LAND USE AND TRANSPORT: SETTLEMENT PATTERNS AND THE DEMAND FOR TRAVEL

Halcrow Group Ltd
in association with

Peter Headicar (Oxford Brookes University, Planning Department)
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Stage 2 Background Technical Report
PPRO/04/07/13

Commission for Integrated Transport (CfIT)

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Halcrow

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Executive Summary

1. Introduction

This background technical report on 'Land Use and Transport – Settlement Patterns and the Demand for Travel' considers the relationship between urban structure and travel. The research seeks to assemble and interpret existing evidence on the influence of urban structure on travel patterns, and to highlight best practice on integrating transport planning into decisions on the location and design of growth settlements. The study reviews the adequacy of existing guidance on the ways in which transport issues should influence planning decisions, identifies barriers that may be hindering better decision-making and explores possible solutions.

The report is published alongside a summary guide on 'Planning for Sustainable Travel' and a website detailing some of the work at: www.plan4sustainabletravel.org

The study takes place in the context of the planning policy aspiration, first formalised in the 1994 version of PPG13, to:

"*Reduce the need to travel, reduce the length of journeys and make it safer and easier for people to access jobs, shopping, leisure facilities and services by public transport, walking and cycling.*" (PPG13. DETR, 2001, para 3)

Attempts to influence land use patterns and promote more sustainable travel need to be also seen against the background of enduring trends such as annual increases in travel volumes and increased dependency on the private car. Recent macro economic difficulties also add a further layer of complexity to the context and to understanding the interactions between urban structure and travel.

The UK Government has committed (2008) the UK to cutting greenhouse gas emissions by 80%, on 1990 levels, by 2050. This strategic aspiration adds a much greater urgency to the debate.

There are difficulties in that many of the relationships between urban structure and travel are complex, multi-directional and subtle. Yet the opportunity exists to use urban planning to contribute much more to sustainability in transport.

2. Literature Review

There is a very rich body of research covering the urban structure and travel demand topic. A review of some 250 papers has been carried out for this study. Much of this, however, is US-based. There is much less evidence covering the UK experience. Much of the literature, particularly the early research, has been fairly basic. The early analysis (Newman and Kenworthy, 1989; Gordon and Richardson, 1989; Cervero, 1989 and 1996; Breheny and Rookwood, 1993; Ewing, 1995), although pioneering and illuminating, was often open to several interpretations. It tended to be inconclusive and causalities remained largely unproven. Important contributions were made in the UK on the role of density and settlement size (Ecotec, 1993; Banister et al, 1997) and location (Curtis and Headicar, 1994, 1995).

The latest research on this topic is providing more clarity in statistical terms, with a focus on multi-variate analysis and some assessment of co-linearity, causality and self selection (Kitamura et al, 1997; Stead, 2001; Krizek, 2003; Handy, Cao and Mokhtarian, 2005; Aditjandra, Mulley and Nelson, 2007; Hickman and Banister, 2008b; Bohte et al, 2009; Cao, Mokhtarian and Handy, 2009; Naess, 2009).

The wide ranging potential of urban structure – including issues of density, settlement size, provision and mix of land use, jobs-housing balance, location, regional structure and accessibility, local street layout and neighbourhood design – covers interventions at a range of scales. The conclusions being

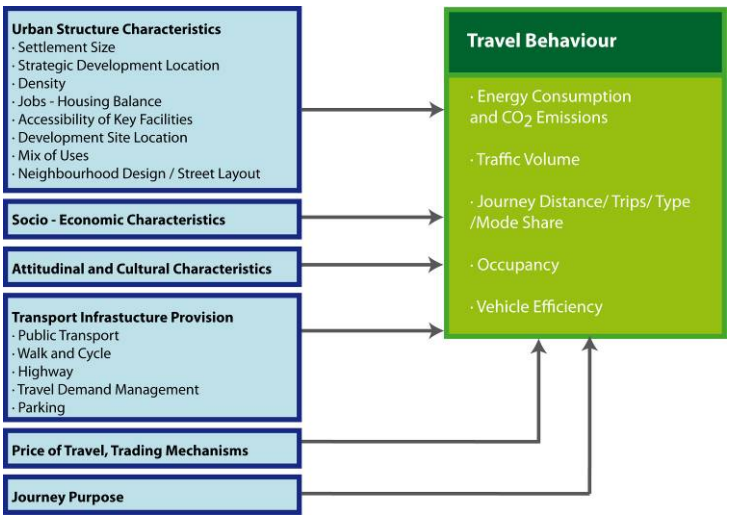
reached are that, all things being equal, there are significant associations between the built environment and travel behaviour, even when socio-economic characteristics and attitudes have been accounted for. Trip lengths and mode share are the most likely of the travel variables to be affected by the form of the built environment.

The impact of changes to the price of travel (and wider issues such as housing availability and price relative to income) remain poorly understood in terms of the land use/transport interaction debate. To analyse the more complex temporal relationships requires longitudinal data, allowing the dynamic processes to be explored by tracking individuals, households and businesses over time. This is one of the areas where future research should be focused. Much of the current available analyses are based on cross sectional data, allowing a view of one 'snapshot' in time.

Figure ES1, for example, highlights the emerging understanding that there is a range of urban structure, socio-economic and attitudinal dimensions to travel. These are also affected by the context (infrastructure provision), price of travel, extent of traffic demand management measures and journey purpose. Relationships work in several directions.

There has been some previous work on good practice in integrating urban planning and transport issues (for example, DOE, 1995; DfT, 2007b; DCLG, 2007b; TCPA, 2008; and Taylor and Sloman, 2008). The guidance tends to emphasise design principles at the neighbourhood or internal site level. There has also been some limited analysis of the institutional use of the evidence, mainly focused on the likely impacts of land use changes resulting from governmental guidance (Oxford Brookes University and WS Atkins, 1996; WSP and Arup, 2005).

Figure ES1. Urban Structure as an Enabler of Travel



3. The Current Data Trends

Analysis using the National Travel Survey (DfT, combined data 2002-06) highlights relationships between residential population density, settlement size and type, accessibility, and various socio-economic characteristics with travel distance and mode share. There are significant correlations. For example:

Density and travel: there is broadly an inverse linear relationship between density and travel, where increased density is associated with reduced travel distance, particularly by car. Distance by public transport increases with density, particularly over 30 persons per hectare. Walking distance is similar over all densities except the highest – over 50 persons per hectare.

Car drivers in Great Britain average 3,660 miles per annum (51% mode share); relative to an average density of 2.5 persons per hectare. In London, a lower average distance by car is evident at 1,876 miles per annum (35% mode share); relative to a higher average density of 46 persons per hectare. The South East, East of England and South West have the highest average distances by car at 4,489 miles per annum (53% mode share), 4,448 miles per annum (54% mode share) and 4,311 miles per annum (53% mode

share); relative to a lower average density of 4.2, 2.8 and 2.1 persons per hectare.

Settlement size/area type and travel: there is a weak inverse linear relationship with increased average distance travelled as settlement size decreases (Figure ES2). The largest differential is between inner London (an average of 4,673 miles per annum) and rural areas (an average of 9,806 miles per annum).

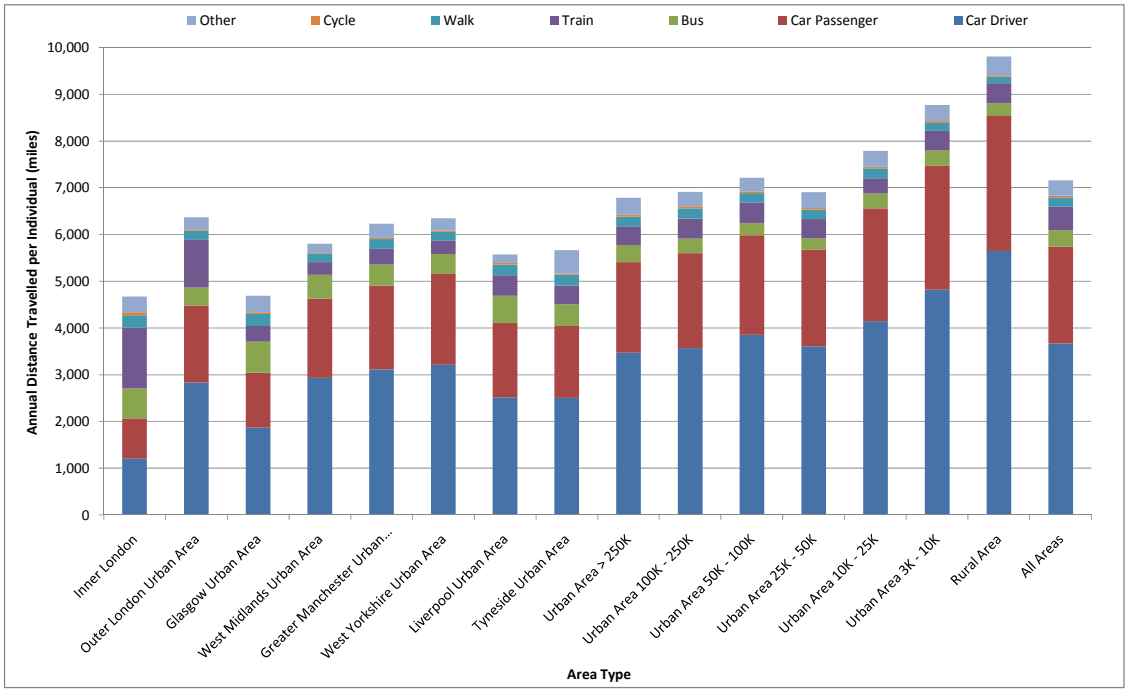
Outer London performs more like the other metropolitan areas in terms of average distance travelled. The highest average distances travelled (in non-rural areas) are in the non-metropolitan urban areas particularly those with a population of under 25,000.

Accessibility and travel: there is broadly an inverse relationship with increased distance travelled by car driver with increased accessibility to key services.

Multi-variate analysis allows us to consider how a variety of variables, in combination, influence travel. Many of the land use and socio-economic variables are significantly correlated with journey distance (again using NTS, combined data 2002-06). Land use characteristics (settlement size, population density, public transport accessibility, jobs-housing ratio) account for 11% of the variation in travel distance. Socio-economic characteristics account for 3% of the variation in travel distance.

There are, therefore, some clear patterns in the data, but the NTS only allows aggregate analysis and not more local investigation of differences. The issues of causality and the contribution of individual land use and settlement variables still need further exploration.

Figure ES2. Average Distance Travelled Annually Per Individual by Area type



(DfT, NTS, 2002-06)

4. Case Studies

A number of practitioner interviews were carried out to further understand the level of practical application of integrating land use and transport planning. The interviews with local authority members and officers were complemented by a limited amount of familiarisation and follow-up work in terms of associated planning documentation. The case study locations are outlined below.

- Regional: North East
- Metropolitan Area/City Region: Greater Manchester
- Growth Area: Milton Keynes/South Midlands
- Growth Point: Oxford/Didcot
- Growth Point: Plymouth/Sherford
- Large brownfield site, previous traditional industrial area: Birmingham/Longbridge
- Smaller scale planned new communities: Cambridge/Northstowe
- Rural: 'Generic' rural experience

There are, of course, many dimensions to practice – by spatial level and context, planning objectives and process, transport proposal and level of resource. It appears, however, that there are difficulties in implementation across many of the case studies. Practitioners constantly reflect that 'good intentions' [concerning integrating land use and transport planning, or sustainable travel behaviour] are modified in view of the difficulties of practical application. These include counter intuitive results and unintended consequences. Within this general finding, a number of more detailed points are made:

The interpretation of 'sustainable development': there is widespread acceptance of PPG13 principles; these are absorbed into 'conventional wisdom'. However, many of these are generic, 'one size fits all' aspirations, and there is little assistance /understanding of how to tailor solutions to the specific context. There is a difference between the presumptions underlying PPG13 and research; the former is concerned with the physical framework to ensure *opportunities* to reduce travel and choice of non-car modes, the latter with observed or prospective change in *actual travel behaviour.*

This is more than a semantic argument and results in difficulties in practice. The resulting 'envelope of discretion' means that sustainable travel outputs are weakened. Many of the case studies demonstrate this experience.

The relative importance attached to transport in policy-making: transport has broadly come to be viewed as a means of delivering other, mainly economic, objectives. The manifestation of this varies according to local circumstances, e.g. the 'spreading' of new development with the aim of securing associated infrastructure investment (North-East, MKSM) and viewing housing growth as means of achieving 'critical urban mass' (Luton, Plymouth). In Cambridgeshire, the spatial strategy has been fundamentally reviewed in response to the changing economic role of the sub-region. The acceptance of major greenfield development on the edge of Newcastle and Plymouth has resulted from the aspiration to secure (better) housing to support employment objectives. Oxfordshire is an exception, as the strategy to date has been dominated by discussions over the extent of the Oxford Green Belt.

In many cases these different priorities lead [inevitably] to the compromising of transport objectives. 'Sustainable travel', in particular, is not identified as a clear policy priority.

The treatment of land use/transport within strategic planning: despite the significance of

strategic development location on travel behaviour, this is given relatively little attention in practice.

There are a number of reasons for this, including the lack of acknowledgement in planning guidance, the dominance of other factors in strategic decision making, and the dissipation of traffic and environmental impacts at the strategic level. Strategic transport impacts are also beyond the scope of interest of particular stakeholders (the opposite of local impacts). The volume and complexity of the interactions and technical work required and the 5-year roll forward of development planning horizons implicitly encourages incremental 'muddling through' (except in the case of particular new settlements/growth areas).

The implications are that the absence of strategic evidence does not invite a careful consideration of trade-offs between sustainable travel and other policy objectives, and the debate is conducted instead in more generalised terms within the 'conventional wisdom' paradigm.

The treatment of land use/transport within local development planning: planning practice does not always follow the neat order implied by legislation and guidance. Local planning authorities in growth situations are often 'ambushed' by developers, negotiating 'off the back foot' in response to applications, without up-to-date strategic plans in place. There is much pressure to maintain 5-year housing land supplies.

Outcomes are influenced by the quality and approach of the developer and by the resources available to the local authority. For example, there is often a shortage of staff capable of handling large, complex applications and a steep learning curve for those involved in negotiating s.106 agreements. There is much uncertainty and mixed response to demand-based 'traffic forecasts' included in Transport Assessments. Traffic restraint (if any) tends to reflect practical and financial, not sustainability, considerations.

5. Recommendations

This background report provides a thorough review of the current international literature on settlement patterns and travel, and data analysis using the NTS dataset. It has also developed an understanding of current practice in England using a series of practitioner interviews. Based on this analysis, a number of recommendations are made which we would see as contributing to better practice in integrating land use and transport planning. These are conceived as suggested changes to guidance which may help practitioners in the field, additional evidence/research to further understand particular topics or trends, and key procedural changes, as outlined below.

1. PPG13 updated as a PPS13 – this can be given much renewed vigour in light of climate change issues, and the greater recent emphasis on traffic demand management, 'smarter choices' and the psychology of travel. The case for updating PPG13 was almost universally acknowledged in the practitioner interviews.

2. Aggregate level empirical analysis - covering urban structure, socio-economic, attitudinal and travel relationships, using NTS and Census data and developing the analysis carried out in this study.

3. Local case study empirical analysis - covering urban structure, socio-economic, attitudinal and travel relationships, using bespoke survey data, building on the approaches developed in Oxfordshire, Surrey, Kent and Tyne and Wear. This should include cross sectional and longitudinal approaches and tackle the issues of self selection and causality.

4. Before and after empirical analysis – testing behavioural responses to certain interventions, including higher density developments, mixed uses, development at certain locations typologies, integrated planning and transport packages. This may also include some reference frame analysis, exploring the actual implementation of knowledge in practice.

5. Benchmarking research – particularly in terms of understanding relative good practice (mode share, average travel distances, trip distribution) and application to the growth areas. This may include improved and/or new decision support tools useable by urban planners and transport planners to assist with site selection and assessment of impacts. Best practice/beacon authorities can be highlighted.

6. Improvements to NTS for future years – including inclusion of attitudinal questions and a different level/type of spatial disaggregation and geo-coding capability.

7. Improvements to the public transport accessibility planning process – including developing the robustness and accessibility of the DfT's national core public transport accessibility indicators. The accessibility topic can also take a wider scope, seeking to reduce trip distances rather than taking the conventional focus of travel choice and mode.

8. Transport futures scenario studies - undertaken at the regional level, potentially using backcasting study approaches. This would assist in identifying futures to be worked towards, and allow a strong monitoring mechanism to be developed, with the strategy and investment programme altered if agreed pathways (and headline targets) are not being achieved.

