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51

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Unleashing the Potential

URBAN TRANSPORT AND MOBILITY

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This document was produced as background for the 2010 International Transport Forum, on 26-28 May in Leipzig, Germany, on *Transport and Innovation: Unleashing the Potential*.

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SYNTHESIS

Urban areas and their populations are expected to grow substantially over the period to 2050, particularly in the least developed countries which are least well placed to tackle the resulting problems.

The objectives of urban transport policy are unlikely to change significantly. However, priorities are likely to change over time, with climate change, resource depletion, health and resilience expected to be of growing importance.

The scale of the problems to be faced, in congestion, pollution, safety, accessibility and the attributes of climate change, is likely to grow even more rapidly than urban populations, as a result of growing motorisation and urban sprawl.

There are considerable opportunities for technological innovation, particularly in motive power sources and vehicle design, and to a lesser extent in the form of driverless public transport systems. However, take-up will be limited by the skills and finance available. Such technologies will not provide a complete answer to the problems which cities will face. Behavioural change will be at least of equal importance, and will require a growing emphasis on demand management.

Innovations in the range of transport policy instruments can be expected to continue, reflecting recent trends in which as many as ten new policy approaches have arisen in each decade. This will provide a wider range of options for cities, but will increase the need for objective evaluation of these innovative solutions.

The development of packages of policy measures, including new technologies and new and existing transport policy instruments, will be of increasing importance. More effort is needed to understand the design of effective policy packages in different contexts, both through underpinning research and through the collection of empirical evidence as leading cities apply such packages.

Barriers to the development and implementation of effective policy instruments arise in the areas of governance, acceptability, finance and regulation. Innovations are needed in all of these areas, and more interdisciplinary research is needed to underpin these innovations. However, governments can already take actions to reduce the impacts of all of these barriers, as illustrated in the recommendations arising from earlier work by ECMT.

The availability of underpinning information and technical and policy skills will continue to be an important barrier to progress, and will particularly affect cities of the developing world. Research into the development of effective decision-support tools is still in its infancy, and is an area in which much can be done to overcome the process-related barriers to effective policy.

The most important contribution is likely to continue to be made by cities which are willing to innovate, whether in policy instruments and packages, in governance, finance or the policy process. However, other cities are typically slow to learn from such innovations, often because they lack a culture of policy learning. The process of policy transfer needs to be enhanced, particularly across regional boundaries where culture and implementation conditions can differ.

In summary, innovation in urban transport policy can be applied at several stages in the policy process. At the early stages of understanding problems and developing possible solutions, innovations in decision-support tools and in the policy making process can help overcome barriers to progress. In considering the range of possible solutions, innovations in technology and also in policy instruments can contribute to a richer policy package. Once policies are being prepared for implementation, innovations in governance, in finance and in increasing public acceptability will help to streamline the implementation process. Finally, when one city has achieved success with an innovative policy, innovations in learning culture and in information exchange can help ensure effective policy transfer to other cities. To be fully effective, innovation needs to be pursued, and encouraged, on all of these fronts.

1. INTRODUCTION

The aim of this paper

This paper is one of a series of source papers prepared for the International Transport Forum's Experts' Session on Innovation and the Future of Transport. This in turn is being held in preparation for the 2010 International Transport Forum, which is designed to highlight the contribution of innovation to the future of transport over the period to 2050. For the purposes of the Forum, innovations considered will include technologies, business models and policies that might drive change. The Forum will also address ways of overcoming the barriers to innovation, and the governance structures at global and national levels necessary to foster such innovations.

Structure

This paper focuses on transport and mobility in urban areas. For the purpose, an urban area is defined as one with a population in excess 750,000, using the UN definition (UNFPA, 2007). Whilst the problems of larger 'mega-cities' are typically more severe, the majority of growth will occur in the urban areas at the smaller end of the scale (*Ibid*.). The pace of change and lack of resources and institutional capacity at these levels pose different but still significant challenges. Based on the brief provided, the paper adopts the following structure:

1. Current trends in the size of urban areas, journey making and journey lengths, car ownership and modal shares, and prospects for 2050 (Section 2).

2. The current objectives of transport policy, the ways in which they have changed over the last forty years, and possible emerging objectives over the next forty years (Section 3).

3. The scale of the problems experienced in urban areas (defined as failure to achieve the objectives listed in Section 3), now and over the past twenty years, and anticipated trends in these problems (Section 4).

4. The technological and policy-related instruments available for overcoming these problems, the increase in the range of instruments available over the last forty years, and the potential for further innovation in the next forty years (Section 5).

5. The likely contribution of these instruments, the importance of combining them into an integrated strategy, and the need for further enhancements in the design and development of such strategies (Section 6).

6. The current barriers to the implementation of such strategies (Section 7).

7. Suggested ways of overcoming these barriers, and the changes in governance and policy making needed to do so (Section 8).

8. Evidence on the practice of innovation and policy transfer in urban transport, and the need for institutional support for innovation (Section 9).

9. A critical assessment of the potential contribution of the innovations discussed in Sections 4-8 (Section 10).

Information sources

In preparing the paper, we have drawn on the output of the ECMT Working Group on Urban Transport (ECMT, 1995, 2002, 2006), the development of the European Commission's Action Plan for Urban Transport (DGEnv 2005; DGTREN 2007, 2009) and our own work with UK local authorities in the DISTILLATE programme (May, Page and Hull, 2008; May, 2009) and internationally for the Volvo Foundations (Marsden et al, 2010). It should be emphasised that most of these sources relate to developed world cities. While we have endeavoured to provide trend data for the developing world, it will be important for others to assess the relevance of our wider conclusions to cities in developing countries.

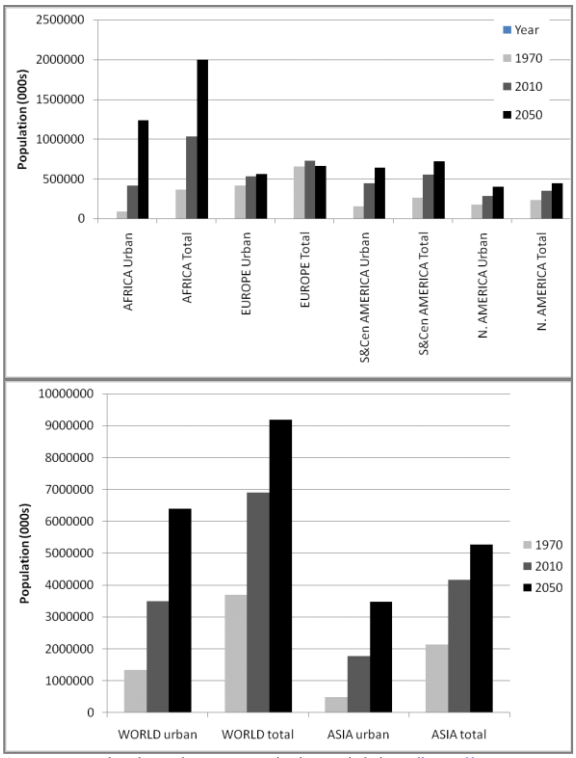
2. TRENDS IN URBAN MOBILITY

Urban areas and urban population

The world's urban population grew from 220 million to 2.8 billion over the 20th Century. In 2010 the world's population will stand at 6.9 billion with just over 50% (3.49 billion) of that population in urban areas. By 2050 it is forecast that there will be 6.9 billion people living in urban areas, comprising 70% of the global population.

There is substantial variation in the current levels of urbanisation in different regions around the globe today with developed countries typically much further down the path of urbanisation than developing countries. Figure 1 shows the urban and total populations for most of the world regions from 1970 to 2050. By 2050 Africa and Asia will have well over half of their population's living in urban areas as is the case elsewhere in the world today. The most developed nations will have urbanisation levels as high as 90%. The combination of longer life expectancy and migration will place unprecedented demands on urban infrastructure of all kinds.

Figure 1: **Urbanisation by world region 1970 to 2050**



The proportion of Asia's population which is urban has grown rapidly from 23% in 1970 to 42% in 2010 and will continue to increase rapidly to 2050 when 66% is forecast to be urban – an absolute increase of 1.7 billion people.

70% of the World's population will be urban by 2050, an increase of 20% from today's levels.

The proportion of the population which is urban is in 2010 already high in Europe and North America at 72% and 82% respectively.

Major growth is anticipated in Africa with the proportion growing from 40% to 62% by 2050, an absolute increase of almost 1 billion people

Source: United Nations Population Division (http://esa.un.org/unup/index.asp).

Table 1 provides an illustration of what this might mean to a small sample of cities from the different regions. The data is taken from the UN population forecasts (United Nations Population Division (http://esa.un.org/unup/index.asp)) which, for urban agglomerations, are only projected as far as 2025.

