measuring transport outcomes and gauging success against policy objectives.

5.3.2 There is a particular lack of data tracking economic growth and travel demand to understand the contribution of background factors and active policies in changing travel patterns.

5.3.3 There is still no accepted measure of congestion; various proxy measures of changes in average speed and average delay additionally suffer from a lack of compatibility.