9. LTPs integrated more fully with the LDF process - including a LTP policy approach and programme developed to implement the development strategy. LTPs can be conceived as forward looking documents, with a greater focus on strategic goal achievement, as well as local problem solving.

The end objective in further integrating settlement structure and transport is in enabling – and actually achieving - more sustainable travel patterns. Greater regional and/or sub-regional analysis appears important. There is a current lack of data/evidence at these levels. This should help place settlements in their wider context of labour market catchments and capture the long distance commuting problem (a large growth area, accounting for a disproportionate amount of energy and emissions). A greater focus on participatory approaches to decision-making is also required, allowing awareness and ownership of the debate to improve. Only then will sustainable travel patterns be more likely to be achieved. Strategic thinking, for the longer term, is critical. Development location and transport investment decisions made today will influence travel patterns for many years to come.

Contents

List of Figures

List of Tables

1 Scope of the Study

1.1 Introduction

This study on "Land use and Transport – Settlement Patterns and the Demand for Travel" considers the relationship between urban structure and travel. The research seeks to assemble and interpret existing evidence on the influence of urban structure on travel patterns, and to highlight best practice on integrating transport planning into decisions on the location and design of growth settlements.

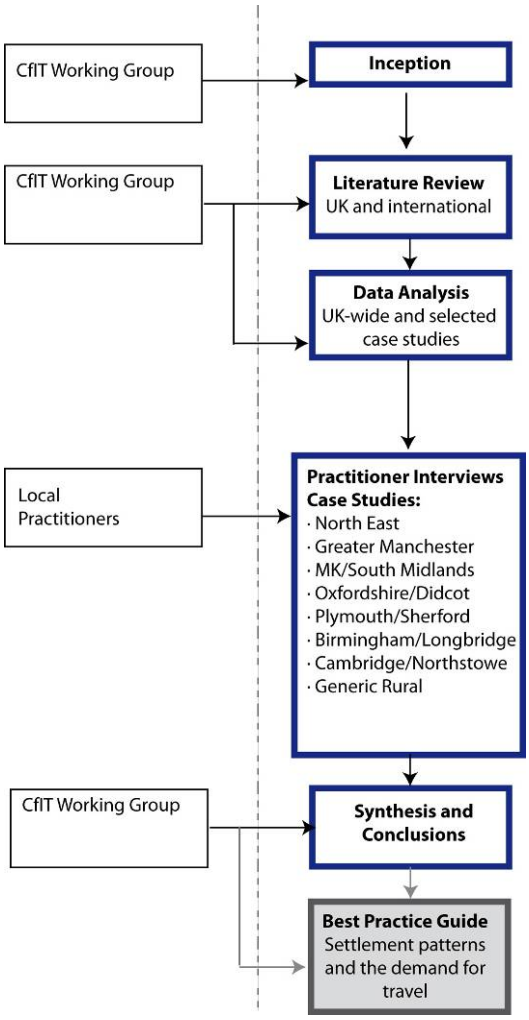
The study is led by the Halcrow Group, in association with Peter Headicar (Oxford Brookes University, Planning Department), Professor David Banister (University of Oxford, Transport Studies Unit) and Tim Pharoah (Independent Consultant), and is funded by the Commission for Integrated Transport (CfIT).

This Stage 2 Background Technical Report reports on the work carried out in the study, including a detailed literature review, analysis of the current trends (using the National Travel Survey (NTS) 2002/03, 2005/06), and a series of practitioner interviews used to understand the current level, and difficulties, of practice in integrating urban planning and transport planning in England. The study process is outlined in Figure 1.

Urban structure: is used throughout this study as the collective term for a number of urban variables analysed in the literature. These include population density, population size, jobs-housing balance and development location.

Travel behaviour: four types of travel variables are typically analysed in the literature – trip frequency, trip length (distance and time), mode choice, or collective variants such as vehicle km and vehicle hours travelled. More recently transport energy consumption and transport carbon dioxide (CO_2) emissions have also been used as a composite metric.

Figure 1. The Study Method



1.2 Study Objectives and Key Issues

The study has been structured to answer a series of study objectives and key issues. These are outlined below.

The study objectives are to:

- Review and validate the contemporary data on regional and local settlement patterns and the demand for travel;
- Review the adequacy of existing guidance on the ways in which transport issues should influence planning decisions at the regional, sub-regional

and local scales, i.e. identify best practice examples, anticipate the implications of evolving structures including Multi-Area agreements and single regional strategies;

- Identify barriers that may be hindering better decision-making and explore possible solutions to overcome these barriers;

- Identify gaps in the knowledge-base and highlight further research opportunities.

The key issues are to understand:

- How extensive is the current evidence base on the interrelationships between land-use and transport, and how influential is it in decision-taking?

- What are the levers that the planning system can use to influence travel patterns at different spatial scales?

- What are the examples of best practice and what can be learnt from them?

- Where are the gaps in the research, and what specific areas might CfIT target to further understand the subject either by itself or others, including Government?

Each of these objectives and issues are directly responded to in Section 5 – Synthesis.

1.3 Study Context

The study takes place in the context of the planning policy aspiration, first formalised in the 1994 version of PPG13, to:

"*Reduce the need to travel, reduce the length of journeys and make it safer and easier for people to access jobs, shopping, leisure facilities and services by public transport, walking and cycling.*" (PPG13) (DETR, 2001, para 3)

Potentially this policy contributes to the three dimensions of sustainable development:

- Economically , by reducing time and other resources consumed in travel generally and by car traffic and associated congestion in particular;

- Environmentally, by reducing pollution and greenhouse gas emissions and improving the safety and quality of local environments through less motorised travel;

- Socially, by facilitating access to services for people without use of a car and by supporting local centres and communities.

In essence land use policy is being directed to improve accessibility, especially by non-car modes. To achieve this requires:

- Appropriate national guidance on policy and best practice;

- Appropriate application of this guidance to the circumstances of individual areas within regional and local development plan documents;

- Acknowledgement of both the above in the consideration of individual development applications.

Recent guidance on transport assessments for development proposals (DfT, 2007c) supports the aims of PPG13 by moving away from a traditional 'predict and provide' approach and considers impacts on the entire transport network [not just roads and traffic]. Transport assessments are required to include consideration of measures to influence travel behaviour through parking management, improvements to non-car modes, travel planning, capacity management and network alterations. The related Circular 2/07 (DfT, 2007d) sets out the Highways Agency involvement in all stages of regional and local

planning processes to help ensure that the existing strategic road network can support development proposals. Other national policy documents related to land use and transport planning are listed in the *Policies and Best Practice Handbook* recently published on-line by the DfT (2008a) to complement new guidance on Local Transport Plans.

Current attempts at influencing land use patterns and promoting more sustainable travel need to be seen against the background of long term trends which have created the setting within which these policies operate.

The dominant feature of transport planning over the last 50 years has been provision to accommodate the transition to mass car ownership and the greater travel volumes arising from increased mobility and income. This has not only greatly improved the opportunities for car travel, it has also created a culture in which, in the vast majority of places, both in practice and expectation, is of unrestrained use of private cars. Until very recently the design and management of development and local road networks has reflected this aspiration. In the process this has created an unattractive and often hostile environment for walking and cycling. Investment in segregated urban public transport systems to provide an attractive alternative has occurred in only a few locations. Meanwhile bus operations have struggled in the face of decline and worsening traffic congestion. Attempts to promote bus use over the last decade continue to face these adverse trends and are further handicapped by a low patronage base consisting mainly of captive users.

The 'new realism' in transport planning (Goodwin et al, 1991) was an important publication in signifying a change in policy approach. A highway-based transport strategy could not keep pace with forecast traffic growth, hence there needed to be a renewed focus on traffic demand management. A series of policy statements have followed (DETR, 1998; DfT, 2004; DfT, 2007a), yet there have been huge difficulties in reducing the annual growth in traffic volumes in the UK. A Transport White Paper is also expected in Autumn 2008.

In terms of urban planning, counter-urbanisation in the form of relatively low density suburban residential growth, has been in progress for more than a century in the UK. There are very few successful attempts to increase densities, or relate development to the public transport networks, in suburban areas across the UK.

There have been additional, and at times divergent, trends in non-residential development:

- Decentralisation of facilities – in large part prompted by the opportunities for car-based accessibility in edge/peripheral areas and facilitated by a more relaxed planning regime operating in the 1980s and early 1990s;

- Sub-regional concentration – investment in new office, retail and leisure developments within larger outlets at a limited number of major urban locations (accompanied by closures in smaller towns) with comparable trends in hospitals and other public facilities. The education sector has also promoted a 'choice' culture, leading to longer school journey distances.

The result is evident in the 'trip length explosion' identified in the 1990s (Potter, 1997) – the disproportionate growth in journeys in the 10-25 mile range in which car use has the highest modal share of all distances.

Although planning policies over the last decade have promoted urban renaissance (Urban Task Force, 1999; DETR, 1999), regeneration and the densification of development, much new housing still takes place at low densities, in suburban areas, and in small freestanding towns.

In addition to the lengthening of trips, a critical feature of the emergence of 'urbanised regions' is the absence of realistic alternatives to car use for inter-town trips outside a limited number of rail-served corridors. Many journeys now reflect 'many-to-many' origins and destinations, making them difficult to serve by public transport. Even in places where the land use/transport system offers good opportunities for sustainable travel, it is still questionable whether these will be used – or even recognised – by people with the option of car use in fulfilling their individual requirements. For example (outside London):

- People who own cars will normally make decisions about their home or work location and use of other facilities in the expectation of accessing them by car. This maximises their 'freedom of choice'. The consequence of this is that a proportion (sometimes all) of the journeys they make regularly will, in effect, be 'car reliant' in nature (i.e. they would not be practicable by other means). Even for relatively local types of trip – trips to school, shopping, and visits to friends and family – a large proportion (a third) are not perceived as practicable by non-car modes (Stradling et al, 2000);

- In households where each adult has access to a car and uses it to fulfil their day to day needs, an attitude of 'car dependence' is likely to prevail [in part this is simply a product of habit – more than 40% of drivers never travel by bus or by train and 70% never cycle]. (Goodwin, 1995).

The extent of (practical) car reliance and/or (psychological) car dependence already makes it very difficult politically to introduce measures of car restraint, because of the number of people who have – or believe themselves to have – 'no choice' but to use their car. Efforts to manage the demand for traffic will certainly need to be targeted at different segments of the population; certain cohorts will have a greater propensity to change behaviour such as the 'malcontented motorists' and 'aspiring environmentalists' (Anable, 2005).

Without the inclusion of 'sticks' as well as 'carrots' in a transport management regime little change in actual travel behaviour is likely to take place in response to the opportunities created through land use planning. This strong attachment to car use presents a central conundrum for practitioners. If certain types of people are unwilling to change their behaviour then securing 'sustainable' land use patterns may have little effect on these cohorts. The effective management of the demand for travel is therefore reliant on a wide range of policy levers, including urban structure. There is some room for optimism, or at least an added impetus for a revised approach. In terms of strategic policy direction, the Stern Review (HM Treasury and Cabinet Office, 2006) makes a very strong argument to act against climate change, with an emphasis on an immediate response. The relative higher cost of car travel, reflecting higher oil prices, also makes efforts towards promoting sustainable transport more acceptable to the public (the price of travel by non-car means is less elastic to a rising oil price). Recent macro economic difficulties also add a further layer of complexity to the context.

The Planning and Climate Change Supplement to PPS1 (DCLG, 2007a) reinforces the role of planning in helping to promote sustainable travel patterns. Towards a Sustainable Transport System (DfT, 2007a) also begins to explore some of these issues. Paragraphs 3.15-3.16 restate that:

"*Reducing people's need to travel will be important to both the climate change and equality-of-opportunity goals. Planning guidance to local authorities used to stress the need for minimum levels of parking provision in new developments, whereas today's debate on PPG13 is about where to pitch maximum levels, taking account of the needs of different types of development. Town centre planning policy sets out a town centre-first approach to development, with proposals in town centres*

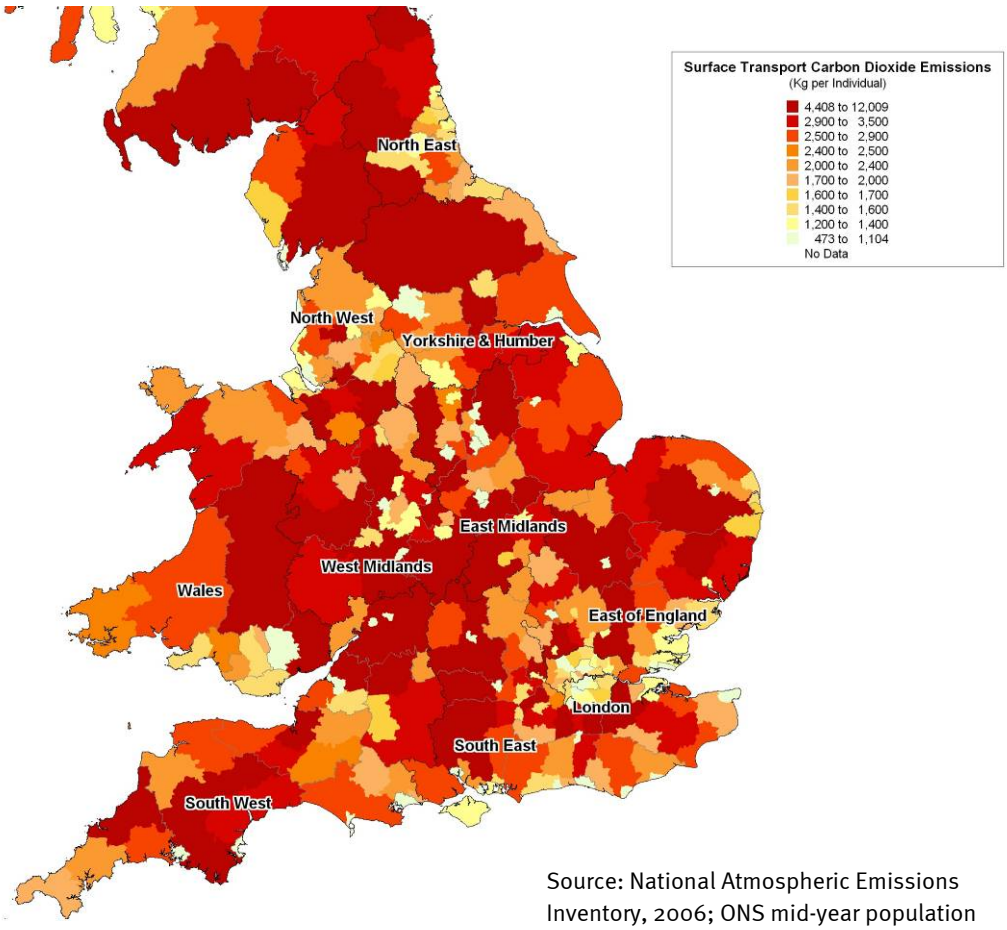
favoured over development outside town centres. Communities and Local Government (DCLG) and the Department for Transport (DfT) are also working with the reformed planning system to ensure that major new developments are located where they can make best use of existing transport links and to facilitate sustainable travel choices".

Under the Kyoto Protocol, by 2008-2012 the UK must reduce baseline emissions of six major greenhouse gases by 12.5 per cent, relative to the 1990 baseline. The UK Government has recently [16 October 2008, Hansard] committed the UK to cutting greenhouse gas emissions by 80% on 1990 levels by 2050, and this has been formalised in the UK Climate Change Act (2008), which also includes intermediate targets.

The impact of these headline targets will have a differential impact across the UK – CO_2 emissions (including those from the transport sector) are very different across the UK (Figure 2).

The lowest per capita emissions are found in London and the larger conurbations. The smaller towns and remote areas have the highest emissions. This reflects travel distance, mode share, occupancy and vehicle efficiency. The new local government performance indicators (NI 186) also require a per capita reduction in CO_2 emissions, including from road transport.

Figure 2. CO_2 Emissions from Surface Transport



Source: National Atmospheric Emissions Inventory, 2006; ONS mid-year population estimates, 2006

The large developmental aspirations in the UK mean that development needs to be more effectively integrated with transport provision if the growth in travel demand is to be managed. The UK Government announced (11 July 2007, Hansard) increased housing targets of 240,000 per annum, to be delivered through a new body in Communities England. This was restated in the Planning White Paper (DCLG, 2007c) and represents 3 million new houses by 2020. This follows a steady increase in the forecast numbers, from the Barker Review (HM Treasury, 2004) and the previous relatively high aspirations for development in the Growth Areas and Housing Market Renewal Pathfinder Areas (The Sustainable Communities Plan, ODPM, 2003). The Planning White Paper also aims: "*to streamline the planning process for nationally significant infrastructure projects to improve efficiency and predictability in the system, without compromising fairness*". The Planning Bill is currently going through Parliament, and if approved, will implement the Planning White Paper proposals.