In the period 2010 to 2025 the African cities outside of Southern Africa have growth rates of more than 50% with Lagos, for example expected to almost double in size from 2000 levels. In Asia, the growth is around 40 to 50% with, for example, an increase of 3.92 million people in Kolkata and 2.39 million people in Guangzhou. To put this in context, London grew by around

4 million people over a period of 60 years in the 1800s, a period before the introduction of the car. Growth rates of 30 to 40% are common across Central and South American cities whilst those in Northern America and Oceania are lower at 20%, a figure which still poses significant challenges.

Table 1: **Growth in selected Countries and Cities (population in 000s)**

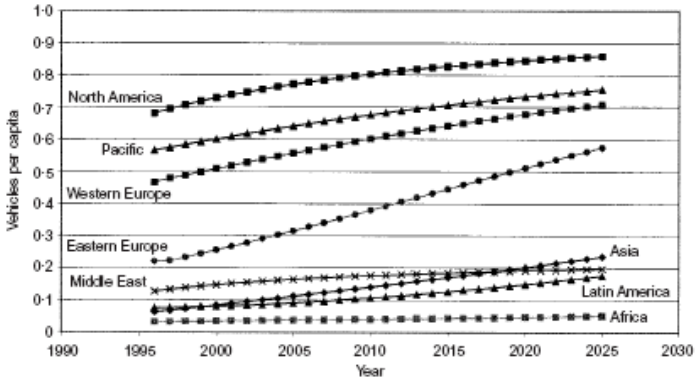
Region	Country	#cities >750k (2007)	Example	Population (000s)			% change 2000-25
				2000	2010	2025	
S-Central Asia	India	60	Kolkata	13 058	14 787	18 707	43
Western Europe	United Kingdom	7	London	8 225	8 567	8 618	5
East Asia	China	141	Guangzhou	7 388	8 829	11 218	52
Western Africa	Nigeria	11	Lagos	7 233	9 466	14 134	95
South America	Brazil	24	Belo Horizonte	4 659	5 575	6 597	42
Northern America	U.S.A	54	Boston	4 049	4 467	4 919	22
Central America	Mexico	17	Guadalajara	3 703	4 198	4 847	31
Oceania	Australia	5	Melbourne	3 433	3 728	4 137	21
North Africa	Algeria	2	Algiers	2 754	3 354	4 235	54
South East Asia	Indonesia	12	Surabaya	2 611	2 845	3 715	42
Middle Africa	Angola	2	Luanda	2 591	4 000	7 153	176

The UN report on urbanisation notes that “the bulk of urban population growth is likely to be in smaller cities and towns, whose capabilities for planning and implementation can be exceedingly weak.” (UNFPA, 2007). Unfortunately data on population growth, and the scale of problems, in these smaller cities is very limited, but it is important that their needs are not as a result overlooked.

Car ownership trends

Dargay (2002) projected changes in the numbers of cars per capita and the amount of traffic per capita in the different world regions. The data was based on recently observed growth rates, forecast changes in GDP and population growth. As Figure 2 shows, all regions of the world are forecast to continue their growth in vehicle ownership per capita although the levels in Asia and Africa remain comparatively low. Nonetheless, the growth in population means that even without a surge in ownership rates there will be a surge in ownership. In Lagos for example, if ownership rates grow from 0.05 per capita to 0.06 over the period from 2010 to 2025 then there will be an 80% increase in the numbers of vehicles owned to around 850k. Evidence from Chinese cities suggests average annual growth rates in per capita vehicle ownership of 10-25% (Darido et al., 2010).

Figure 2: **Forecast changes in vehicle ownership per capita**



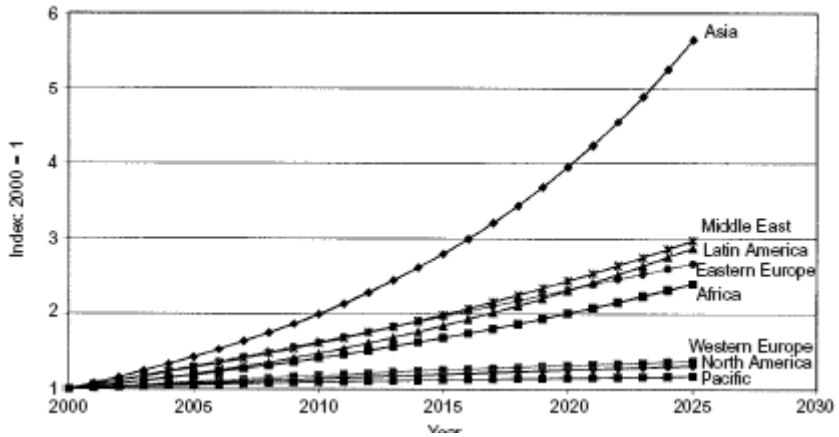
Source: Dargay, 2002.

Journeys in cities now and in 2050

The quality of data to track travel trends varies significantly across the globe. Whilst for developed countries it is often substantial and well documented, in developing countries it is patchy where it exists. There are significant difficulties in tracking travel behaviour where very large proportions of travel are made by bicycles, powered two-wheelers and para transit. Ticketing information is not reliable in many cities. Freight data is also difficult to obtain in developing countries. The absence of reliable data today makes the projection of future impacts difficult as few cities have models which relate supply to demand and other policies. This section necessarily restricts itself to a summary of headline trends.

The combination of growth in ownership and growth in population produces a growth in forecast distance travelled as shown in Figure 3.

Figure 3: **Estimated changes in road traffic levels relative to year 2000**



Source: Dargay, 2002.

Whilst there will be a larger proportionate increase in distance travelled on inter-urban journeys it is also true that more vehicle journeys will be made in cities. In Asia, the prospect of even a doubling or tripling of trips by car within cities (compared with a sixfold increase in kilometres travelled nationally) would pose significant challenges.

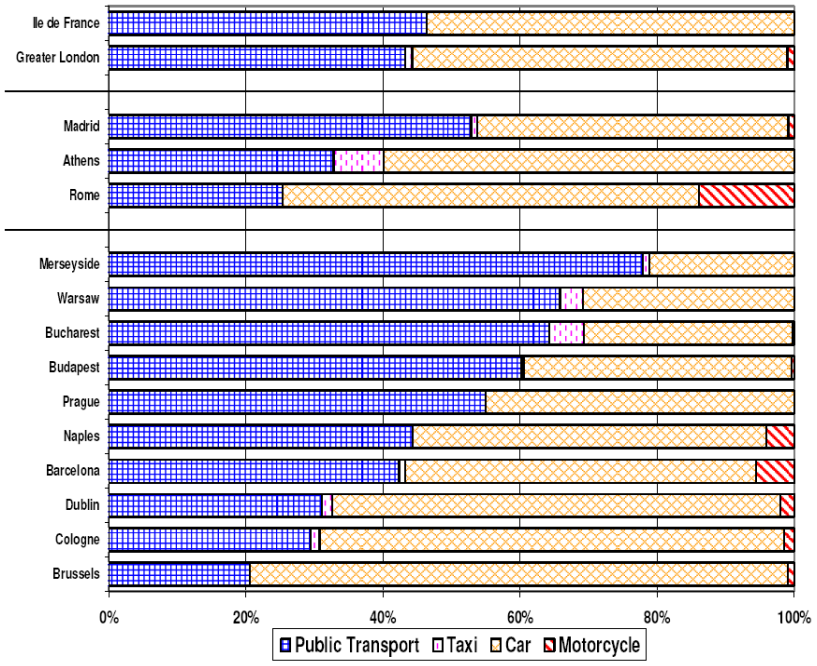
Modal shares for person trips in cities now and in 2050

The mode share of private car, public transport, cycling and walking varies very significantly across cities. The UITP Millennium Cities Database finds evidence of public transport mode shares as low as 6.7% in Chicago and as high as 73% in Hong Kong. Wright and Fulton (2006) confirm this to be true of developing cities too, with for example public transport mode shares of 27% in Havana (Cuba), 47% in Cairo (Egypt) and 71% in Bogota (Columbia). Much of the variation can be explained by factors such as urban density, relative prices and speeds of public versus private transport and the reach and quality of the public transport network. Even within a world region, cities which are quite close can have significantly different mode shares as a result of the different policies and history of development of the systems (see Figure 4).

One notable difference between developed and developing countries, particularly those in South East Asia, is the importance of powered two-wheelers where the mode share is as high as 42% in Hanoi (Vietnam) and 45% in Ougadougou (Burkina Faso) (Wright and Fulton; 2006).