There are difficult issues for practitioners in dealing with the differences in priorities [and inconsistencies] in the guidance. The DfT is still mainly orientated to road investment, with some recent emphasis on inter-urban rail (including high speed rail), so the economic objectives tend to be more important than the environmental and social. The DCLG's new planning regime means that many key decisions (which have transport implications) remain beyond local control. The planning balance has also recently moved towards the developer (e.g. draft PPS6 proposes dropping the needs test on retail location, which may make edge of centre developments easier). All locational decisions have implications for transport.

The argument hence seems to be emerging that the climate change, energy consumption and development agendas, when considered together, mean that a very different approach to the integration of urban and transport planning is required. Guidance such as Planning Policy Guidance Note 13 (PPG13) (DETR, 2001) may need to be revisited against a number of emerging issues, including the requirement to differentiate approaches between urban areas and more radically tackle the emerging strategic issues. Certainly good practice in integrating urban planning and transport can be more effectively shared, particularly in highlighting its potential contribution to sustainable development.

Urban planning as a discipline needs to contribute more to sustainability in transport, indeed part of the spatial planning remit is to move beyond traditional land use planning into areas such as transport. Equally, the transport planning profession needs to think more widely in terms of the "toolkit" available for achieving sustainability in transport; this includes the pivotal role of urban structure. There are difficulties in that many of the urban structure and travel relationships are complex and multi-directional. However, the first step here is to reassess the potential contribution of urban planning in reducing the demand for travel.

1.4 Structure of the Report

The remainder of this report tackles these difficult issues and is structured as follows:

- Section 2: Literature Review
- Section 3: Current Data Trends
- Section 4: Case Studies
- Section 5: Synthesis
- Section 6: Recommendations

The views expressed in this report are, of course, from the authors and do not necessarily reflect those of CfIT or any of the local authorities, practitioners or members interviewed.

2 Literature Review

2.1 An Emerging Topic

There has been a very healthy debate, over the last 30 years and more, concerning urban structure and the demand for travel. Some of this debate has been centred on experience in the UK, continental Europe and Australia, but the majority has been carried out in the US. A number of land-use characteristics are associated with travel patterns. The attractive proposition is that, if the relationships between a range of urban structure variables (say population density, settlement size, mix of use, etc.) and travel can be understood, then, by implication, land use planning (and other spatial planning methods) become very important tools in managing the growth in travel demand. A detailed examination of the literature and data, however, reveals much complexity.

As discussed previously, there are also a number of emerging drivers pointing towards a revisit of the evidence. Some of today's most topical issues - the growing imperative of climate change; the need to conserve finite energy resources; the interest in moving towards sustainability in transport and urban (and suburban) living; an increased emphasis on quality in urban design; high house prices in most parts of the UK, partly as a result of restricted housing supply (although recent macro economic trends are leading to reduced house prices), future plans for much increased housing supply, and an associated ambitious developmental agenda in the UK and elsewhere - are all emphasising the need to revisit the role of urban structure in generating travel.

2.2 The International Debate

A detailed review of the international literature has been carried out for this study – covering some 250 papers and publications. In general, the urban structure and travel literature is interesting in that it is attempting to understand a complex activity. The rationale for travel varies hugely by individuals and context, hence this makes analysis of urban form and travel problematic. The subject is more complex than envisaged at first glance due to the difficulties of isolating the effect of urban form on travel relative to other socio-economic, attitudinal and contextual factors.

Literature Coverage

The typical coverage found in the literature is provided in Table 1 (Annex 2 also provides a more detailed meta-analysis of the literature). A range of 'independent' urban structure variables are perceived as being linked with travel, typically including density and settlement size, but also wider variables such as mix of use, location, accessibility and local street or neighbourhood layout. There is, therefore, analysis at a variety of scales.

Table 1. Typical Coverage of the Literature

Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Method of Analysis
▪ Density ▪ Settlement size ▪ Provision and mix of land use, jobs housing balance ▪ Location ▪ Regional structure and accessibility ▪ Local street layout, neighbourhood design, parking ▪ Socio-economic characteristics ▪ Attitudinal and cultural characteristics	▪ Traffic volume ▪ Number of trips ▪ Travel distance ▪ Mode ▪ Car ownership ▪ Journey purpose, e.g. journey to work, non-work travel ▪ Congestion ▪ Energy consumption ▪ CO_2 emissions ▪ Electronic social interaction rather than physical travel	▪ Theoretical argument ▪ Descriptive analysis ▪ Bi-variate analysis, e.g. correlation analysis ▪ Multi-variate analysis, e.g. regression analysis ▪ Simulation, e.g. modelling, including land use and transport integration models ▪ Various datasets, e.g. aggregate and disaggregate level travel surveys ▪ Some limited longitudinal analysis, but mainly cross sectional data used

Socio-economic, attitudinal and contextual variables are also considered as important in the urban structure and travel relationship.

Travel is viewed as a 'dependent' variable in several guises – traffic volume, number of trips, mode share, etc. A number of composite metrics are also used – energy consumption and CO2 emissions. There is also an emerging literature on the development of the network society, with important implications for travel in the future.

Methods of analysis also vary hugely between the studies, ranging from theoretical argument, to descriptive analysis, bi-variate and multi-variate analysis and simulation studies. Most analysis uses cross-sectional data; there is little use of longitudinal data.

Themes within the Literature

There has traditionally been little consensus within the body of research as to the relationships between land use and travel, and less still as to how (or indeed whether) land use can (or should) be structured to reduce travel. Much of the debate is polarised, broadly reflecting either a belief in the value of urban planning interventions or various degrees of scepticism.

There have been a number of useful reviews of the literature, mainly with a focus on US material. Some of these are inconclusive: "*the evidence is mixed and messy*" (Crane, 1999); but the more recent reviews are beginning to develop some firmer conclusions, for example:- "*there are many answers to the question 'does the built environment influence travel activity' – it depends on the type of physical activity, the aspect of the built environment, the characteristics of the individual*" (Handy, 2005); and "*Trip frequencies appear to be primarily a function of socio-economic characteristics of travellers and secondarily a function of the built environment; trip lengths are primarily a function of the built environment and secondarily socio-economic characteristics; and mode choice depends on both. Studies of overall vehicle miles travelled (VMT) or vehicle hours travelled (VHT) find the built environment to be much more significant, largely due to the differential trip lengths*" (Ewing and Cervero, 2001).

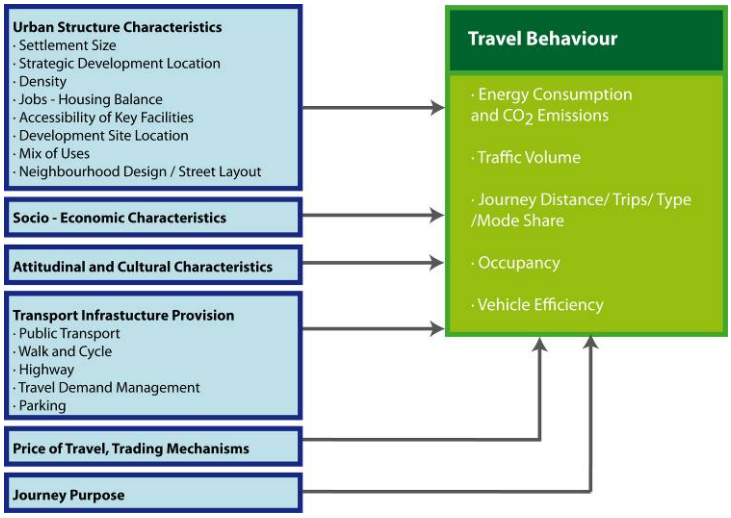
The most recent work in the US has started to tackle the difficult empirical issues – including those of co-linearity (whether urban structure variables, such as density, affect travel, or whether it is the associated factors, including public transport provision and accessibility); the direction of causality and 'self selection' (whether urban structure influences travel, or whether travel preferences influence the choice of location). Recent studies from the US show significant associations between the built environment and travel behaviour, even when attitudes have been accounted for, providing support for a direct causal relationship (Krizek, 2003; Handy et al, 2005; Cao et al, forthcoming 2009). There is little comparable work that incorporates the attitudinal dimension in the UK (though some is being developed, see Aditjandra et al, 2007; Hickman and Banister, 2008b).

The UK situation is, of course, very different in terms of the urban structure and travel context, and, indeed, price of travel. Hickman and Banister (2007a), and this study, review some of the UK and wider material. Although much of the early research concentrated on bi-variate relationships, individual urban structure variables usually only prove weakly significant with travel behaviour. If urban structure is to be used in managing travel demand, it is likely to be a collective effort involving multiple variables. The complexity of the urban structure and travel topic, in the physical sense of the built environment, revolves around a number of themes including density, settlement size, mix of use and jobs-housing balance, location, regional structure and accessibility, local streetscape and neighbourhood layout and parking supply. All of these are (to a greater or lesser extent) under the control of urban planners. Composite impacts can also include synergetic impacts. Most of the recent analysis uses multi-variate

analysis and controls for socio-economic differences (Stead, 2001; WSP and Arup, 2003; Hickman and Banister, 2007a).

Figure 3, for example, highlights the emerging understanding that there is a range of urban structure, socio-economic and attitudinal dimensions to travel. These are also affected by the context (infrastructure provision), price of travel, extent of traffic demand management measures and trip purpose. Relationships are multi-directional.

Figure 3. Urban Structure as an Important Enabler of Travel



It appears that urban structure may account for around 10% of the variation in travel energy consumption; socio-economic characteristics (including attitudinal characteristics) around 20-30% of the variation in travel. Together, urban structure and socio-economic characteristics account for around 60% of the variation in travel. Note this is based on analysis of the journey to work of new households in Surrey (Hickman and Banister, 2007a, 2008b). Contributory factors and relationships are likely to vary by context. The remaining 40% remains unknown – reflecting contextuality and/or other variables (including non or under-specified urban structure, socio-economic and attitudinal/cultural characteristics). The approximate 10% contribution of urban structure is hence very important, especially within the context of national and regional travel patterns.

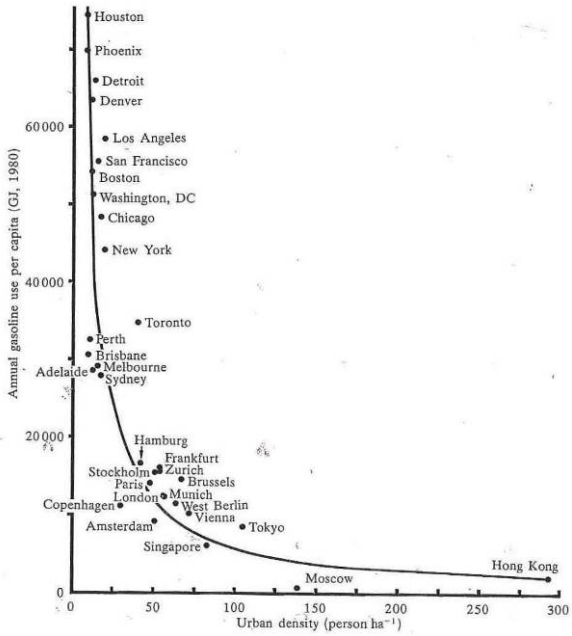
Much of the analysis in the UK is limited by the data available. The National Travel Survey (NTS) is not ideally suited to this scale of analysis; the Census is very intermittent, and limited to the journey to work. Other surveys are more local (Headicar and Curtis in Oxfordshire, 1994; Stead in Kent, 1999; Hickman in Surrey, 2007; Aditjandra, Mulley and Nelson in Tyne and Wear, 2008), but all are limited in their wider application. The US data is much more extensive.

Density and Settlement Size

The more recent complex research analysis, of course, builds upon some pioneering early work (which tended to be more simplistic in analysis technique). Some of the early studies (Newman and Kenworthy, 1989a; Gordon and Richardson, 1989; Roberts, 1991; Breheny and Rookwood, 1993) were very influential in generating interest in the topic and provided an early understanding of likely relationships. They were mainly focused on the issues of density and settlement size and travel. The Newman and Kenworthy work is well known in practice (Figure 4).

There are even earlier reference points on this topic – Soria y Mata (1894) on the linear city, Le Corbusier (1929) arguing for high densities in the 'the skyscraper in the park', and Wright (1935) for the low density 'broadacre city'.

Figure 4. Density and Energy Consumption



(Newman and Kenworthy, 1989a)

Some authors argue for the compact city and that there is a strong relationship between density and transport energy consumption (e.g. Newman and Kenworthy, 1989a and 1999). Others are more cautious and suggest that land use factors are, at most, only a small part of the travel picture, and that other factors, such as income, are more important in influencing the variation in travel (e.g. Handy, 1995; Gordon et al, 1997).

Ecotec (1993) and Banister et al (1997) provided early analyses of the UK National Travel Survey (NTS) dataset, finding that there are relationships with density and settlement size and travel. The Ecotec work in particular established a base of understanding about land use and transport relationships in the UK and fed into the development of the 1994 version of PPG13.

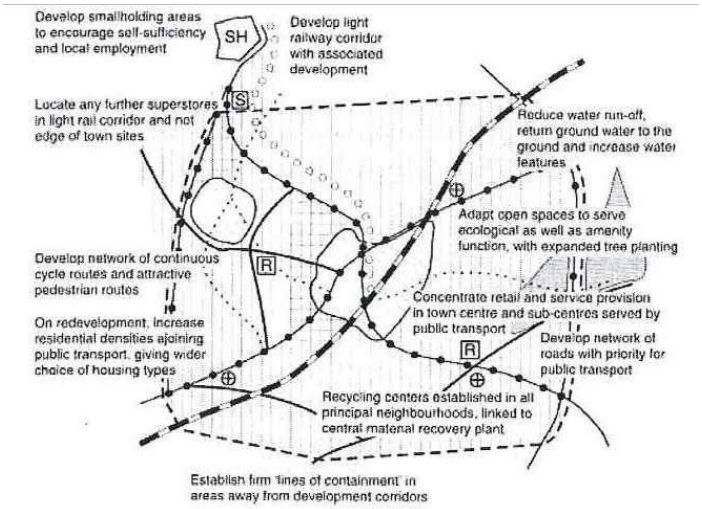
WSP and Arup (2005) also note that travel distance decreases with increased settlement size. Their analysis suggests that there are advantages in locating residential development in urban areas with a minimum of 25,000 population, but few appreciable changes beyond this (updated NTS analysis is provided in Section 3 of this report). Cervero (1996c) considers that density exerts a stronger influence on mode share than land use mix.

Some authors, controversially, put forward a different viewpoint and contend that continued dispersal will lead to a natural 'co-location' of activities and reduced travel (Gordon and Richardson, 1989 and 1997). Such views tend to be based on the US suburban context. There are also issues raised around the acceptability of various policy stances, particularly the public acceptability of compaction (Breheny, 1992b and 2001). It is argued here that suburbanisation has been stimulated by lifestyle choice and that attempts towards urban compaction are running against the aspirations of the majority of the public. Breheny warns of the need to test compaction policies for veracity, feasibility and acceptability. Handy (1996a) also points to one of the empirical difficulties – co-linearity, e.g. whether the impact of density on travel patterns is due to density itself or of other variables associated with density (such as good transit or a central location).

Within the British context, there is a strong link between settlement size and density. There are also some difficulties in applying the theory - in terms of individual development densities, it may take several decades before a policy of higher densities has a material effect on overall densities. The debate has also moved on somewhat from the compact versus dispersed argument, towards the spectrum in between, including polycentricity and 'deconcentrated concentration' as important principles – with growth concentrated at multiple locations (Owens, 1992; Breheny and Rookwood, 1993 – Figure 5). Hall and Ward (1998) describe their 'sustainable social cities of tomorrow', developing the early garden city ideals of Ebenezer Howard into notional development clusters along [re-opened] railway lines in the UK (Figure 6 – the case of Anglia). We will see that these ideas have been influential in places such as Sherford and Northstowe.

Most recently there has been debate on the network city, hierarchies and polynuclear development (Castells, 1996; Graham and Marvin, 1996; Negroponte, 1996; Hall and Pain, 2006) which could have enormous implications for future travel patterns.