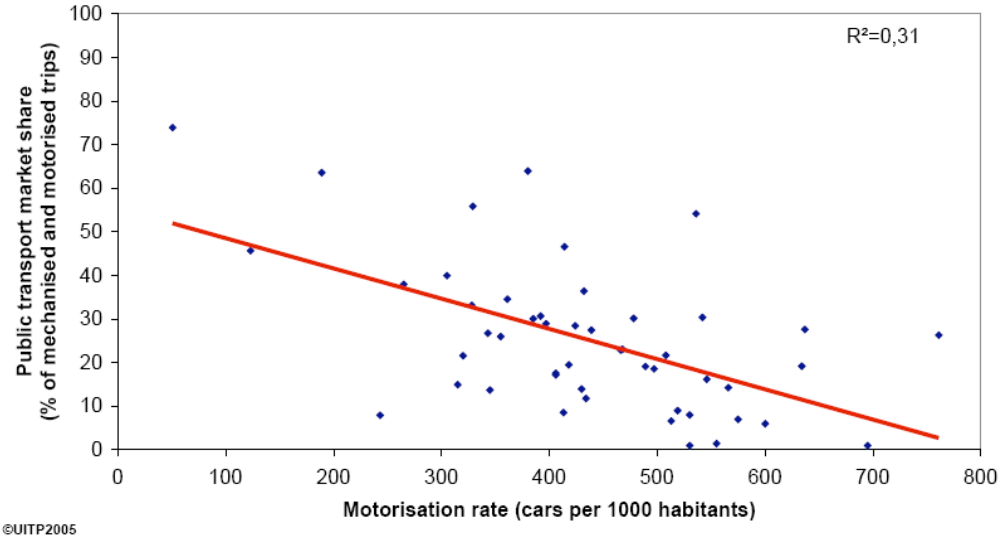
Both the Millennium Cities and the EU Benchmarking project databases show that as GDP rises car ownership rises and this has a generally negative impact on public transport mode share as more people travel by car (Figure 5). Whilst there is still significant variation in this relationship (which suggests that the policy framework remains influential) it is likely that there will be significant increases in motorisation in cities in the coming decades. Darido et al. (2010) reviewed evidence for changing mode share in Chinese Cities and found that in the past 20 years there has been an increase of 20% or more in car mode share in Beijing, Shanghai, Linfen and Guangzhou and around 10% in several other cities. This has largely been at the cost of a decline in non motorised transport journeys.

Figure 4: **Weekday mode share**



Source: Taylor and Clifford, 2006).

Figure 5: **Public transport mode share versus motorisation rate**



Source: Vivier, 2006.

Whilst there is a general trend for declining public transport use, there are cities that have managed to stabilise or slightly increase their public transport usage levels over the last two decades including London, Madrid, Paris, Vienna, Singapore and Hong Kong (*Source*: UITP Millennium Cities Database). The future mode share of cities will be determined in part by the broader changes to car ownership and income in countries and cities but it can also be significantly influenced by policy choices.

3. THE OBJECTIVES OF URBAN TRANSPORT POLICY

The meaning of sustainability

In understanding the needs of urban transport policy, we need to appreciate the objectives which cities and national governments are attempting to achieve, and the potential conflicts between them. Many agencies internationally now refer to the need for urban transport to become more sustainable, but definitions of sustainability differ. Sustainability was defined broadly by the Brundtland Commission (Brundtland et al, 1987) as meeting the needs of today's citizens without prejudicing the ability of future generations to meet their needs. This focus on fairness between ourselves and our grandchildren has been broadened since to include what is often referred to as the "three legged stool" of sustainability (Lautso et al, 2004): economic, environmental and social sustainability.

Possible objectives of sustainable transport

Most reviews of policy attempt to clarify the definition of sustainability by identifying the principal objectives to be addressed in achieving sustainability. The 2000 ECMT report on Sustainable Transport Policy (ECMT, 2000) identifies a set of objectives, which are shown in Table 2 in relation to the principal "legs" which they support (May and Crass, 2007).

Table 2: **Transport objectives and their contributions to sustainability**

ECMT transport objectives	Sustainability "leg"		
	Economic	Social	Environmental
Improving transport safety	✓	✓	
Creating wealth	✓		
Improving access		✓	
Reducing congestion	✓		✓
Reducing severance, fear, intimidation		✓	
Protecting landscapes and biodiversity		✓	✓
Reducing noise			✓
Reducing greenhouse gas emissions			✓
Improving air quality			✓

Source: ECMT, 2000; May and Crass, 2007.

A 2001 policy statement by European Transport Ministers (EC, 2001, quoted in DGEnv, 2005), defined a sustainable transport system as one which:

- Provides for basic access and development needs.
- Supports safety and human and ecosystem health.
- Promotes equity within and between successive generations.
- Is affordable, fair and efficient.
- Offers choice of transport mode.
- Supports a competitive economy and balanced regional development.
- Limits emissions and waste within the planet's ability to absorb them.
- Uses resources at rates which permit renewal or substitution.
- Minimises impacts on the use of land and the generation of noise.

This list is similar to that from ECMT, but adds:

- Promoting health (social);
- Increasing equity within and between generations (social);
- Being affordable and efficient (economic);
- Using resources within renewal or replacement rates (economic, environmental); and
- Minimising the use of land (economic, environmental).

Conversely, it surprisingly only makes passing reference to climate change.

Changes in objectives over time

While the term sustainability was not in common use forty years ago, most of these objectives were already being pursued in the 1970s. The only ones missing from the 1973 Greater London Development Plan (GLC, 1973) and the OECD study of Better Towns with Less Traffic (OECD, 1974) were concerns over the wider impacts on health, the threat of global warming, the needs of future generations and, to some extent, the issue of resource depletion.

Table 3: **Current priority of objectives in South East Asian cities in comparison with Europe** (Emberger et al, 2008)

Objectives	Priority		
	High	Medium	Low
Economic efficiency	● ■		
Protection of the environment		■	●
Liveable streets and neighbourhoods		● ■	
Safety	■	●	
Equity and social inclusion			● ■
Contribution to economic growth	● ■		
Intergenerational equity			● ■

Legend:
- ● South East Asian cities (results of SPARKLE seminars and workshops).
- ■ European cities from the PROSPECTS survey (May and Matthews, 2007).

Priorities among objectives

However, experience suggests that it is difficult to satisfy all of these objectives in the same ways. In particular, the economic and environmental objectives can often be seen to be in conflict. It is therefore important to understand the relative importance which cities assign to different objectives. A European survey of 60 cities (May and Matthews, 2007) asked them to identify the relative importance of the seven objectives considered for inclusion in the 2003 Decision Makers' Guidebook (May et al, 2003, 2005). These are listed in Table 3, and relate closely to the list in Table 2. A subsequent survey explored the applicability of these objectives to cities in South East Asia (Emberger et al, 2008). As Table 4 shows, there are a number of clear parallels, in that European and South East Asian cities both give high priority to efficiency (and particularly the relief of congestion) and economic growth, and both give low priority to intra- and inter-generational equity. However, there are also important differences, with South East Asian cities giving less emphasis to environment and safety. South East Asian cities also added a further objective, of protecting local culture, which was perhaps implicit in the European concepts of environment and liveability, but had not been identified as a separate issue.

Possible future changes in emphasis

Looking ahead over the next forty years, it would be easy to assume that the set of policy objectives might not change much. However, there are already emerging interests in security against terrorism, and resilience against natural disasters such as those arising from climate change (IPCC, 2007), and transport is increasingly being seen as contributing to other policy sectors such as education and inclusion (DfT, 2009a). More importantly, it seems likely that priorities will change, with cities being required to respond more directly to the challenges of climate change (IPCC, 2007; DfT, 2009a,b; Richardson et al, 2009) and resource depletion (ODAC, 2009).

4. TRENDS IN THE SCALE OF URBAN TRANSPORT PROBLEMS

Overview

Urban transport problems are most easily identified by considering the extent to which the objectives listed in the previous section are not being met. In this section we consider evidence on problems associated with each of the objectives. It should be noted that evidence on many types of problem is limited, and that estimates of anticipated trends in problems are extremely rare.

Congestion

Congestion poses a very significant cost on the economies of all countries. Whilst congestion can occur on inter-urban routes, the majority of congestion costs occur in urban areas. Even in the UK, where inter-urban commuting trips are common place, 89% of lost time on roads is in urban areas (Eddington, 2006). The full calculation of the costs of congestion on the economy requires a good understanding of both the nature of the congestion and the values of time of the affected road users. Global estimates of congestion cost are therefore difficult to establish. Table 4 shows the estimated congestion costs in the UK, USA and Canada. Typical average speeds are also shown for a range of cities which confirms that, even with lower motorisation levels, major cities across the globe are subject to chronic congestion problems.

Table 4: **Congestion costs and average peak hour speeds**

Country	National Congestion Cost	City	Average Speed	
			Speed (Km/hr)	Year
United Kingdom	$27Bn (1998)	London	17	2005
		Manchester	27	2004
Canada	$2.3-3.7Bn (2002)	Not available		
China	n/a	Beijing	12	2003
India	n/a	Delhi	15	2003
		Chennai	13	2003
			Ratio of peak: free flow travel times	
United States of America	$87.2Bn (2007)	Los Angeles	1.49	2007
		Atlanta	1.35	2007
		Miami	1.37	2007

Sources: Transport Canada (2006), Peng (2005), Puchera et al., (2005), Schrank and Lomax (2009), Grant-Muller and Laird (2006).