Figure 5. 'Sustainable Development'



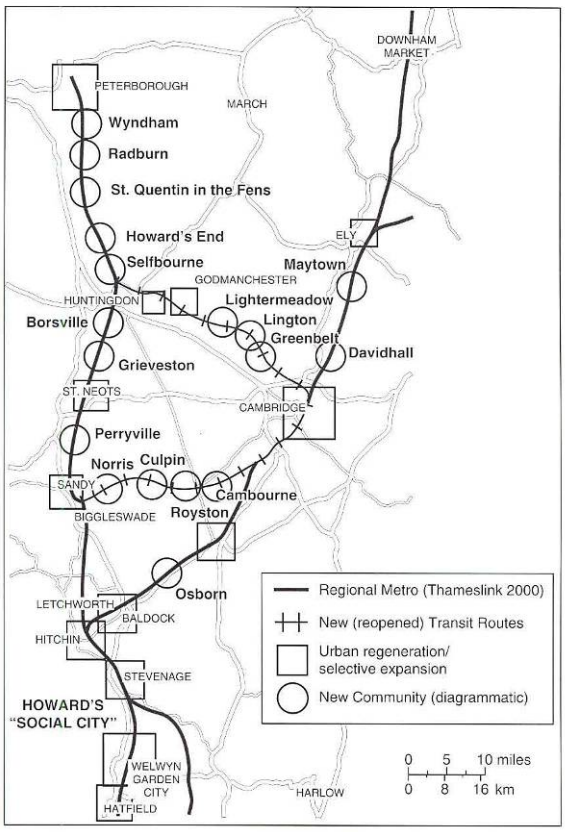
(Breheny and Rookwood, 1993)

Mix of Use/Jobs-Housing Balance

Cervero (1989a and 1996a) developed much of the early literature concerning jobs and housing balance, arguing that communities with effective balance (0.75-1.50 jobs per household) are associated with higher than average self containment ratios and low car dependency. Suburban workplaces with jobs-housing imbalance have low walk and cycle mode shares and are car dependent. Cerin et al (2007) have considered workplace proximity and walking to work propensity.

There has been little empirical work in the UK on this topic (though there is usually some discussion of this issue in the preparation of regional spatial strategies), with the exception of some early work concerning proximity of facilities – diversity of services and facilities in close proximity reduces distance travelled (Banister, 1996; Farthing et al, 1995, 1997) and some as part of multi-variate analysis (Hickman and Banister, 2007a).-

Figure 6. Sociable Cities – A Proposed 'City of Anglia'



(Hall and Ward, 1998)

Location

Some early work found that commuting distance increased with distance from the urban centre, in London, Manchester and Birmingham (Spence and Frost, 1995). Curtis and Headicar (1994, 1995) and Headicar, 1997, 2000) developed the important theme of contextual difference, based on analysis in Oxfordshire, finding that new housing development located outside existing urban areas or close to the strategic transport network increased travel distance and influenced mode split. They also refer to the empirical difficulty/issue of self selection.

Regional Structure and Accessibility

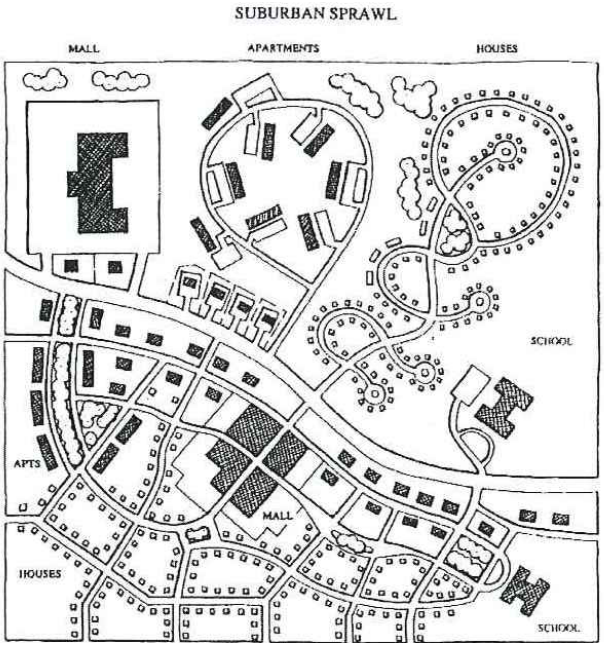
Local accessibility (commercial employment within a zone) and regional accessibility (access to regional centres) are seen as influencing retail trips, with shorter distances where accessibility is high (Handy, 1993). Regional accessibility is viewed as having more impact on the frequency and length of trips than density or land use mix in the immediate area (Ewing, 1995a; Kasturi et al, 1998; and Pushkar et al, 2000). Within Surrey, energy consumption in the journey to work reduces almost linearly as accessibility to town centres increases (Hickman and Banister, 2007a).

Local Street Layout/Neighbourhood Design/Parking

Some early work has been developed on network and streetscape layout/design and travel. Much of this has been US based and is linked to the New Urbanist movement. Duany, Plater-Zyberk and Speck (1992), for example, consider suburban sprawl and more traditional design typologies (Figure 7). Calthorpe (1993) also argues for transit orientated development patterns on the premise that they would help manage the demand for travel.

There are very few studies which directly assess the travel associated with different network design types, i.e. have an empirical base. Of those available, 'good' streetscape design, including fine-meshed grid-networks which facilitate walking and cycling, are associated with higher public transport, walk and cycle mode shares and trip rates, but with a weak significance (again, there are other factors involved in the rationale for travel). Conversely cul-de-sac style, poorly connected networks, and high traffic volume roads with fast moving traffic are associated with lower public transport, walk and cycle mode shares and trip rates (Cervero and Gorham, 1995; Handy, 1995; Hess et al, 1999; Hickman and Banister, 2007a; Aditjandra, Mulley and Nelson, 2007). Meurs and Haaijer (2001) describe the effect of spatial characteristics, including the home, street and neighbourhood, as having a significant impact on shopping, social and recreational trips in the Netherlands. Marshall (2005) explores the types of streets and urban layout that might be used as the basis for urban design.

Figure 7. Suburban Sprawl and Traditional Neighbourhood Development



(Duany, Plater-Zyberk and Speck, 1992)

Also very relevant here is the 'space syntax' body of work. This examines the influence of spatial configuration, including network geometry, on social life. Although the analysis covers wider objectives than the management of travel demand there is a strong aspect that considers movement implications (Hillier et al, 1993; Hillier, 1996; and Hillier and Penn, 2004; and others).

Parking and travel is a much under researched topic, yet seems particularly important as a factor in travel behaviour. There are key issues around supply, demand and urban aesthetic in terms of dead spaces displacing more active uses. Raising the cost of parking at workplaces is seen as important in reducing single occupancy drivers (Hess, 2001). Llewelyn Davies and JMP (1998) considered the

application of parking standards in the South East, UK.

Attitudinal and Cultural Dimensions

The attitudinal and cultural aspects of the urban structure and travel relationship are likely to be very important, with attitude playing an important contributory role. Kitamura et al (1997) developed some of the early work here, suggesting that attitude to travel is more strongly associated with travel behaviour than land use characteristics. The implication is that land use characteristics may not significantly alter travel demand unless attitudes were also changed. Bagley and Mokhtarian (2002) develop further similar findings, whilst Dieleman et al (2002) develop comparable results in the Netherlands.

Krizek (2003) shows that people who prefer to walk or use public transport may choose to live where the opportunities for these modes are greater, however that those locating to areas with higher residential accessibility decrease their vehicle miles travelled. Schwanen and Mokhtarian (2005b) assess the contribution of neighbourhood type dissonance (current neighbourhood type and preference) and travel outcome. One result from this body of work has been a more thorough evaluation of issues such as self selection (for example, in Handy, 2005; Handy et al, 2005; Zhou and Kockelman, 2007; Cao et al, forthcoming 2009). The emerging conclusion from much of the work is that the built environment is associated with travel, even after accounting for attitudinal characteristics.

Within the wider transport planning literature, Goodwin (1995), Stradling et al (2000) and Anable (2005) have considered the propensity of individuals and societal groups to change travel behaviour. This work draws on psychological theory, and suggests that there are particular cohorts in society more pre-disposed to use sustainable modes of travel.

The Price of Travel

The price of travel is also likely to have an influence on travel and also the land use and travel relationship. Typical travel price elasticities are reviewed by Graham and Glaister (2004) and Goodwin et al (2004) – suggesting that they are around -0.15 in the short term and -0.3 in the longer term[1]. The price of travel may account, in a large part, for some of the differences in research findings on urban structure and travel between the US and Europe. Owens (1992) notes that if travel costs are low an urban structure of 'decentralised concentration' is likely to be more energy intensive than centralisation, because of the large amount of cross-commuting. By deduction, higher travel costs may make this form of urban structure more effective.

Simulation Studies and Multi-Variate Analysis

As discussed, the more recent research has become much more sophisticated in methodological terms. Some of the early developments included simulation studies, which attempted to assess the likely travel impacts of various locations of development. Rickaby et al (1992) provided an interesting early simulation using an archetypical town.

There has been much recent use of multi-variate analysis. Most studies now make efforts to control for wider influences on travel behaviour (including socio-economic and even attitudinal aspects), moving beyond the simplistic bi-variate urban structure and travel relationship. Many types of statistical tests are used to test the significance of the various relationships in existence. Co-linearity, causation and self selection issues are now

1 Elasticity refers to the sensitivity of travel according to a change in price. For example, if a 10% increase in the price of travel led to a 3% decrease in travel, the price elasticity would be -0.3 (-3/10).

being examined in some detail. Temporal changes are less well examined, with little use of longitudinal studies; cross-sectional studies are much more popular. Some of the recent multi-variate analyses include Kitamura et al (1997); Cervero and Kockelman (1997), Schwanen et al (2001, 2002a, 2002b); Bagley and Mokhtarian (2002); Ewing et al (2003); Schwanen and Mokhtarian (2005a, 2005b); Handy et al (2005); Zhou and Kockelman (2007), etc.

This type of analysis has been much less frequent in the UK. Stead (2001) brings together a number of urban structure and socio-economic variables. Regression analysis on UK NTS data suggests that socio-economic variables are more important in explaining the variation in travel, but land use variables play a significant role. Socio-economic characteristics explain up to 55% and land use variables up to 27% of the variation in distance travelled at the survey area level. Important socio-economic influences include income, car ownership and availability, age and gender, family size and socio-economic group. As discussed previously, WSP and Arup (2005) provide some analysis using the NTS in the UK, but mainly with a focus settlement size.

Hickman and Banister (2007a, 2007b) also provide some regression analysis using a case study of Surrey. As discussed previously, the findings indicate that urban structure may account for around 10% of the variation in travel energy consumption; socio-economic characteristics (including attitudinal characteristics) around 20-30% of the variation in travel energy consumption, based on journey to work analysis.

2.3 Previous Good Practice Guidance

There has been some previous work on good practice in integrating urban planning and transport issues. The guidance tends to emphasise particular design aspirations and/or principles at the neighbourhood or internal site level, but rarely gives any empirical grounding.

The Good Practice Guide to PPG13 (DOE/DfT, 1995) provided a range of good practice examples and brief case studies to help integrate land use and transport planning, though is now somewhat out-of-date.

DCLG (*Eco-towns Prospectus,* 2007b) set out general guidelines for small new towns of at least 5-20,000 homes. These are intended as 'exemplars' of sustainable development. The guidance suggests that these must be 'places with a separate and distinct identity', be well linked to nearby towns and cities, and have a 'good range of facilities within the town' (p.4). Travel-related guidance (p.15) is covered in five bullets - including requirements for an area-wide travel plan, high-quality public transport links, provision of cycling/walking facilities, design that places key public services together, and traffic demand management. The prospectus notes that consideration should be given to the impact of development location on roads and congestion.

Very much related is DCLG's *Draft Planning Policy Statement on Eco-towns* (DCLG, 2008b). Within this a number of criteria are defined:

"An eco-town is a new settlement of between 5,000 and 20,000 homes which demonstrates the highest levels of sustainable development and should act as an exemplar for future developments. Eco-towns are most appropriate where they are near to and well-connected to existing settlements, particularly major centres of employment, retail and leisure. However there are other circumstances where a small new settlement in more remote locations may be suitable" (para 4.1).

Transport standards are as outlined below (paras 4.12-4.16):

"Travel in eco-towns should support people's desire for mobility whilst achieving the goal of low carbon living. The town should be designed so that access to it and through it gives priority to options such as walking, cycling and public transport, thereby reducing

residents' reliance on private cars. To achieve this, homes should be within 10 minutes walk of a) frequent public transport and b) neighbourhood services." There should also normally be a maximum walking distance of 800m from homes to the nearest school for children aged under 11.

Planning applications should include travel plans which demonstrate:

- how the town's design will enable at least 50% of originating trips to be non-car;
- good design (e.g. Manual for Streets) and community travel principles;
- how transport choice messages will be provided from 'day one' of residential occupation;
- how the carbon impact of transport in the eco-town will be monitored.

Where an eco-town is close to an existing settlement, applications should also demonstrate:

- options for ensuring that key connections around the eco-town do not become congested as a result of the development;
- significantly more ambitious targets for modal share than the 50% mentioned above.

DfT (2008b) provide advice on building an 'effective sustainable transport system' in new developments, focused on growth points and eco-towns. The document promotes cycling and walking, reduced car use, parking management, good street design, and access to public transport but does not provide specific thresholds for these measures.

The Town and Country Planning Association (2008) develop an *Eco-towns Transport Worksheet*, setting a number of design principles and benchmarks. For example, car mode share should be no more than 25% of all journeys in exemplar eco-towns and good practice would be 40%. Concepts from European best practice such as 'filtered permeability' are also put forward, also the use of 'ped-sheds' analysis designating pedestrian catchment areas. Several case study examples are provided from European developments.

BioRegional and the Commission for Architecture and the Built Environment (CABE, 2008) provide guidance for the design of eco-towns. Again the transport coverage is minimalist, though a number of benchmarks are suggested against CO_2 emission reduction aspirations. Travel-related recommendations are progressive, including:

- a 75% reduction in miles travelled by private car [against local average];
- public transport service frequencies of 10-15 minutes during the daytime;
- a maximum of one car parking space per household [and ideally 0.6];
- a target of at least 66% of employment accessible by sustainable modes with one local job/workspace per household.

From the urban design literature, English Partnerships (*Urban Design Compendium*, 2000) emphasise the importance of transport in neighbourhood urban design; and Cowan (2008) advises on design and access, etc.

Transport for Quality of Life (Taylor and Sloman, 2008) has also produced criteria for achieving sustainable transport in new developments, again focused on the masterplanning process. The criteria are drawn from a review of the literature and include coverage of development location, density, local facilities and jobs, street layout and design, public transport, parking, restraint to car movement and smarter choice travel behaviour programmes. The authors, for example, recommend minimum net densities of 100 dwellings per hectare,

parking standards as maxima of 0.5 spaces per unit, and investment in public transport before sites are developed for housing. This type of guidance, with a summary masterplanning checklist and criteria for achievement, has much scope for further development.

General issues within the documents are the lack of empirical evidence behind the aspirations and guidance, the lack of contextuality (solutions should differ by circumstance), and the lack of mapping against strategic targets. Transport issues are very often only conceived as internal design issues; there is little coverage of strategic issues. Guidance documents from the urban design arena also tend to treat transport tangentially.

Of the wider guidance documents associated with this topic, the *Manual for Streets* (DfT, 2007b) provides advice on best practice in local street layout/design, with a particular focus on the internal layout of new residential areas. This brings together the urban design and traffic engineering disciplines. Jones, Boujenko and Marshall (2007) develop the concept of designing for 'link and place', with considerable analysis concerning what might constitute link and place functions in different contexts.

A related methodology from north America is the *LEED for Neighborhood Development Rating System* (U.S. Green Building Council, 2008). LEED (Leadership in Energy and Environmental Design) has been developed as an accreditation programme for sustainable buildings with different ratings granted depending on achievement level. The new *LEED for Neighborhood Development* system covers almost 50 criteria – ranging from 'Smart Location' to 'Reduced Water Use'. Many criteria address spatial planning and sustainable transport, including 'reduced automobile dependence', 'school proximity', 'compact development' and 'walkable streets'. This thus begins to develop the concept of an urban good practice structural index (with a range of criteria), similar to those that are beginning to be thought through in the UK.

2.4 Institutional Use of the Evidence

To date there has been little [if any] research amongst practitioners in Britain explicitly on their familiarity with land use/transport relationships or their use of the evidence reported previously in this section in planning decisions. Rather the work that has been undertaken has focused on the adoption of policies contained in PPG13 and their actual or projected impact. The extent to which these policies adequately reflect the research evidence or can be considered an appropriate interpretation of it for use by local practitioners is, of course, a separate issue (see case studies reported in Section 4 of this report).

The previous Government-funded projects on this topic have had two distinct strands:

1. (sponsored by the predecessors of DCLG) –the projects were concerned with the take-up of PPG13 in local planning policies and their effectiveness measured in terms of their influence in individual planning decisions (Ove Arup and Partners, 1996 and 1999). The 1999 exercise was titled a 'Pilot Study' but no further work has been done even though – because of the lead times in the planning process and the revised 2001 version of the PPG – it is expected that the PPG may have had greater influence more recently;

2. (sponsored by DfT and its predecessors) – were concerned with the likely effects on travel behaviour, at a strategic level, of land use changes resulting from the PPG. Changes were relative to a 'business as usual' scenario from the National Transport Model. The work (Oxford Brookes University and WS Atkins, 1996; WS Atkins 1999; WSP and Arup, 2005) has become progressively more developed in seeking to quantify the extent of changes in travel behaviour as between different area-types. It necessarily requires evidence or informed judgements to be made about the effect of the PPG on planning policies

and development outcomes, i.e. as researched in (1). The work undertaken by WSP and Arup includes evidence on overall development outcomes (this is missing from the first strand).

The conclusions are that planning policy is having a marked effect on the location of retail development (though primarily through PPG6) and increasingly, with PPG3, upon the location of new housing. However, policy does not seem to be impacting upon the location of office development, although market forces are leading to pronounced concentrations within individual regions. Outside London there is also evidence of only a weak relationship between employment density and mode of travel to work, suggesting untapped potential to influence mode share at the workplace end. This interpretation is supported by evidence quoted by several sources of a reluctance amongst planning authorities to make decisions which imply restraint on car use, in part because of concerns over their inability to secure and guarantee quantum improvements in public transport which are seen as a pre-requisite.

Modelling undertaken by WSP raises doubts as to whether 'improvements' in land use planning would have a material impact on the volume of traffic (relative to what it would have been otherwise) – certainly in the more pressured areas. This is because the resulting 'gains' in less traffic from shorter trip lengths and higher non-car mode shares are offset by 'losses' from car users taking advantage of the less congested traffic conditions to travel more (induced traffic). However this work was undertaken before the recent increases in fuel costs and it is a matter for debate whether, in line with the precautionary principle, the scope for less traffic offered by improved land use policies merits pursuing nonetheless.

There is some early work being developed in Norway that considers why certain knowledge sets are not translated into practice in the field. This is conceived in terms of different 'frames of reference' (Rein and Schön, 1993; Tennøy, 2008). These are applied by professionals in a given situation. These influence their interpretation of a set of 'objective' conditions and the meaning they attach to national and local policy.

2.5 Conclusions

There is certainly a very rich body of research covering the urban structure and travel demand topic. Much of this, however, is US-based. There is a dearth of evidence covering the UK experience. Much of the literature, particularly the early research, has been simplistic. There are problems with this. For example, there are no present day 'compact cities', polycentric' cities or 'dispersed cities' – these are all notional urban forms (Banister, 2005). Real life tends to be of hybrid form and in a state of continuous change. Hence the polarity of argument tends to reflect stereotypical/ entrenched positions.

The early analysis, although pioneering and illuminating, was often open to several interpretations. It tended to be inconclusive and causalities remained largely unproven. The latest research is providing much more clarity on the topic, with a focus on multi-variate analysis and some assessment of co-linearity, causality and self selection. The wide ranging potential of urban structure – including issues of density, settlement size, provision and mix of land use, jobs-housing balance, location, regional structure and accessibility, local street layout and neighbourhood design – covers interventions at a range of scales. The conclusions being reached are that, all things being equal, there are significant associations between the built environment and travel behaviour, even when socio-economic characteristics and attitudes have been accounted for. Trip length and mode share are the most likely of the travel variables to be affected by the form of the built environment.

The impact of changes to the price of travel (and wider issues such as housing availability and price relative to income) remain poorly understood.

To analyse the more complex temporal relationships requires longitudinal data, allowing the dynamic processes to be explored by tracking individuals, households and businesses over time. This is perhaps where future research should be focused. Much of the current available analyses are based on cross-sectional data, allowing a view of one 'snapshot' in time.

There is also a possibility that the spread of opportunities which people expect to choose from [reflecting their level of 'discernment' and 'ability to choose'] is becoming wider over time; hence the meaning of self containment or proximity of activity location may be becoming less influential. The counter to this is that 'poor' urban structure effectively locks in car dependency, whilst a 'more effective' urban structure can enable more balanced travel choices. Not all people will choose to use non-car means, yet the aggregate trends are likely to show less car dependency.

There are some final intriguing developments. These are related to the development of the 'network society'. Here electronic social interaction has the potential to substitute for physical travel: "*to make geographic distance obsolete*" (Cairncross, 1997); "*the space of flows may supersede the space of places*". (Castells, 1996). The current trends show technological developments and use leading to a complex adaptation of travel behaviour, with a much more complex network of interaction, including a similar amount of physical travel and a huge increase in electronic interaction. A greater development of the network society, perhaps in an era of higher travel costs, may mean that this balance changes markedly. The relationships between urban structure and travel demand may similarly change hugely in future years.

Although the debates concerning urban structure and travel have been running for 30 years and more, it seems very timely, indeed critical, that the issues are revisited in terms of the literature and current data analysis. The debates are likely to run on and on. In the meantime practitioners should seek to use the various facets of urban structure in a much more positive manner as a key potential tool in restricting the demand for travel.

3 The Current Data Trends

3.1 Contextual Travel Patterns

The second part of the analysis explores the relationships between urban structure and travel with the available aggregate datasets in Great Britain. As noted previously there are some limitations in what can be done – the National Travel Survey, for example, can usually only be analysed at an aggregate scale, at the regional level or higher, for sample size reasons.

Figures 8 illustrates the huge growth in aggregate passenger distance over time (1952-2006) – the 'mobility explosion'. Figure 9 shows the dominance of the private car in mode share terms.

The DfT's national core public transport accessibility indicators detail the level of public accessibility to key services such as education, healthcare, employment and shopping. A composite measure of accessibility has been developed from the DfT's threshold based indicators, allowing a comparative examination of the quality of accessibility by public transport to key services across England (outside London). This analysis (see Table 2) reveals that:

- Public transport accessibility to key services across both the urban and rural areas of the English regions is, in relative terms, greatest in the South East (85%), East Midlands (81%), West Midlands (80%), East of England (79%), Yorkshire and Humber (78%), North West (78%), South West (77%) which are all at or slightly above the English average of 78%. The only exception to this is the North East which at 54% is considerably below the national average highlighting significant challenges in respect of public transport accessibility to services.
- Public transport accessibility to key services is generally considerably higher in urban areas (86%) than in the rural areas (49%). This pattern is repeated across all regions of England with the urban areas of the North East region at 60% being significantly below the English urban average of 86%.

The level of accessibility is closely linked to urban structure, transport provision and facility provision, hence draws together this topic quite effectively (also see Figures 16 and 17).

Table 2. Regional Variation in Public Transport Accessibility to Key Services in England

Region	Rural	Urban	Combined
East Midlands	56.0%	91.4%	81.3%
East of England	51.0%	90.7%	78.8%
North East	28.0%	59.5%	53.8%
North West	39.5%	82.3%	77.5%
South East	58.3%	92.1%	84.9%
South West	47.7%	92.1%	77.4%
West Midlands	40.8%	87.3%	80.4%
Yorkshire and Humber	49.8%	84.2%	77.7%
England (Outside London)	49.2%	86.4%	78.4%

Population and household accessibility to a basket of key services. Source: National core public transport accessibility indicators (DfT, 2004).

Figure 8. Growth in Aggregate Passenger Distance – 1952-2007 (Billion km)

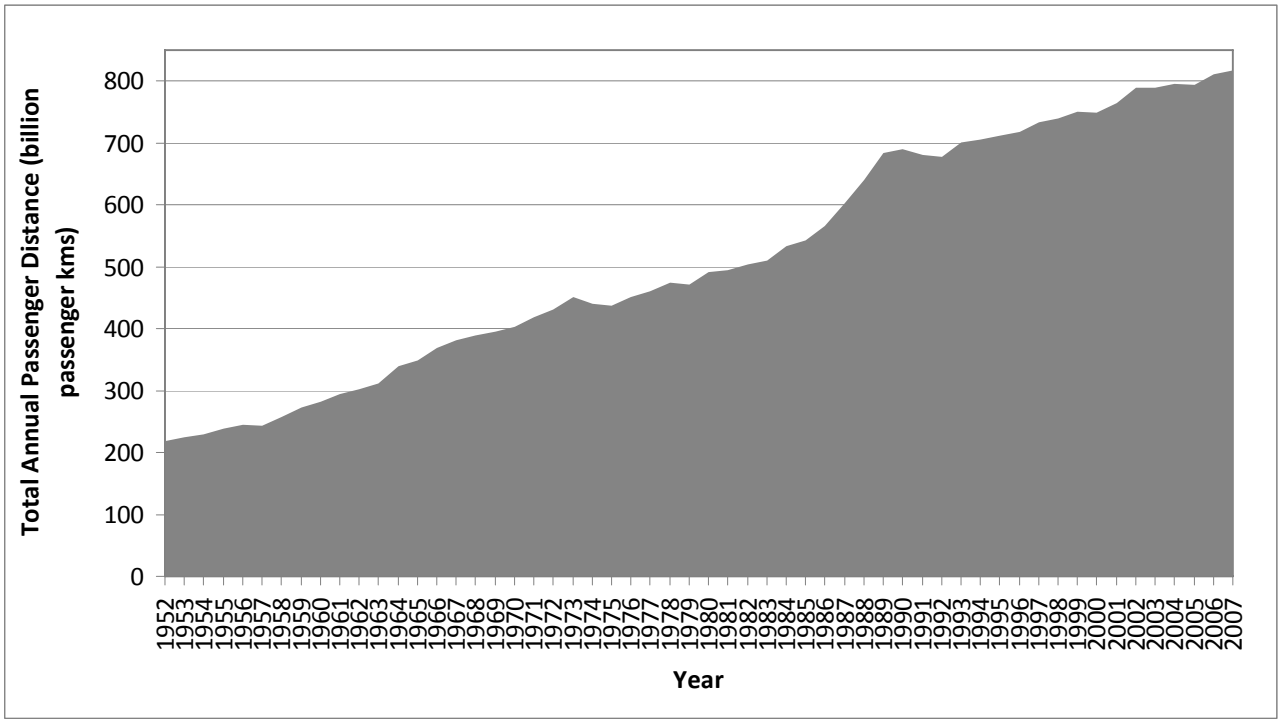
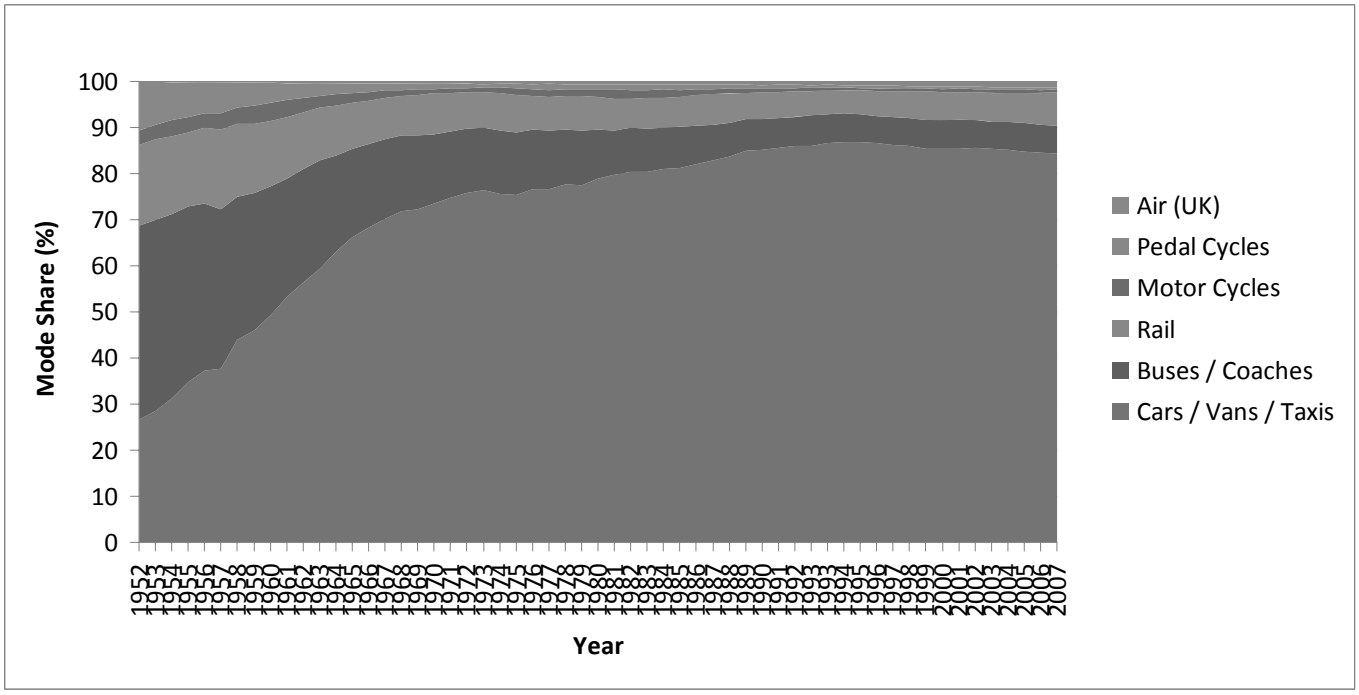


Figure 9. Changes to Mode Share (Distance) – 1952-2007



(Source: Transport Statistics Great Britain, 1952-2006 - DfT, 2008)

3.2 Great Britain Analysis: Bi-Variate

The dataset used in the analysis is the National Travel Survey (NTS) (DfT, combined data 2002-06). The NTS is useful in monitoring long-term changes in travel patterns. Individuals in sampled households are interviewed face-to-face to collect personal information, such as age, gender, working status, car access and driving licence holding. The data is based on a seven day travel diary. This provides details of trips undertaken, including purpose, method of travel, time of day and trip length.

The analysis below illustrates a number of the bi-variate relationships evident between urban structure and travel. As discussed in some of the recent academic literature, the likelihood is that relationships are rather more complex (multi-variate) and two-way. The final part of the work therefore develops some multi-variate analysis, including controlling for socio-economic and attitudinal aspects (where the datasets allow). Most outputs are given at Government Office Region.

Data analysis draws from a basket of **urban structure** characteristics:

- Residential population density;
- Settlement size/type;
- Accessibility (household accessibility to services).

Socio-economic and **attitudinal** characteristics:

- Individual characteristics (age, sex) and household characteristics e.g. household structure and income.
- Typical cohorts within the population based upon NTS attitudinal questions.

The following **transport variables** are examined to provide an analysis of the "dependent" travel behaviour:

- Average annual passenger miles by mode of travel;
- Average annual passenger trips by mode of travel;

Population Density and Annual Average Distance Travelled (Figure 10 – NTS, 2006)

- Great Britain: car drivers average 3,660 miles per annum (51% mode share); relative to an average density of 2.5 persons per hectare;
- London: a lower average distance by car at 1,876 miles per annum (35% mode share); relative to a higher average density of 46 persons per hectare;
- South East, East of England and South West: the highest average distance by car at 4,489 miles per annum (53% mode share), 4,448 miles per annum (54% mode share) and 4,311 miles miles per annum (53% mode share); relative to a lower average density of 4.2, 2.8 and 2.1 persons per hectare.

Population Density and Annual Average Trips Travelled (Figure 11 – NTS, 2006)

- Great Britain: individuals average 1,037 trips per annum, with car drivers 430 trips; relative to an average density of 2.5 persons per hectare;
- All Government Office Regions: average a similar number of total trips per annum, with the clear exception of London at 897 total trips and 252 car trips per annum.

Population Density Band and Annual Average Distance Travelled (Figure 12 – NTS, aggregate 2002-06)

- Broadly an inverse linear relationship, where increased density is associated with reduced travel distance, particularly by car. Distance by public transport increases with density, particularly over 30 persons per hectare;
- Walking distance is similar over all distances except the highest – over 50 persons per hectare.

Population Density Band and Annual Average Trips Travelled (Figure 13 – NTS, aggregate 2002-06)

- There is some differential by density band, but mostly reflecting trip mode share rather than total trips; the 0-1 persons/ha cohort deserves further analysis (the low number of trips is possibly a result of extremely low density/remote areas generating a low trip rate);
- Less car-based trips are evident at the higher density bands, and these are offset by increased public transport, walk and cycle trips.