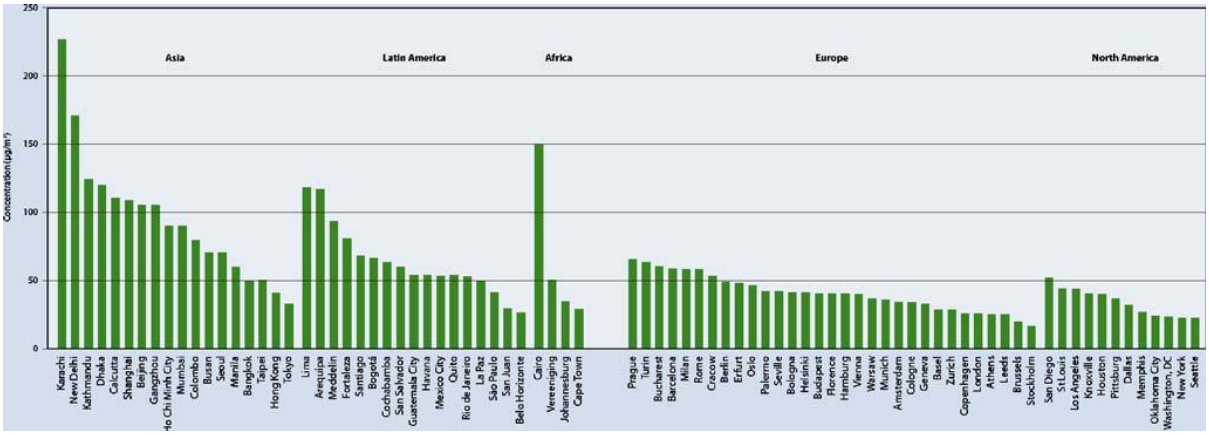
Of great concern for the future is the potential for congestion to deteriorate rapidly. As more and more routes become oversaturated the delay costs can spiral. In the US, Schrank and Lomax (2009) estimate that in the past 25 years, urban congestion costs have increased fourfold whilst the UK estimates that under a business as usual scenario the costs to the economy could increase by as much as one-third year on year by 2025 as more of the network reaches saturation point (Eddington, 2006). Although the levels of congestion in central areas tend to stabilise once very high levels are reached there is an inevitable spread of the peak hours over longer periods and wider areas which are less well served by public transport. Puchera et al. note that in no city in India has the rate of growth of road space reached 1% per year. The environmental consequences of trying to match demand with supply are prohibitive but equally importantly the practicalities render such an approach highly capital intensive yet futile.

Air quality

As the knowledgebase about the relationship between emissions and health outcomes grows it is clear that several pollutants have very significant adverse health impacts, particularly on those who, perhaps through pre-existing respiratory conditions, are more vulnerable to them. The WHO suggests that poor air quality brings forward around 2 million deaths per year annually (WHO, 2009) and that the disease burden "falls most heavily on developing countries, particularly those in Asia" (Krzyzanowski and Cohen, 2008). The contribution of transport to the disease risk varies significantly across the globe with, for example, some developing countries still having significant domestic air quality issues due to the continued use of wood burning stoves. Whilst the data on air quality is patchy in the developing world, it is clear that transport does form a significant part of most cities' toxic pollution emission inventories (WHO, 2006).

The main pollutants of concern are particulate matter (PM_{10} and $PM_{2.5}$) and oxides of nitrogen. In Asia, particulates are currently a source of concern although the growing vehicle fleet will lead to increases in nitrogen oxides. Similarly, cities in Latin America have high levels of both particulate and nitrogen oxides (WHO, 2006 and Figure 6). Despite their comparatively low motorisation rates, larger African cities have poor air quality compared to most European cities.

Figure 6: **Annual average PM10 concentrations observed in selected cities worldwide**



Source: WHO, 2006.

Whilst the adoption of improved vehicle technologies offers a route to lowering vehicle emissions, particularly in developing countries where many older vehicles remain in use, there are limits as to the extent to which this will resolve the issue. Nitrogen dioxide is, for example, produced by complete and efficient combustion and it is proving difficult to achieve the stricter air quality standards being adopted in Europe.

Climate change

In 2004, transport accounted for 26% of world energy use and 95% of this was generated by fossil fuel burning internal combustion engines. The Intergovernmental Panel on Climate Change estimates that "Unless there is a major shift away from current patterns of energy use, projections foresee a continued growth in world transportation energy use of 2% per year, with energy use and carbon emissions about 80% above 2002 levels by 2030… In developing countries, transport energy use is rising faster (3 to 5% per year) and is projected to grow from 31% in 2002 to 43% of world transport energy use by 2025" (Metz et al., 2007, p48). Of course, countries with high motorisation have far higher per capita emissions than developing countries (Short et al., 2009). For example, the average CO_2 per capita in London is 1.3 tonnes whilst in Delhi it is 0.4 tonnes (Hickman and Banister, 2009).

In contrast to toxic air pollutants, the origin of greenhouse gas emissions is largely irrelevant to its impacts on the global environment. With current technologies, there is a strong correlation between the kilometres driven and the greenhouse gas emissions produced (largely carbon dioxide). In the UK 78% of trips are below 10 miles in length but these only account for 39% of CO_2 emissions from passenger cars. Higher density development is known to be associated with lower per-capita energy consumption, even after controlling for socio-economic status and differences in transport costs (Vivier, 2006). Mode shift to public transport therefore offers significant potential benefits in reducing the amount of fuel consumed by private cars as do measures to promote walking and cycling. The impact of rising congestion on the effectiveness of public transport as a competitor to the car is therefore of concern.

Whilst the challenge of cutting greenhouse gas emissions poses significant challenges to urban transport planning in all countries, the challenges for many cities will also require significant adaptation to climate change. This can include more intensive and more frequent significant rain storms and hurricanes and more sustained periods of higher temperatures. Whilst the exact nature and severity of the change is not wholly clear, the vulnerability of communities to these effects and the costs which they wreak are becoming clearer. Hurricane Katrina, for example, was estimated to have created $100 billion worth of damage in the US alone.[1]

Casualties

In 2004, the World Health Organisation estimated that almost 1.2 million people were killed in road traffic accidents whilst as many as 50 million people are estimated to be injured, representing "the combined population of five of the world's large cities" (WHO, 2004, p3). It is the main cause of death in those aged 40 and under and the direct economic costs globally have been estimated at US$ 518 billion (*Ibid*).

In Africa, Asia, the Caribbean and Latin America the majority of road deaths are among pedestrians, passengers, cyclists, users of motorised two-wheelers, and occupants public transport users, whilst in most high-income countries the majority are car users (predominantly because of the high mode share of the private car). There are also significant disparities in accident and injury rates, and in trends in those rates across the globe, reflecting the focus which some countries have placed on tackling the issue, as shown in Table 5.

Table 5: **Predicted road traffic fatalities by region**

Predicted road traffic fatalities by region (in thousands), adjusted for underreporting, 1990–2020

Region[a]	Number of countries	1990	2000	2010	2020	Change (%) 2000–2020	Fatality rate (deaths/ 100 000 persons)	
							2000	2020
East Asia and Pacific	15	112	188	278	337	79	10.9	16.8
East Europe and Central Asia	9	30	32	36	38	19	19.0	21.2
Latin America and Caribbean	31	90	122	154	180	48	26.1	31.0
Middle East and North Africa	13	41	56	73	94	68	19.2	22.3
South Asia	7	87	135	212	330	144	10.2	18.9
Sub-Saharan Africa	46	59	80	109	144	80	12.3	14.9
Sub-total	121	419	613	862	1 124	83	13.3	19.0
High-income countries	35	123	110	95	80	–27	11.8	7.8
Total	156	542	723	957	1 204	67	13.0	17.4

[a] Data are displayed according to the regional classifications of the World Bank.

Source: reproduced from reference *1*, with minor amendments, with the permission of the authors.

Source: WHO (2004), p39.

1. www.infoplease.com/ipa/A0882823.html.

Noise

Traffic noise can disturb sleep patterns, affect cognitive functioning and aggravate some cardiovascular problems (den Boaer and Schroten, 2007). As noise is related to the amount of activities being conducted and the noise intensity of those activities it is not surprising that it is largely an urban problem. Hooghwerff et al. (2000) concluded that the spread of exposure to noise in the EU15 was as shown in Table 6.

Table 6: **Estimated exposure of the EU population to road traffic noise**

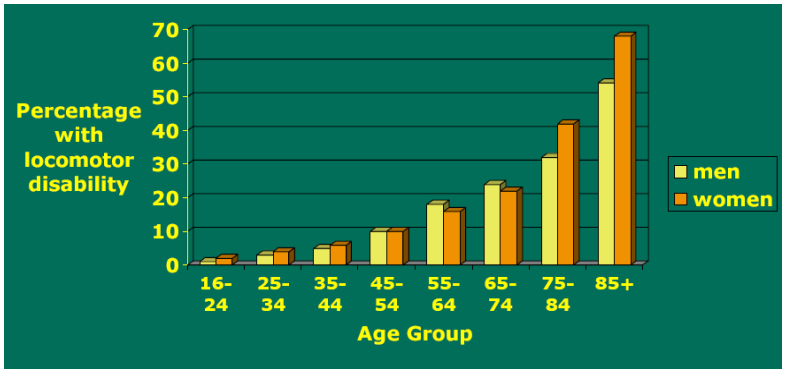
L_{dn}dB(A)	<55	55-65	65-75	>75
% exposed	68	19	11	2
Population (M)	251	71	41	8

Den Boer and Schroten (2007) estimated the social cost of road traffic noise in the EU22 at 38 (30 - 46) billion euros per year whilst for rail the estimates were about 2.4 (2.3 - 2.5) billion euros (in total around 0.4% of GDP). This is forecast to rise over the next decade at least. Although the measurement of noise in developing countries is not as commonplace as congestion or air pollution, estimates from seven corridors in Jaipur, India found L_{dn}dB(A) levels of around 70 (Agarwal and Swami, 2009) indicating that large metropolitan areas in developing countries will be facing noise problems considered to be severe.

Access problems

There will be significant increases in pressures to make the transport system more accessible to those with mobility restrictions, both as a result of changing attitudes to disability and as a result of the ageing of the population. Around one in ten of the UK working population is estimated to have a disability (Burchardt, 2000), a figure typical of many other European countries. Although age is not a perfect predictor of mobility problems, on average mobility problems increase with age as a result of declining levels of physical function (see Figure 7).

Figure 7: **The link between age and disability**



Source: Frye, 2005.

In developed countries such as the UK, the proportion of the population over 65 is already at 17% and forecast to grow to 25% by 2050, with 10% of the population over 80. In less developed areas of the world, the proportion of over 65s is only 6% today but will increase to 22% by 2050 with 314 million people over the age of 80. There are lower driving licence holding rates amongst the over 65s and a greater reliance on public transport as a means of travel.

The impacts of ageing and poor accessibility are likely to be highly context specific and dependent, in part, on the availability of a broader social security system and the nature of family support structures to overcome the barriers faced. Nonetheless, there is increasing acceptance

of the impacts of poor access and loss of independent mobility on economic potential, health and well-being (Lucas, 2004). The costs of providing public transport and other mobile support services for older people seem set to grow over time. This may be offset to a limited degree by increased income from fuel taxes as the cohort of older people holds more driving licences and vehicles although the costs are likely to be incurred at a city level whilst the revenues from fuel tax often accrue to national finance ministries. More generally, the costs of providing for elderly people will increasingly be borne by a smaller proportion of the population.

The principal threats to urban areas

The principal threats to urban areas stem from the anticipated growth in road traffic levels. Whilst this additional mobility will bring economic benefits to many, it will place increasing burdens on inadequate road networks with severe and interconnected problems. Congestion will damage the viability of public transport and this in turn has detrimental impacts on accessibility. Equally, vehicles stuck in traffic generate more emissions. The rise in car use will inevitably place greater safety risks on vulnerable road users and in particular pedestrians, cyclists and powered two wheeler users.

Technology promises to bring some improvements to toxic exhaust emissions over the next decades as fleets become more modern and cleaner fuels are introduced. In developed countries, there is a prospect that improved technology may also stabilise and then reduce climate change emissions – but this is not so in developing countries where the growth rate in ownership will be much higher.

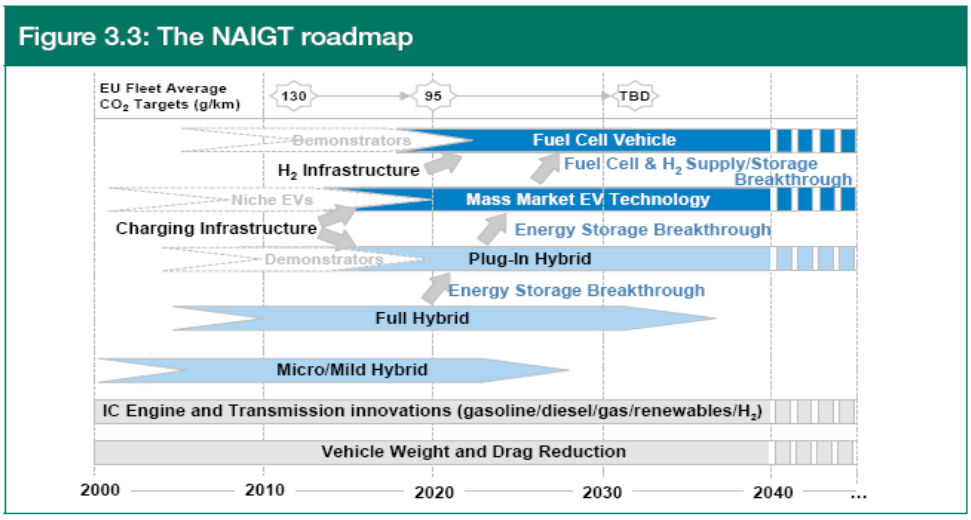
In summary, the growth in vehicle use threatens most of the key objectives of transport policy. Safety, noise and air quality pose direct public health risks on a major scale. Climate change impacts will worsen over coming decades with potentially devastating consequences. Some cities and regions are more vulnerable than others. Accessibility and inclusion are under threat and the severity of this problem will grow as the population ages. Whilst the distribution of problems differs across the globe the total impacts are in thousands of billion dollars.

5. THE AVAILABLE POLICY INSTRUMENTS

The role of technology

It is often argued that technological developments can provide solutions to most of the problems identified in the previous section. It is certainly the case that technological improvements have been the principal source of reductions in atmospheric pollution, and a significant contributor to casualty reduction. The major opportunities lie in the use of technology to reduce greenhouse gas emissions and oil dependency. Figure 8 provides a technology road map for the reduction of carbon emissions from road transport. The most immediate opportunities arise from reduced vehicle weight and drag, new fuels for internal combustion engine and the further development of hybrid technology. Plug-in hybrids, mass market electric vehicles and fuel cells have potential in the longer term. Several studies have assessed the potential of such technologies, and suggest that they may be able to contribute around half of the required reduction in CO_2 emissions by 2050 (Bristow et al, 2008; Banister and Hickman, 2006). In developing countries the production of electric motorbikes may offer an earlier route to lower carbon vehicles which better matches the composition of the fleet.

Figure 8: **A technology road map**



Source: DfT, 2009b.

Ways of achieving behavioural change

It is clear, therefore, that technology alone will not address the objectives outlined above, and that behavioural change will be needed in addition. Fortunately there is an increasing range of tools available to the urban transport planner to achieve such change. While this increasing range of solutions enhances the potential for achieving a more sustainable transport system, progress is restricted by the lack of awareness of many of these measures and of their potential impacts. To address this, a web-based knowledgebase and option generation facility, KonSULT, has been developed (www.konsult.leeds.ac.uk; Kelly et al, 2009). KonSULT uses a six-way categorisation of types of policy instrument, and a brief summary is provided below, drawing on information in KonSULT, of the potential of each.

Land use

Changes in land use help determine the demand for transport, and the use of higher density, mixed development linked to public transport services can help to reduce journey lengths and car use. As an example, a doubling of residential density can reduce journey lengths by 30%. More specifically, limitations on parking provision in new development can help encourage the use of other modes. However, land use change in established cities takes time, and thus will have a more limited short term impact (Paulley and Pedler, 2000).

Infrastructure

New roads can help to reduce congestion and remove traffic from sensitive areas. However, unless capacity is removed elsewhere on the network, they are likely to attract additional traffic; it is common for 80% of traffic on new urban roads to have been generated by their provision (Coombe, 1996). New light rail services can attract users from cars; typically 20% of users transfer from the car, and 20% are new users, with the rest coming from existing public transport and walking. However, their car reduction potential will be limited to the corridors in which they are introduced (Mackett and Edwards, 1998). These infrastructure projects will be expensive, and care is needed to ensure that they provide value for money. Lower cost options such as bus rapid transit are emerging as more cost effective ways of achieving similar reductions in car use (Wright and Hook, 2007).

Traffic management

Traffic management can increase the capacity of road networks at much lower cost than new road provision. Even in developed cities it is often possible to achiever 10% to 15% increases, which will help increase the efficiency of network use. Again there is a danger that such increases will attract additional traffic. An alternative is to reallocate road space to public transport, walking and cycling, or public realm projects. These may lead to reductions in car use, but the evidence on the scale of such reductions is limited (Goodwin et al, 1998).