Area Type and Annual Average Distance Travelled (Figure 14 – NTS, aggregate 2002-06)

- The largest differential is between inner London (an average of 4,673 miles per annum) and rural areas (an average of 9,806 miles per annum);
- Outer London performs more like the other metropolitan areas in terms of average distance travelled;
- The highest average distances travelled (in non-rural areas) are in the non-metropolitan urban areas, particularly those with a population of under 25,000. There is (broadly) a weak inverse linear relationship within the urban area category with increased average distance travelled as settlement size decreases.

Area Type and Annual Average Trips Travelled (Figure 15 – NTS, aggregate 2002-06)

- Again, the average number of trips shows less differential; there are broadly the same number of trips by area type. The only exception is inner London with a reduced number of trips, particularly by car.

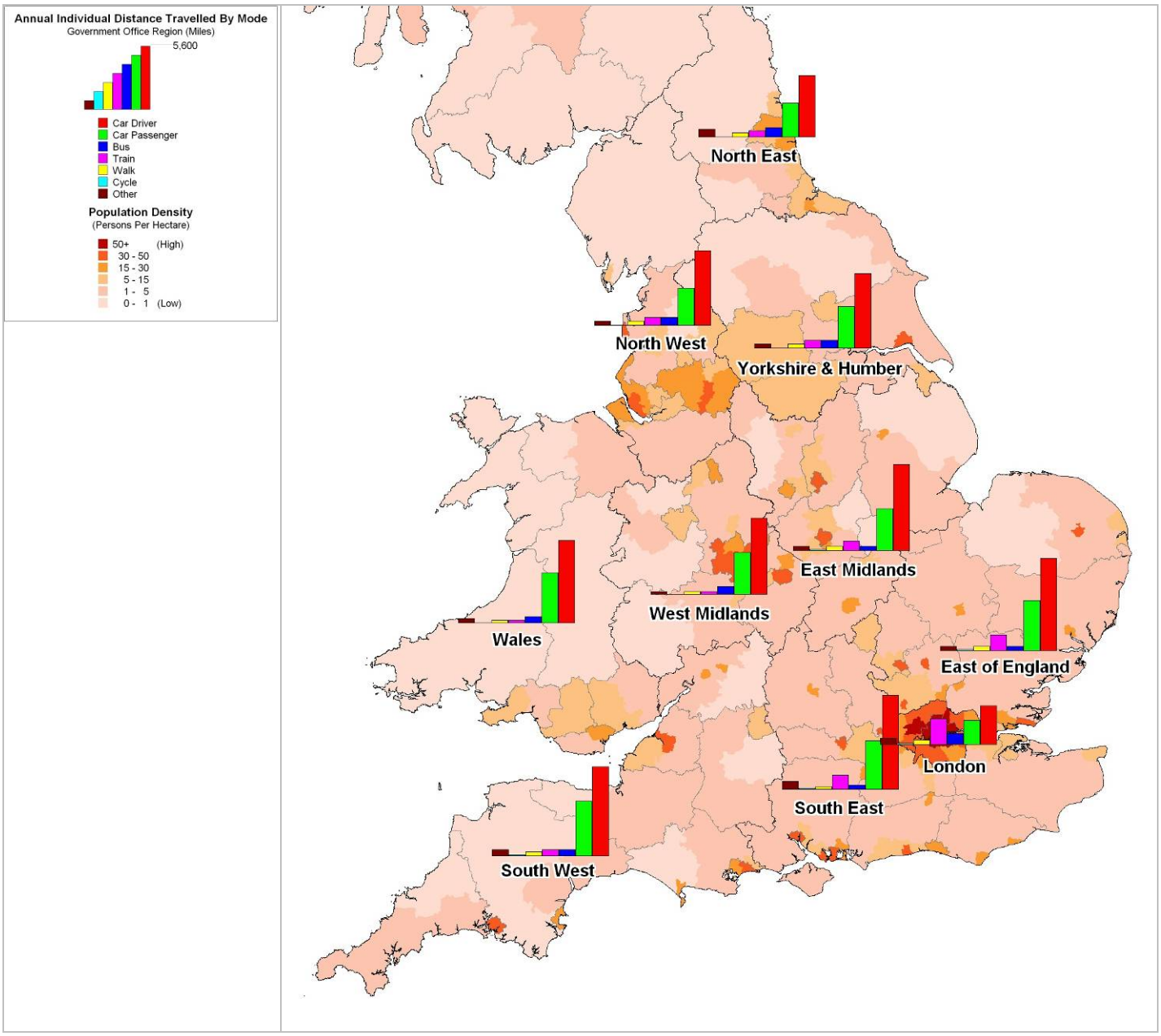
Public Transport Accessibility and Annual Average Distance Travelled (Figure 18 - NTS aggregate 2002-2006).

- Average annual travel distances reduce as public transport accessibility (accessibility to a composite of key services) increases over the 70% threshold, with the exception of remote areas with poor accessibility where travel distances are also relatively low. Areas with very good levels of accessibility (over 80%) have lower levels of car use and higher proportions of public transport, walking and cycling.
- Individuals resident in areas with the lowest levels of public transport accessibility to key services have amongst the lowest annual travel distances (6,838 miles per annum England) and relative mode shares of bus and train travel (10%) with accompanying high levels of car related travel (82%). For regions with the highest levels of public transport accessibility to key services the relative mode share of bus and train travel is highest (26%) with the corresponding mode share of car related travel being lowest (65%).

Public Transport Accessibility and Annual Average Trips Travelled (Figure 19 - NTS aggregate 2002-2006).

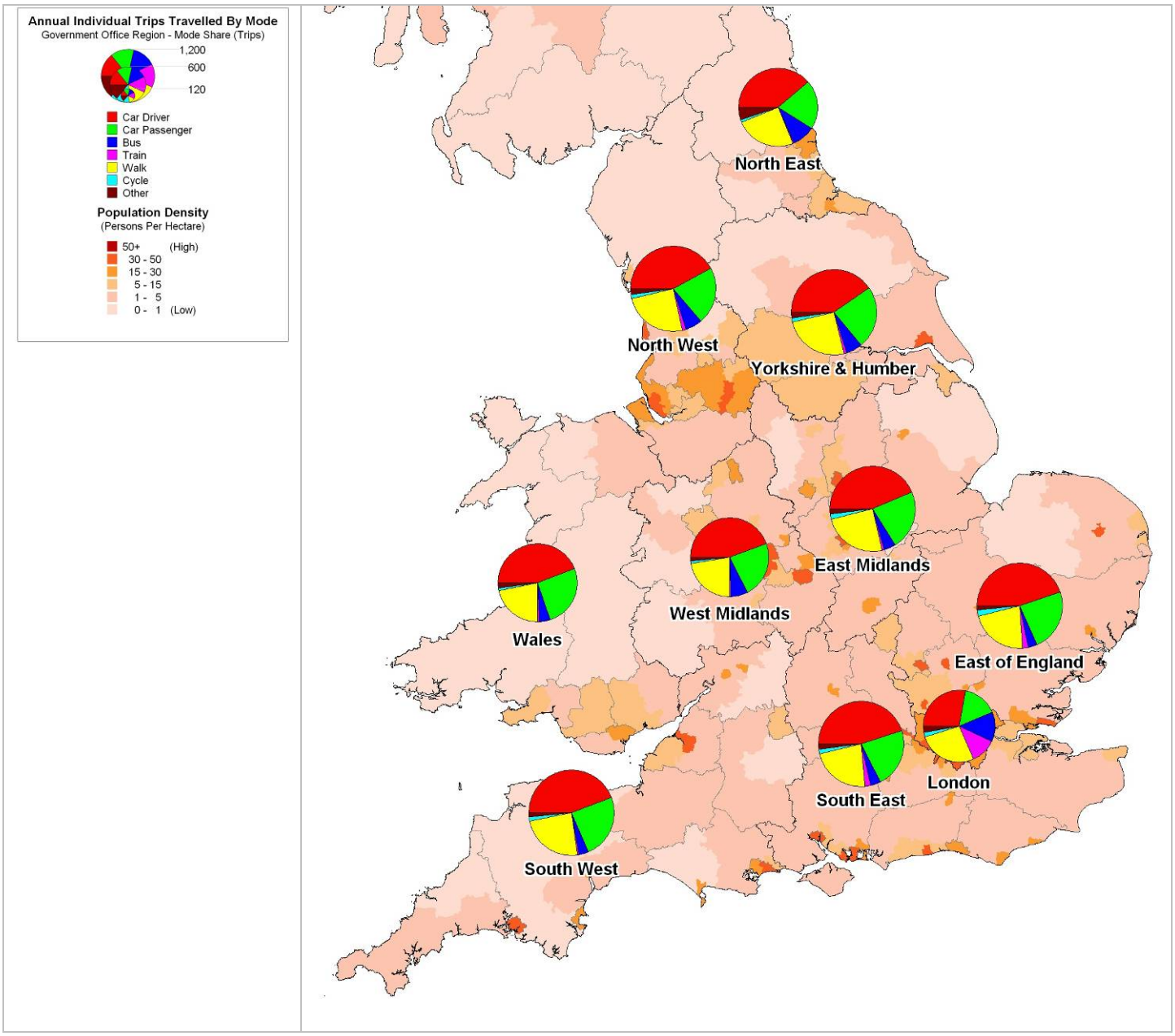
- As public transport accessibility increases the absolute number and relative mode share of public transport use (bus and train) increases in terms of the average number of trips made annually per year by the individual. Again, individuals resident in areas with the lowest levels of public transport accessibility have the lowest annual trip rates (1,002 trips per annum), lowest mode shares of bus and train (6%) with accompanying high levels of car related travel (63%).
- For regions with the highest levels of public transport accessibility to key services the relative mode share of bus and train trips is highest (20%) with the corresponding mode share of car related travel being lowest (50%).

Figure 10. Population Density and Annual Individual Distance Travelled by Mode (Miles)



(Source: NTS 2006 and Census 2001)

Figure 11. Population Density and Annual Individual Trips Travelled by Mode – Mode Share (Trips)



(Source: NTS 2006 and Census 2001)

Figure 12. Average Distance Travelled Annually Per Individual by Population Density Band (Great Britain, 2002-2006)

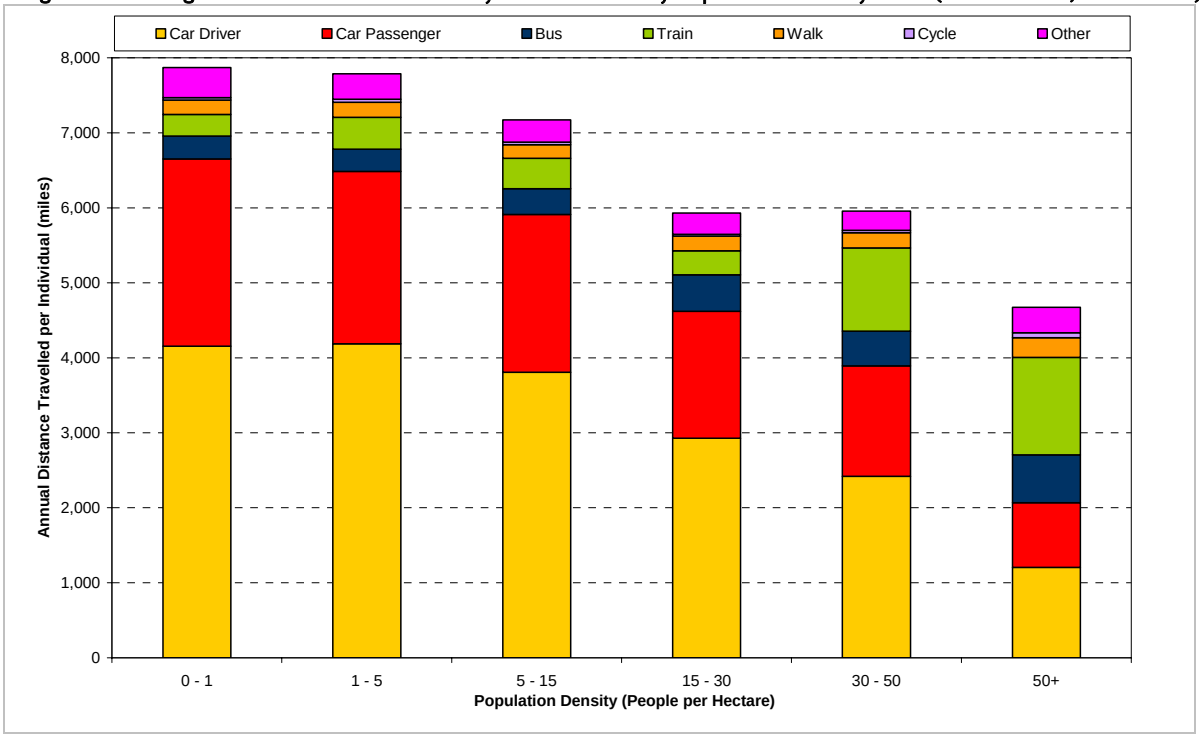
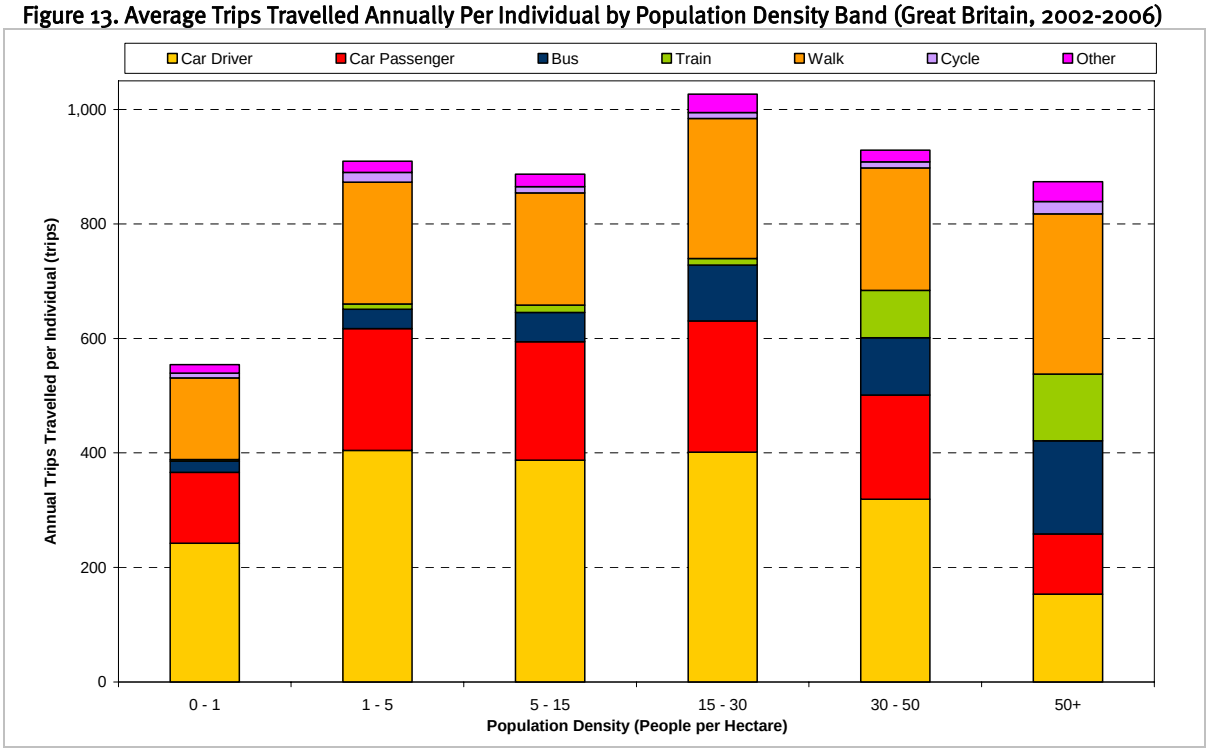


Figure 13. Average Trips Travelled Annually Per Individual by Population Density Band (Great Britain, 2002-2006)



(Source: NTS aggregate 2002/06 and Census 2001)

Figure 14. Average Distance Travelled Annually Per Individual by Area Type - 2002-2006 (Great Britain, 2002-2006)