Service provision

Improvements in bus service frequencies, network coverage and quality provide a lower cost way of increasing public transport capacity. While less effective than light rail provision, they can still attract perhaps 10% of new users from cars (Balcombe et al, 2004).

Information and awareness

One of the most interesting developments has been in the use of personalised journey planning, which makes individuals aware of the impacts of their travel patterns, and of the alternatives available to them. Several case studies have suggested that car use can be reduced by around 15% in the target population. However, these reductions need to be sustained over time (Bonsall and Chatterjee, 2009). Telecommunications as an alternative to travel can also assist, with perhaps 10% of commuting trips being amenable to home working (Lyons, 1998).

Pricing

Simpler fare structures and lower fares can both increase the attractiveness of public transport and, once again, perhaps 10% of new users will come from the car. However, such fare reductions need to be subsidised in the long term, and can prove to be very expensive (Balcombe et al, 2004). An alternative is to impose charges on car use. These have been found to reduce traffic in affected areas by around 15% to 20%, and are an important source of funding for the broader transport strategy. The main barrier to their use is public opinion (May et al, 2010).

The development of new policy instruments

The last forty years have seen a continuing process of development of new types of policy instrument. Of the 50 instruments included in KonSULT, only around half were available forty years ago, and several have only emerged in the last twenty years. The majority of these innovations have been in the application of information technology and psychology to transport planning, but schemes like shared bicycle fleets and car clubs are also relatively novel. Given this, it seems likely that the range of policy options will increase further over the next 40 years, but it is difficult to speculate on the nature of those developments. Some are likely to come from the developing world, where informal transport systems are increasingly being incorporated into mainstream transport planning. Others will arise from new technologies. Recent research has investigated the potential of cybercars and personal rapid transit, and has suggested that, when targeted to appropriate areas, they could help to reduce car use by around 10% (Muir et al, 2009). What is clear is that there will be a continuing need to evaluate these new developments and to assess their potential for wider application.

6. THE IMPORTANCE OF AN INTEGRATED STRATEGY

The need to combine policy instruments

Figure 9 provides a simple summary of these assessments, and of the potential contribution of each type of policy intervention to each of the sustainability objectives outlined above. It can be seen that no single type of instrument scores best against all objectives but that each has a significant contribution to make. This suggests that an effective strategy is likely to be based on a combination of different types of approach.

Figure 9: **The contribution of different types of intervention to policy objectives**

	Technology	Land use	Infrastructure	Management	Information	Pricing
Climate/Oil	● ● ●	● ●	●	●	● ●	● ● ●
Pollution/Noise	● ●	●	●	● ●	● ●	● ●
Safety/Health	●	●	● ●	● ● ●	● ●	●
Exclusion		● ●	●	● ● ●	●	
Congestion	●	● ●	● ●	● ●	● ●	● ● ●
Growth	●	● ● ●	● ● ●	● ● ●	●	● ●

Key: ● ● ●: High contribution.

Approaches to designing an integrated strategy

A review of the principles for the design of such combined strategies (May et al, 2006) has indicated two broad approaches. The first focuses on the concepts of synergy and complementarity, in which each policy instrument reinforces the other, thus enabling the combination to achieve a greater impact than either on its own. The second considers the political, institutional and financial barriers to implementing a given policy instrument, and identifies other instruments which can help overcome these barriers. Both of these approaches are employed in the KonSULT option generation facility (Kelly et al, 2008).

Evidence on appropriate strategies

In parallel, two research programmes have independently identified the key elements of a sustainable urban transport strategy. The EC PROPOLIS project (Lautso et al, 2004) used a common analysis and evaluation methodology in seven cities to assess the contribution of different packages of policy instruments. It concluded that the key contributors were improvements to public transport services and fares and pricing of urban car use, and that a third element of more concentrated land use development was needed to reinforce these two transport measures. The net present value of such strategies was estimated at between $1 000 and $3 000 per capita (Lautso et al, 2004). A separate UK project (May et al, 2005) used optimisation techniques to identify that set of policy instruments which performed best against a given set of objectives. It, too, identified bus frequency increases, fares reductions and charging for car use, together with low cost improvements in road capacity as the most effective combinations, with a net present value of between $3 000 and $6 000 per capita. These optimal strategies typically reduced car use by around 15%, when compared with pre-existing strategies. However, it is important to stress that these solutions are specific to the context in which they were developed, for European cities and using policy instruments on which there was considerable documented evidence.

There are several cities which have an international reputation for their pursuit of such integrated strategies, and can be considered as innovators in urban transport policy. Singapore is perhaps the best documented; it has pursued a consistent policy for almost four decades in which car ownership and use have been controlled, public transport has been enhanced and land use has been planned to be compatible with the transport strategy. As a result its level of car ownership is around a third of that of comparator cities, and serious congestion is a rare occurrence (May, 2004). The UITP database has recently been applied to identify cities which have achieved a reduction in car use over time, and the factors which have helped explain such reductions (UITP, 2006). Freiburg, Vienna and Zurich are all examples of cities which have used demand management, public transport improvements and land use planning to achieve such trends; Freiburg in particular has also used improvements in both walking and cycling (Buehler and Pucher, 2010).

The need for further research

It is almost certain that the packages of most suitable measures will differ in cities which are more car-dependent, and also in those of the developing world, which are experiencing much more rapid growth. Moreover, some of the more recent developments, such as personalised journey planning, appear likely to add significantly to the performance of such strategies (Bonsall and Chatterjee, 2009). This is an area of urban transport policy in which more research and empirical evidence is needed.

7. THE BARRIERS TO IMPLEMENTING EFFECTIVE STRATEGIES

The barriers to implementation

An earlier study by the European Conference of Ministers of Transport (ECMT, 1995) had already focused attention on the importance of improvements in public transport, better management of road space and controls on the demand for car use as the key elements in a sustainable urban transport strategy. A subsequent review (ECMT, 2002), however, concluded that, while cities were generally aware of the most appropriate solutions, the implementation of such sustainable transport strategies was "more easily said than done".

The review covered 168 cities around the world. It highlighted as the principal barriers poor policy integration and coordination, counterproductive institutional roles, unsupportive regulatory frameworks, weaknesses in finance and pricing, poor data quality and quantity, limited public support and lack of political resolve. This led in turn to the publication of a set of key messages to national governments, who were seen as crucial in enabling and supporting local government initiative (ECMT, 2002). A follow-up to that study confirmed its findings and identified a further barrier of weaknesses in the process of policy formulation (ECMT, 2006). It sent a further key message that "national governments should support local or regional authorities through technical, financial or other means as necessary and appropriate in the development, appraisal, monitoring and evaluation of integrated, sustainable, urban travel strategies". A subsequent review of four ECMT projects, on accessibility enhancements, carbon reduction, safety and urban transport, identified similar barriers in all four areas of policy, and made a series of recommendations for ways in which governments might address them (May and Crass, 2007).

The impact of these barriers

Parallel research in the UK has shed light on the extent to which these barriers differ in their impact between types of policy instrument. Hull (2009) reported a survey of UK local authorities on the barriers to implementing different policy instruments, in terms of "seriousness scores" calculated as the product of scores of importance and difficulty of implementation, for each of a range of policy instruments. These are shown in Table 8 for overall implementation, and for each of a number of stages in the design and implementation process (May, 2009). It can be seen that local authorities experience the greatest difficulty with influencing bus services, fares, demand management and land use, which are precisely the policy instruments which the research reported above has shown to be the most important contributors to a sustainable transport strategy. Moreover, the four policy instruments which are the hardest to implement suffer at most stages in the policy process.

Changes in barriers over time

Research into the barriers experienced in urban transport policy is relatively recent, and there is therefore little evidence on how they have changed over time, or vary by location. It seems likely that most of the barriers identified by the ECMT are of long standing. Certainly finance, public support and political resolve were barriers at the time of the 1973 Greater London Development Plan inquiry, and it seems probable that the Plan was constrained by limitations in the policy process and in the data available. It is probably in the area of integration and institutional roles that the barriers have become more acute over the last forty years, as more public and private sector agencies have become involved in elements of transport policy.

Table 8: **Barriers to the implementation of policy instruments at each stage of the policy process** (May, 2009)

	Overall implement	Monitoring	Option generation	Finance	Modelling	Appraisal	Coordination
Buses	•••	••	○○	○○○	•••	••	○○○
Demand mgmt	•••	••	○○○	○	•••	•••	○○
Fares	•••	••	○○	○○○	•••	•••	○○○
Land use	•••	••	○○○	○	•••	••	○○○
Light rail	••	-	○	○	••	••	○○○
Soft options	••	-	○○	○○○	••	•	○
Traffic mgmt	••	•	○	○	••	•	○
Information	•	-	○	○	•	•	○○
Slow modes	•	•••	○	○○	•	•	○
Roads	•	•	○	○	••	••	○

Key:
- ••• Seriousness score > 0.5 (Hull, 2009).
- •• Seriousness score 0.4 – 0.5 (Hull, 2009).
- • Seriousness score < 0.4 (Hull, 2009).
- ○○○ Most severe problems identified in DISTILLATE case studies and Atkins (2006).
- ○ Least severe problems identified in DISTILLATE case studies and Atkins (2006).
- - Not addressed in the survey.

8. OVERCOMING THE BARRIERS

Recommendations for governments

In a review of work by the ECMT (1995, 2000, 2002, 2006) and the European Commission (DGEnv, 2005; DGTREN, 2007, 2009), May and Crass (2007) summarised the recommendations on the governmental and inter-governmental action needed to overcome these barriers. The original paper cites sources for each recommendation, and notes that the most appropriate remedies will depend on the context within which urban transport is currently planned. An abridged version of the recommendations is provided below.

Institutional barriers

National governments need to provide a coherent national policy framework for transport and land use. In particular they need to specify effective and consistent regulatory and pricing regimes, and ensure consistency between the planning of national and regional/local transport networks. While transport policy will usually be the responsibility of the Transport Ministry, collaboration and coordination is needed with Ministries of Finance, Planning, Environment and Industry; these ministries need to adopt a common vision for transport. National governments also need to establish appropriate institutional structures for lower tiers of government, but should avoid the disruption caused by frequent institutional change.

National governments should devolve to regional and local governments those decisions which are best made at those levels, and provide the responsibilities, financial support, knowledge and encouragement to enable those decisions to be made. However, it will be important to maintain consistency of approach throughout these tiers of government. At local level, administrations need to have responsibility for a coherent area, which ideally should cover the whole travel to work area. Each local (and regional) authority needs to be able to coordinate its approaches to planning and operations, to the planning of transport and land use, and to the treatment of different modes.

The private sector has much to offer in financing, procurement and management of infrastructure and services. However, its focus on commercial objectives will not necessarily be consistent with the objectives of a sustainable transport system. Governments should design partnerships with the private sector to ensure that it is contributing effectively to those objectives; this might better be achieved through franchising rather than outright privatisation. The need for such partnerships is made more acute by the requirement to pursue integrated strategies, in which different policy instruments are often the responsibility of different agencies. More guidance on the development of appropriate partnership working has recently been made available (Forrester, 2009).

Process barriers

Transport systems have long term impacts, and take time to change; governments therefore need to plan them consistently over a period of decades, and to protect them from the vagaries of the shorter political cycle.

Governments need to ensure that national, regional and local transport strategies are based on a clearly agreed set of policy objectives, and on the priorities between them. Care needs to be taken in pursuing any one objective that the solutions adopted are compatible with other policy objectives, and that any co-benefits are fully accounted for in selecting preferred solutions. Targets can be an effective means of articulating objectives, but governments need to ensure

that they relate directly to the outcomes desired, are challenging but achievable, and are selected to cover the full range of policy objectives in a consistent way. Governments should adopt horizon years for targets which are sufficiently far ahead to permit progress, but close enough to be challenging.

Governments need to place greater emphasis on identifying current and future problems and their underlying causes, and ensuring that the public fully understands the nature of the problems to be overcome, and the need to do so. Governments should use this clear understanding of problems to facilitate selection of the most appropriate solutions. These solutions should be drawn from the full range of types of policy instrument; in particular governments should make more use of demand side measures. The option generation facilities described above have been designed to help achieve this (Kelly et al, 2009).

No one solution will be sufficient to tackle the majority of problems faced. Governments should therefore base their strategies on effective packages of measures, in which each reinforces the effects of the others, and include measures which help overcome the financial or acceptability barriers of other elements of the package. As noted above, this requirement for integrated strategies poses particular governance challenges.

Strategies need to be designed to manage risk effectively. Appropriate approaches include adopting a phased approach in which public acceptability and financial support can be sustained, and allocating commercial and public policy risks appropriately between the private and public sectors. Where new technologies are being considered, a further set of risks arises. Cities will typically wish to keep the technological risk low in the early stages of novel strategies. However, more rapid technological progress can be made if these risks are shared between the city, the technology developer and national government.

More generally, improved decision-support tools are needed to enable cities to enhance their policy processes. Recent research has targeted the development of such tools on the process barriers of greatest concern to local government (May, 2009).

Political and acceptability barriers

Governments need to develop a vision and make a stable political commitment in the long term if sustainability is to be achieved. In many cases a political champion, supported by an effective technical team, can provide the most effective means of achieving radical change.

Governments can best engender public support by increasing awareness of the problems to be faced both now and in the longer term. In many cases, target groups and non-governmental organisations can be identified who will help support the case for action. The public are less likely to accept measures which are novel or which aim to influence demand for travel. In presenting such solutions, it is important for governments to demonstrate that they are the most effective way to solve the problem, and that long term benefits will justify any short term disruption.

Effective consultation and participation throughout the policy process is a vital contributor to successful policy formulation. Participation should commence with joint agreement over objectives and problems, should contribute to the selection of individual solutions and packages, and should continue throughout the process of implementation. Participation in these ways may extend the initial stages of policy formulation, but should accelerate the process of implementation. It is important for governments to work with the media in stimulating support for the strategy. Care needs to be taken not to present them with complex technical arguments or to provide the opportunity for them to emotionalise issues.

Information and skills barriers

Governments should adopt regular monitoring of the performance of the transport system as an integral part of the planning process, and should use the resulting information to assess the effectiveness of the policies implemented and the nature of the problems still to be tackled. The data collected should reflect the policy objectives and desired outcomes, and be consistent with any targets set. Benchmarking can be a valuable tool for enabling similar administrations to learn from one another. Where appropriate, awards for successful authorities can be an effective way of stimulating enhanced performance. A study for ECMT demonstrated the serious limitations on data collection for monitoring in many developed countries (May et al., 2008b). Guidance is available on the development of a monitoring framework and the selection of appropriate performance indicators (Marsden and Snell, 2009).

More research is needed into the cost effectiveness of alternative policy instruments. In particular, a greater understanding is needed of the contribution of many demand side measures and of new technologies. An ex-post analysis will be of particular value in understanding the transferability of solutions and in promoting evidence-based design. However, it is important that such evaluations are seen to be objective and trustworthy (Marsden et al, 2009).

Skills in transport planning, design and implementation are often limited even in smaller cities in the developed world, and the shortage is particularly acute in developing world cities. The skills needed to implement and sustain new technologies will be further limited, and this strengthens the argument for avoiding over-reliance on technological solutions.

Financial barriers

Financial support from national (and supranational) governments needs to be provided sustainably over the longer term. It needs to be provided for the strategy as a whole rather than its constituent parts, and to be applied consistently to all types of policy instrument. Finance should be allocated to the solutions which are shown to be the most cost-effective. Funds raised through Public Private Partnerships should be applied in ways which are consistent with the overall strategy. Care should be taken to avoid implementing less cost-effective infrastructure projects simply because private finance is available. In the UK context, a Finance Toolkit has recently been developed to assist cities and governments in making the most effective use of the sources of finance available (Binsted and Paulley, 2009).

Taxation and charging for transport use represents an important policy instrument, and governments should design it to be consistent with the overall strategy. In particular, taxes and charges should be applied as close to the point of use as possible, should reflect the externalities imposed by the journey being charged, and should be consistent across the modes.

Legislative and regulatory barriers

Legislation may be needed in some countries to enable the implementation of demand-side measures, to permit effective regulation, or to establish appropriate institutional structures. Regulation of operators should where possible adopt a franchising approach, in which operators are encouraged to innovate while continuing to meet the overall policy objectives. Regulatory approaches need to be reviewed regularly to ensure that they remain effective. Regulations applied to operators and, in particular, to users, are only as effective as the enforcement procedures which support them. Where regulatory approaches are to be adopted, governments need to ensure that enforcement resources are available, that the enforcement agent adopts an approach which is consistent with the overall policy objectives, and that the effects of enforcement action are regularly reviewed and fully explained to the public.

9. EXPERIENCE IN POLICY TRANSFER

In all of the issues outlined above, cities are actively looking to learn from one another. However, relatively little is known of the process of policy transfer between cities. A recent study conducted interviews in eleven cities in Europe and North America which were known to be innovative in their approaches to transport policy (Marsden et al, 2010). Six principal motivations for looking for policy lessons from elsewhere were identified. Strategic need was the dominant motivation, but other factors included policy collapse, curiosity, political intervention, financial support and the desire for legitimisation and influence. This is in line with the findings from other fields of study (e.g. Dolowitz and Marsh, 2000 and Rose, 2005).