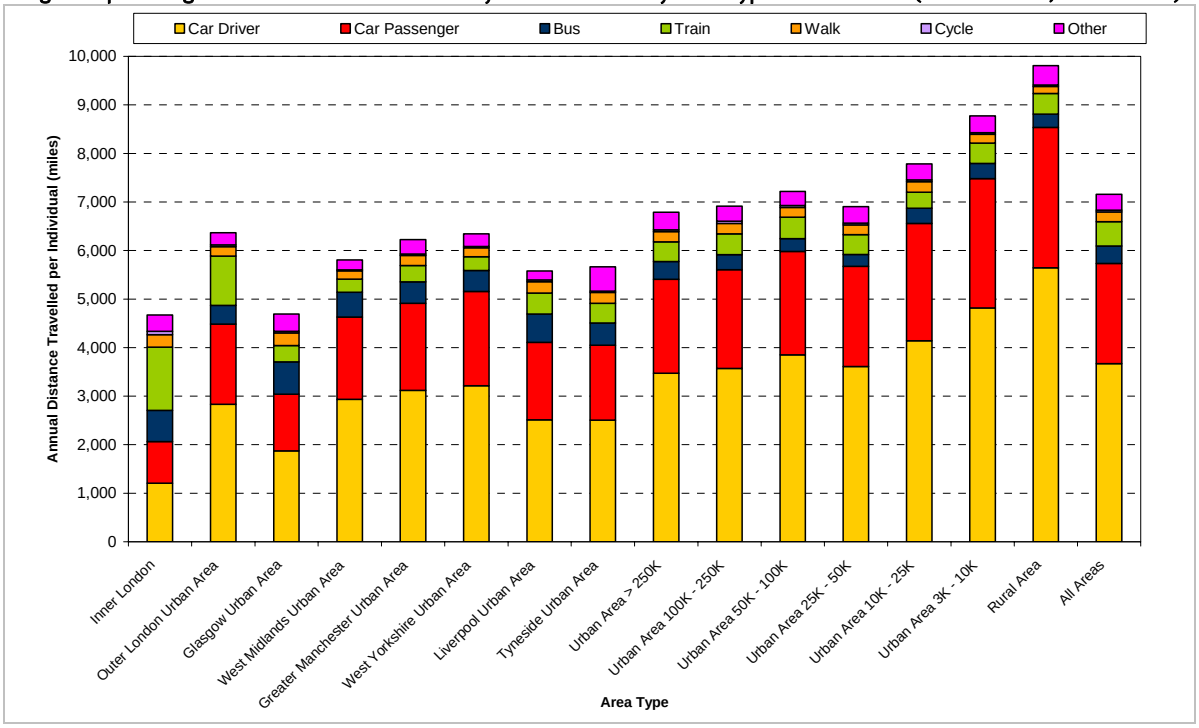
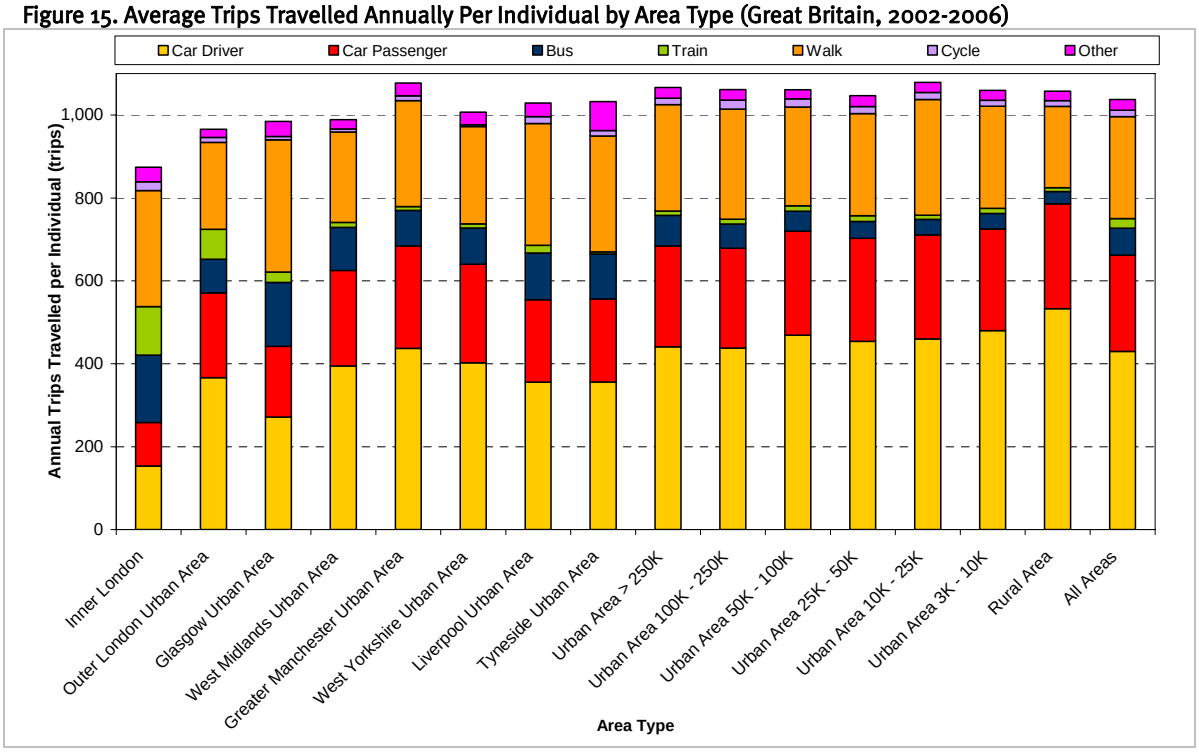
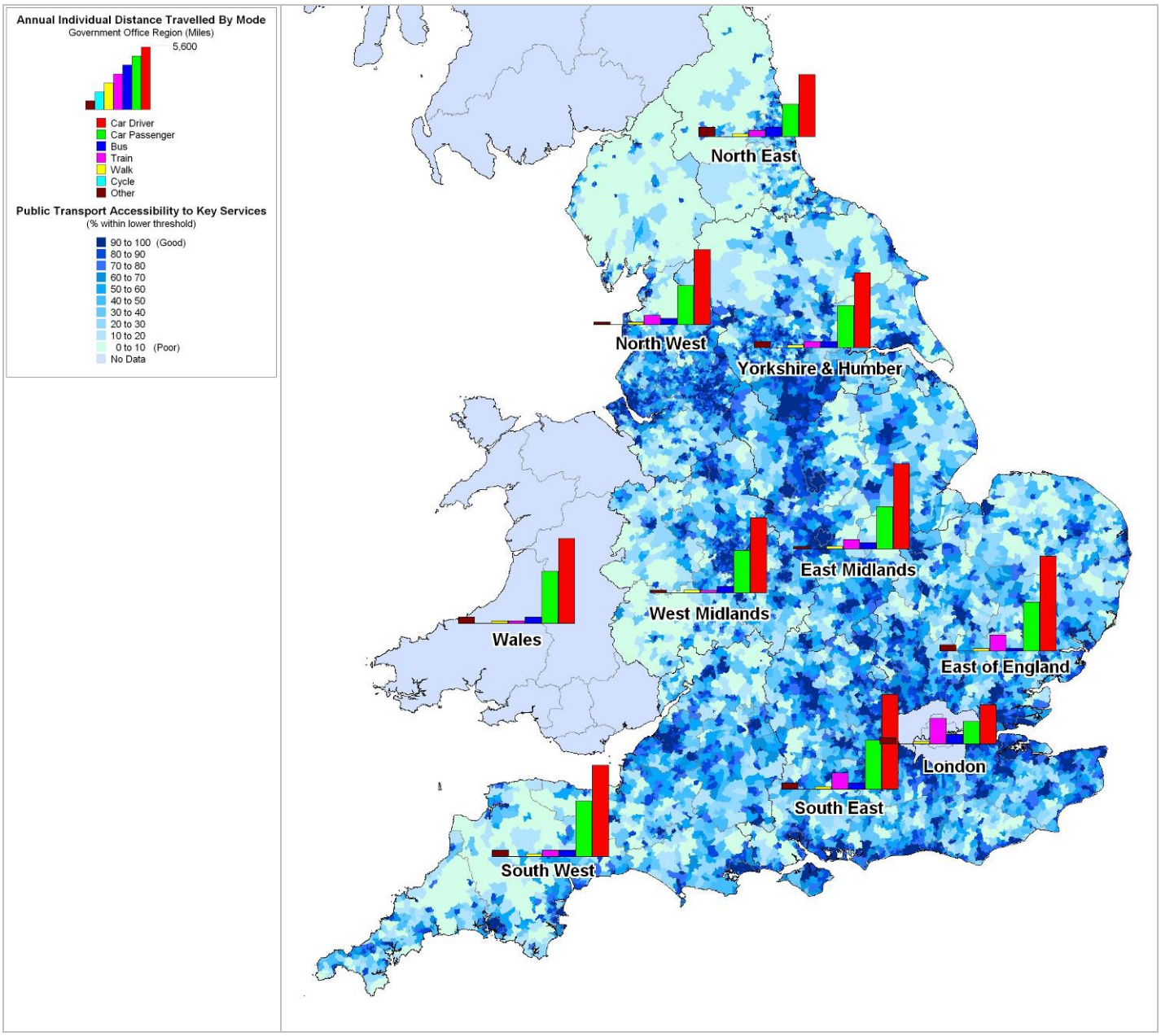


Figure 15. Average Trips Travelled Annually Per Individual by Area Type (Great Britain, 2002-2006)



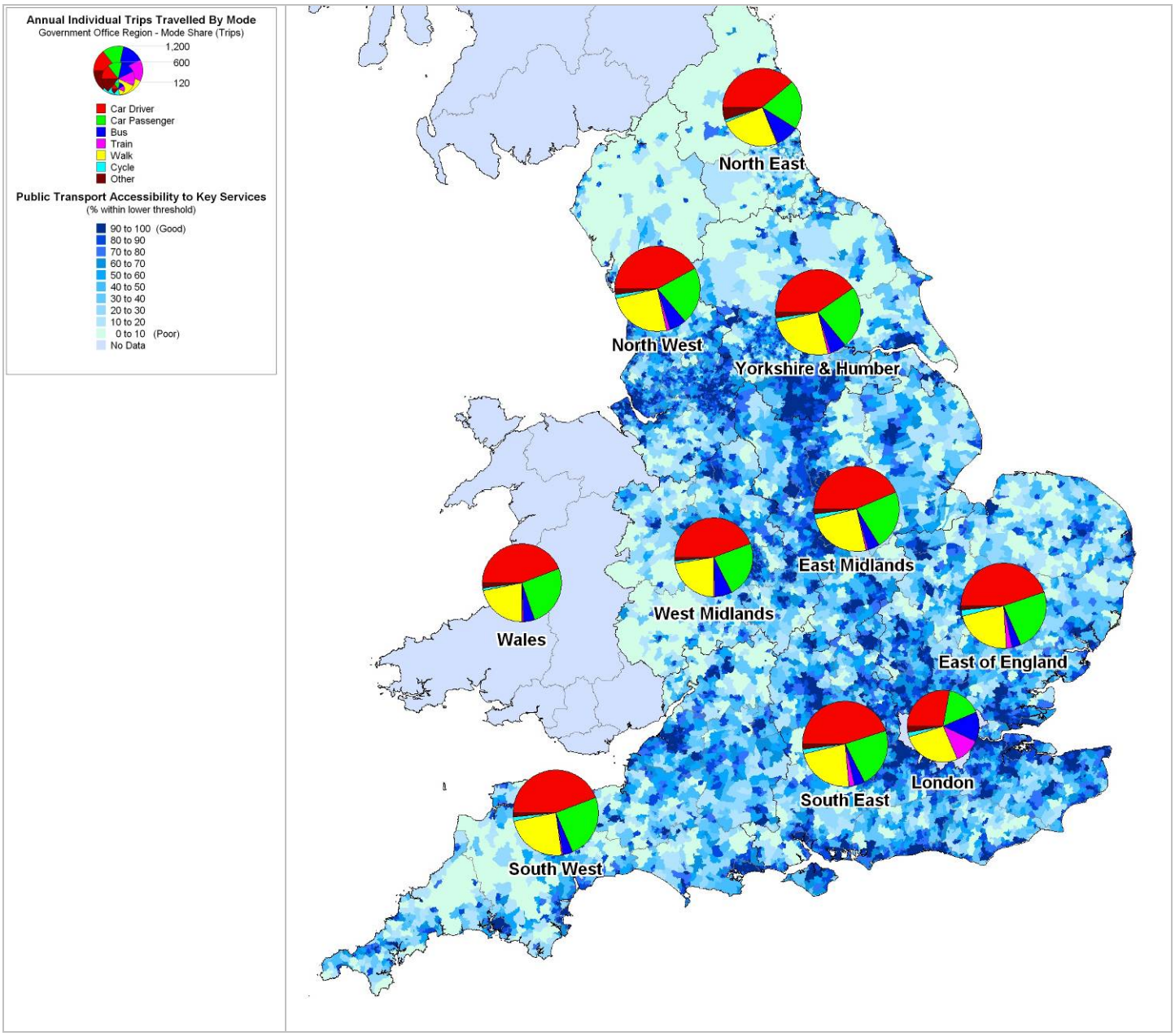
(Source: NTS aggregate 2002/06 and Census 2001)

Figure 16. Public Transport Accessibility to Key Services and Annual Individual Distance Travelled by Mode (Miles)



(Source: DfT National Core Accessibility Indicators, 2004; NTS, 2006)

Figure 17. Public Transport Accessibility to Key Services and Annual Individual Trips Travelled by Mode



(Source: DfT National Core Accessibility Indicators 2004; NTS, 2006)

Figure 18. Average Distance Travelled Annually Per Individual by Accessibility Band (England, 2002-2006)

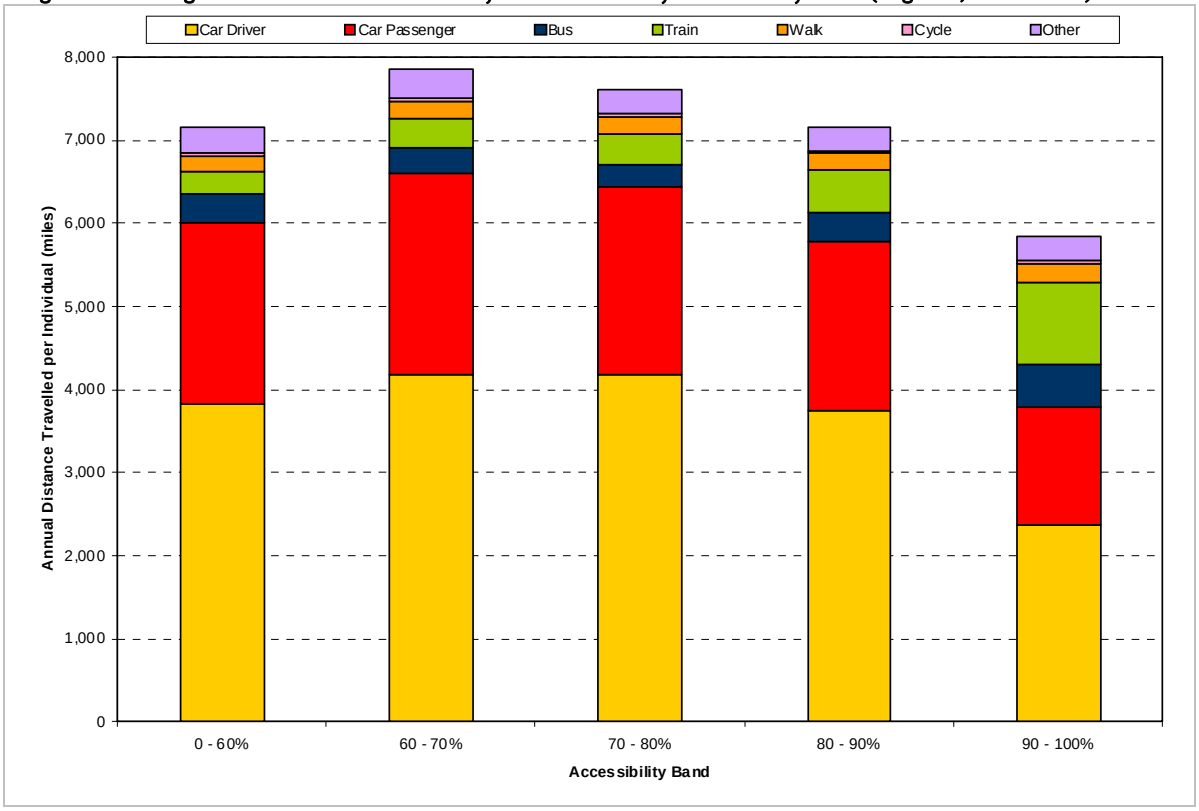
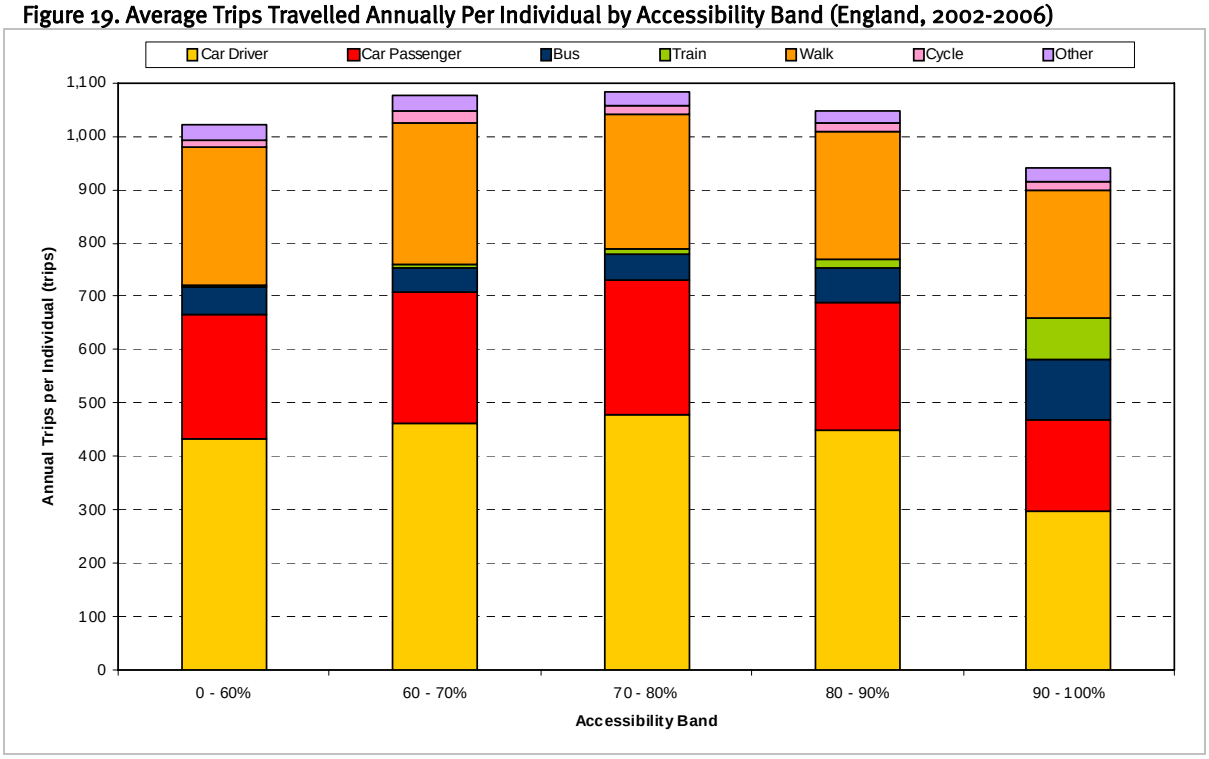