Local officials and politicians dominated the process of initiating policy transfer, and local officials were also the leading players in transferring experience. However, private suppliers, consultants and to a lesser extent academics also played a role in the provision of information. These actors used a range of sources of information. Informal networks and information sharing through professional contacts were the predominant methods of initial knowledge transfer. Although local officials heard about new developments through shorter media articles in newspapers and the technical press, they placed much greater trust in findings and suggestions reported by known colleagues and in first hand data. Good practice guides and project reports were not seen to tell the full story and were thus thought to risk displaying a positive reporting bias. The mix of informal information scanning from news media and the reliance on personal contacts was described as an unsystematic and potentially sub-optimal approach to searching for policies.

This unsystematic approach, and the perceived inadequacies of the available information, are both barriers to effective policy transfer. However, the existence of an organisational learning culture appears to be the most critical factor in determining the extent to which cities attempt to learn from elsewhere, and how they approach the search. The effects of learning culture are closely linked to the constraints on time and the degree of reliance on informal networks. Cities which reported more supportive environments and which made resources available also reported much larger networks of contacts (in volume, geographic and policy spread).

A prioritisation exercise which assessed solutions proposed by the interviewees against the barriers to policy transfer led to four key proposals of: improving cities' policy learning; investing in policy networks; developing more concise policy focused literature which deals with transferability issues; and developing better techniques or opportunities for information searching (Marsden et al, 2010). We suggest that investment in understanding the lessons from the first handful of implementations of a new policy is crucial to determining the potential the policy has to transfer. Few policies spread at a very rapid rate although there is evidence that, with sufficient support, the rate at which they spread can be accelerated (Kern et al., 2007).

There are particular difficulties in policies transferring across regions which lack cultural and/or policy similarity and in particular from the developed to the developing world. Whilst some policy instruments may transfer well, others may be disproportionately expensive or ill matching to the local culture and, even if adopted, will have less support and be less effective (Stead et al., 2008). Given the resources required to investigate alternative solutions, the improvements suggested by the cities seem crucial to avoiding some of the current weaknesses in the evidence base. It may also be necessary to promote more regional learning processes. For example, the Lagos BRT system operates on quite a different model from that of Curitiba and Bogota and may be more readily transferable to Africa and Asian cities (Kumar, 2008).

10. KEY MESSAGES

Urban areas and their populations are expected to grow substantially over the period to 2050, with a few exceptions in countries experiencing population decline. Growth rates are likely to be particularly acute (typically 30 to 50% over the next two decades) in the least developed countries which, in turn, are least well placed to tackle the resulting problems.

The objectives of urban transport policy are unlikely to change significantly over the period to 2050. However, priorities are likely to change over time, with climate change, resource depletion, health and resilience expected to be of growing importance.

The scale of the problems to be faced, in congestion, pollution, safety, accessibility and the attributes of climate change, is likely to grow even more rapidly than urban populations, as a result of growing motorisation and urban sprawl.

There are considerable opportunities for technological innovation, particularly in motive power sources and vehicle design. Innovations in the form of driverless public transport systems are also becoming available, although take-up has been very slow, and a significant initiative will be needed to encourage cities to be willing to adopt them.

These technological developments will continue to offer important solutions to the problems of urban transport, but the take-up, particularly in developing countries, will be limited by the skills and finance available. In no case will technology provide a complete answer to the problems which cities will face. Behavioural change will be at least of equal importance, and will require a growing emphasis on demand management.

Innovations in the range of transport policy instruments can be expected to continue, reflecting recent trends in which as many as ten new policy approaches have arisen in each decade. This will provide a wider range of options for cities, but will increase the need for objective evaluation of these innovative solutions.

The development of packages of policy measures, including new technologies and new and existing transport policy instruments, will be of increasing importance. It is already clear that a focus solely on technology and supply-side interventions is inadequate. Moreover, it will continue to be an unaffordable approach for cities of the developing world. Much more effort is needed to understand the design of effective policy packages in different contexts, both through underpinning research and through the collection of empirical evidence as leading cities apply such packages.

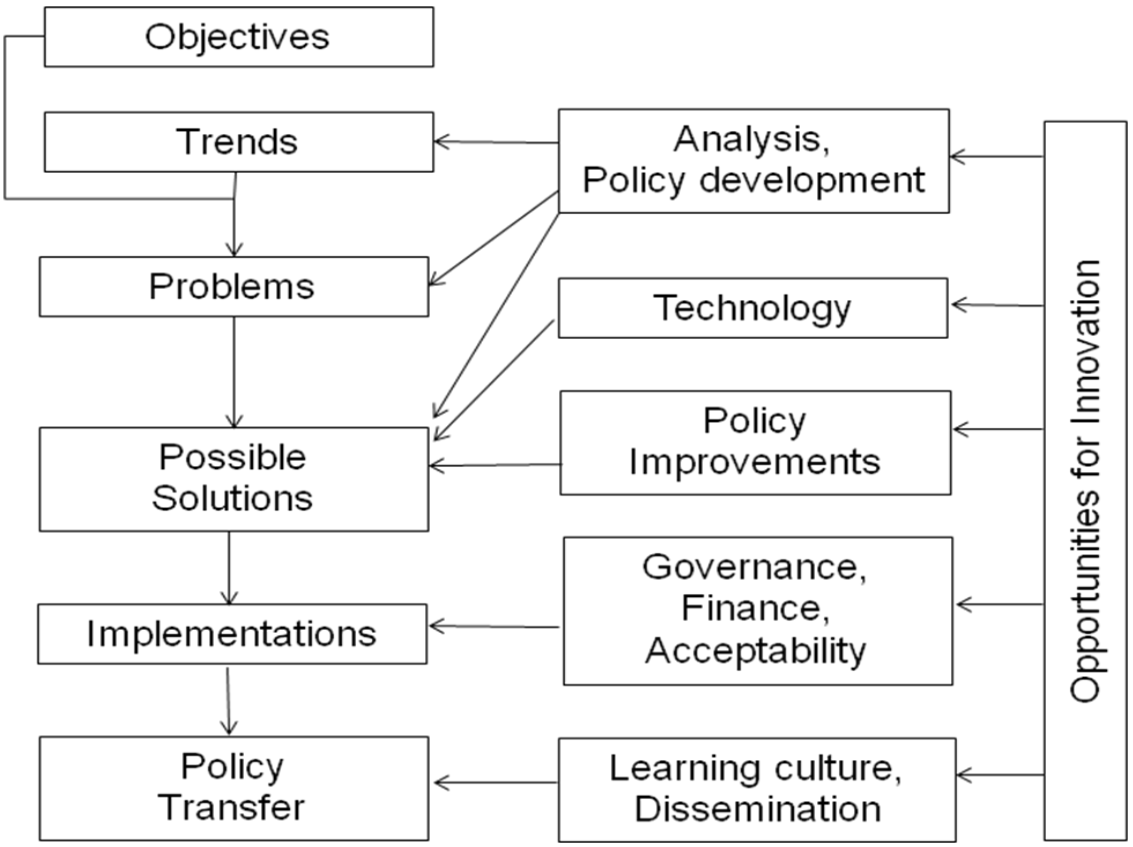
There remain a wide range of barriers to the development and implementation of effective policy instruments, and these barriers are even more acute in their impact on policy packages. The principal barriers arise in the areas of governance, acceptability, finance and regulation. Innovations are needed in all of these areas, and more research bridging the boundaries between engineering and economics on the one hand, and political science, psychology and sociology on the other, is needed to underpin these innovations. However, governments can already take actions to reduce the impacts of all of these barriers, as illustrated in the recommendations arising from earlier work by ECMT.

The availability of underpinning information and technical and policy skills will continue to be an important barrier to progress, and will particularly affect cities of the developing world. Training and dissemination of good practice will be particularly important, but needs to reflect the requirements of different city contexts. Research into the development of effective decision-support tools is still in its infancy, and is an area in which much can be done to overcome the process-related barriers to effective policy.

The most important contribution is likely to continue to be made by cities which are willing to innovate, whether in policy instruments and packages, in governance, finance or the policy process. However, other cities are typically slow to learn from such innovations, partly because the innovations are often not evaluated effectively, but mainly because such "follower" cities often do not have in place a culture of policy learning. More needs to be done to support the development of more effective policy transfer methods, particularly across regional boundaries where culture and implementation conditions can be quite different.

In summary, innovation in urban transport policy can be applied at several stages in the policy process, as illustrated in Figure 10 below. At the early stages of understanding problems and developing possible solutions, innovations in decision-support tools and in the policy making process can help overcome barriers to progress. In considering the range of possible solutions, innovations in technology and also in policy instruments can contribute to a richer policy package. Once policies are being prepared for implementation, innovations in governance, in finance and in increasing public acceptability will help to streamline the implementation process. Finally, when one city has achieved success with an innovative policy, innovations in learning culture and in information exchange can help ensure effective policy transfer to other cities. To be fully effective, innovation needs to be pursued, and encouraged, on all of these fronts.

Figure 10: **The roles of innovation in urban transport policy**



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