Figure 19. Average Trips Travelled Annually Per Individual by Accessibility Band (England, 2002-2006)



(Source: DfT National Core Accessibility Indicators 2004; NTS, 2002-06)

3.3 Great Britain Analysis: Multi-Variate

Multi-variate analysis is given in Table 3 to highlight how the range and combination of urban structure, socio-economic and attitudinal variables contribute to changes in travel. Again the NTS is used, with aggregate data 2002-06.

Travel distance is expressed as a function of land use, journey type and socio-economic characteristics. Where possible (given the non-continuous nature of some of the variables) natural logs were taken to allow for direct elasticities to be estimated.

Reflecting the analysis of Stead (2001), many of the land use and socio-economic variables are significantly correlated with journey distance. Land use characteristics (settlement size, population density, public transport accessibility, jobs-housing ratio) account for 11% of the variation in travel distance. Socio-economic characteristics account for 3% of the variation in travel distance.

The range of effect is measured by estimating separate regressions for each of the variable types, excluding all other variables. This leads to four separate R^2 values, three for the restricted models: land-use (R^2_{R1}), journey type (R^2_{R2}) and socio-economic (R^2_{R3}) as well as one for the unrestricted model (R^2_{UR}).

Table 3. Linear Regression Outputs

Variable	General Model		Journey Variables	Land Use Variables	Socio-Economic Variables
City, 50-250k	-0.038	***		☑	
City, 25-50k	-0.040	***		☑	
City, 25k or less	0.119	***		☑	
County population density	0.001			☑	
Public transport accessibility	0.004	***		☑	
Income	0.203	***			☑
Sex (female)	-0.145	***			☑
Jobs-to-housing ratio	0.131	***		☑	
Journey made by car	0.448	***	☑		
Car access	-0.065	***			☑
Business trip	0.423	***	☑		
Education trip	-0.529	***	☑		
Escort education trip	-0.930	***	☑		
Shopping trip	-0.386	***	☑		
Other escort trip	-0.509	***	☑		
Other personal business trip	-0.491	***	☑		
Visit friends at private home trip	-0.161	***	☑		
Visit friends elsewhere trip	-0.226	***	☑		
Entertain/public activity trip	-0.211	***	☑		
Sport participate trip	-0.347	***	☑		
Holiday base trip	1.159	***	☑		
Day trip	0.195	***	☑		
Year	0.010	***			☑
Constant	6.742	***			
Adjusted R-squared	0.125		0.006	0.110	0.033
Observations	1,292,333				
Range of effect *(contribution)*					
Min			0.000	0.086	0.010
Max			0.006	0.110	0.033

Notes:

***=Significant at 1%, **=Significant at 5%, *=significant at 10%

Base is 'other trip' in city of population >250k

4 Case Studies

4.1 Introduction

An important part of the study is to further understand the level of practical application in integrating land use and transport planning, and potentially using settlement structure to manage the demand for travel. This has involved a number of practitioner interviews at a selection of case study locations.

These have been used to review the adequacy of existing guidance on this issue, identify best practice examples, identify the barriers that may be hindering better decision making and explore possible solutions to overcome these barriers. A number of case studies (Table 4) are developed below, as agreed with the CfIT Working Group.

The investigation consisted of a series of interviews with local authority members and officers, with a limited amount of familiarisation and follow-up work by the project team in terms of associated planning documentation.

We would like to thank the interviewees for giving their time to the project and for the open and constructive manner in which they participated.

A workshop also discussed the emerging findings from the practitioner interviews and wider study. This was held at Oxford Brookes University on 7 November 2008.

Table 4. Case Study Locations

Scale	Range of Options	Case Study
Regional	9 English regions	(1) North East
Metropolitan Area/City Region	7 metropolitan areas	(2) Greater Manchester
Growth Area	4 Growth Areas	(3) Milton Keynes/South Midlands
Growth Point	29 Growth Points	(4) Oxford/Didcot (5) Plymouth/Sherford
Large brownfield site, previous traditional industrial area	Various	(6) Birmingham/Longbridge
Smaller scale planned new communities/eco towns (proposed)	Various self standing new community proposals/ 10 shortlisted eco town proposals	(7) Cambridge/Northstowe
Rural	Various	(8) Generic rural experience

It is worth noting here that the interview findings are not likely to be representative of experience across England. They are likely to illustrate the better areas of practice. For example, the areas discussed represent the growth areas and places with development aspirations. It is arguably these areas that attract the better quality practitioners/greater funding. Also, there is likely to be some form of 'self selection' in the people who responded to our invitation to an interview – again these are likely to be the people interested, and most knowledgeable, on this topic.

It was interesting that the land use/transport interaction topic often did not chime clearly with their main areas of work and/or concern. This was because their spread of responsibilities embraced a much wider range of subjects of which transport was only a part and – arguably correctly – a 'subordinate' or facilitating role at that. In this context issues of land use/transport interaction, other than in a very generalised sense, were essentially regarded as sideline 'technical' matters.

With this study, the case studies are used to generate conclusions and recommendations which reflect 'contemporary practice' in a variety of situations across the country. Our case studies embody differences along several dimensions, notably:

- Regionally – implying broad socio-economic and geographical differences;
- Spatial level – from regional and conurbation through to county, district and specific major developments;
- Geographical setting – established settlement pattern, relative settlement sizes and socio-economic characteristics, existence of motorways and other major transport features;
- Planning objectives – the nature of dominant planning objectives (economic regeneration, housing growth, countryside protection, etc);
- Planning process – the extent to which the statutory planning process has been progressed to provide a policy base for negotiations with individual developers;
- Transport proposals – the nature of any major proposals already in the pipeline (given the long time period over which planning and delivery takes place and the degree of competition for funding);
- Level of staffing – the scale of professional resource which is available and the experience of the individuals directly involved.

In addition, as noted above, the perspective taken on any particular set of conditions will vary according to the role of our interviewee(s) – whether politician or professional and, amongst the latter, whether a strategic planner, development control planner, transport analyst, etc.

Even in the selected case study areas our investigations have necessarily been very brief. Typically any particular planning exercise carries with it a vast catalogue of negotiation and documentation which would ideally require a research project of its own to explore fully. Given the complexity of the subject-matter and the practical constraints of the project it is inevitable that the 'evidence' on which we are basing our conclusions is derived in a rather heuristic manner. It cannot consist of definitive and verifiable 'results', but rather reports and interpretations of the information which our interviewees chose to give us. The exercise is better viewed as the testing of a series of previously generated propositions and in practice the line of questioning pursued in much of the interviewing was geared to this end.

4.2 Case Study 1: North East

The North East region of England, one of 9 English regional authorities, is selected as an example of regional efforts to integrate urban planning and transport. It includes a number of interesting dimensions to the debate:

- The influence of transport in allocating new growth, for example through the recent Regional Spatial Strategy (RSS);
- Effectiveness of integrating the Regional Transport Strategy (RTS) and RSS and ease of working together for spatial planners and transport planners;
- Potential impact of a change in regional planning responsibilities (i.e. Regional Development Agencies (RDAs) now jointly responsible with Leaders Board to prepare single Regional Strategies from 2010 onwards) on the extent to which transport considerations influence land-use decisions;
- Impact of new Multi-Area Agreement (MAA) funding in the Tees Valley, which provides the ability to plan transport initiatives over a wider area, on decisions about the location of new development and ensuing influence on travel behaviour.

Key Development/Strategy Discussed

The major project discussed in this case study is North East of England RSS[2], as adopted in July 2008 (North East Assembly/DCLG). It incorporates the RTS and sets a broad development strategy for the region to 2021.

Table 5. Key Statistics for North East of England

Metric	North East	England
Resident population size	2,515,442	49,138,831
Population density (people per hectare)	2.93	3.77
Accessibility ranking	53.8%	78.4%
% journey to work by car	64%	61%
% journey to work over 10km	26%	28%
% traffic growth (1997-2007)	15%	14%
Transport CO2 emissions, tonnes per person	1.92	2.25

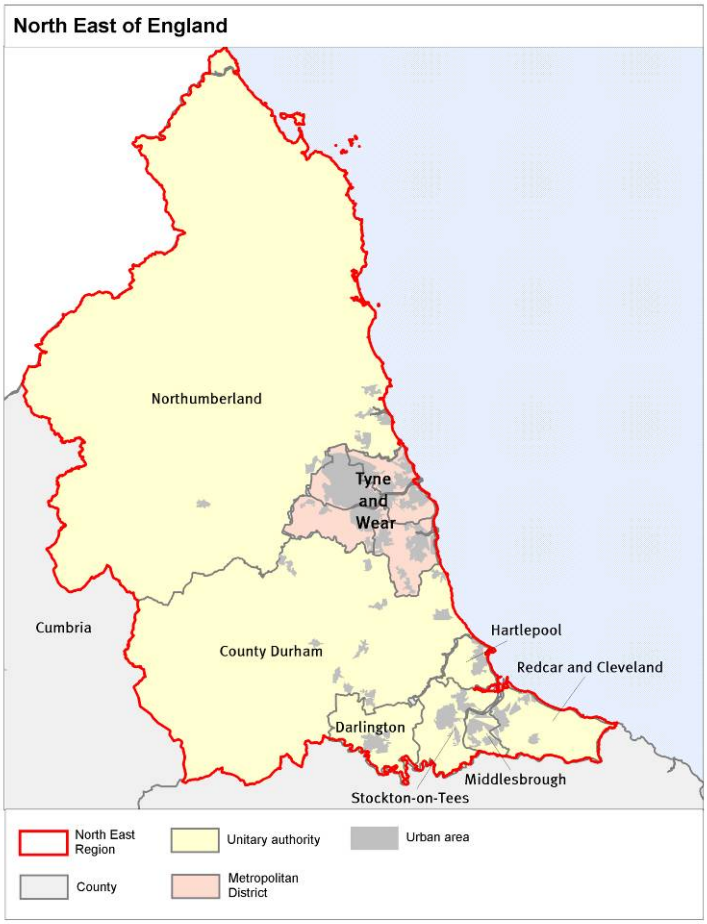
Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.

The Northern Development Area (Great North Park) in Newcastle is also used as an example of the challenges of delivering on integrated land use and transport planning in the region.

Currently, the local authorities, new Regional Planning Body (ANEC) and RDA are working together to implement the RSS and to support sub-regional planning in the North East (e.g. co-location of ANEC staff in the RDA). The Northern Development Area has been partly built out with new housing and an employment area.

2 More details on the North East RSS can be found at www.northeastassembly.gov.uk/rss

Figure 20. North East Case Study Area



Interview Findings: Current Practice and Lessons Learnt

Practitioners in the North East expressed concern that the RTS is not particularly well integrated with the spatial strategy in the RSS. Transport projects listed in the RTS/RSS are not well prioritised, making it difficult to for local authorities to obtain funding from the Department for Transport (DfT). A more focused and evidence-based approach would help to determine transport priorities and key challenges in the North East. The Regional Funding Allocation (RFA) process will require local authorities and other key regional bodies to make decisions about priority investments.

Practitioners acknowledged that exurban drift is a reality in the North East with office and housing development moving out of cities and other urban areas. The existing complex spatial structure does not fit well with sustainable transport, with the exception of some urban areas (i.e. around the Metro in Newcastle). Car ownership rates are low compared to the rest of the country but few 'real' congestion points on the existing road network facilitates car-based commuting and encourages more exurban drift.

Nonetheless, the importance of increasing public transport in city-regions is being discussed, particularly in the context of its contribution to agglomeration economies. Newcastle-Gateshead, in particular, would stand to benefit from this policy direction.

The North East case illustrates that working at the city-region and sub-regional level is an effective way (despite some difficulties) to achieve better integration between spatial and transport policy – strategic decisions can be made. For example, county boroughs in the Tees Valley are working mutually to develop sub-regional transport strategies, which have helped to secure integrated blocks of Multi-Area Agreement (MAA) governmental funding. The local authorities in Tyne and Wear are also starting to move in the direction of integrated strategic planning. Both sub-regions are basing their analysis on travel to work areas and the Government appears interested in supporting this strategic scale of planning.

Thus, strategic planning units at the city or sub-regional level should be encouraged, provided sufficient staff capacity and skills can be built or maintained. Although sub-regional planning has "moved backwards" from the mid-1980s (e.g. "the bus did not compete with the Metro then"), the Tees Valley has maintained a level of awareness of integrated land use and transport planning because capacity was retained by keeping the Tees Valley strategy unit. This has provided the basis for more evidence-based

policy development and strategic planning than in other parts of the region.

Conversely, the impact of the loss of strategic planners and a strategic planning unit is evidenced in the Tyne and Wear sub-region, where individual authorities are sometimes in conflict and the capacity for strategic planning is low. One practitioner said that some local authorities seem to 'struggle' to produce Local Development Frameworks. Nonetheless, the Government appears committed to more integrated regional strategies and the RDA and new Leaders Board contributing to professional expertise in this area.

Project delivery is a key challenge to achieving development patterns that reflect the principles of integrated land use and transport planning. The Northern Development Area in Newcastle is an example of an attempt to encourage growth in the city. However, nearby Green Belt areas were released as part of the development plan and the controversial project made national media headlines. The development proposals were marketed on the quality of the development, for example design, sustainable transport, and so on, but another key driver was that Sage (the only FTSE100 employer in the area) wanted to locate its headquarters in the new development. At present, the standard of delivery is below the level of sustainability and quality that had been planned; and Sage is the main employer.

Process/Governance

Practitioners felt that there is a good relationship between the RDA and ANEC. Moreover, there is support for a regional-level strategy, but less support for the RDA as a planning authority. It is intended that the Regional Leaders Forum will provide a Government mechanism for greater integration in strategy and preparations have begun for this transition. It was also noted that there is tension between the regional and sub-regional level but good relationships help to move agendas forward.

Economic development is widely accepted as the key issue to be tackled in the North East, often seen as more important than environmental or social objectives. Nonetheless, the RSS has been criticised for aiming for an aspirational level of economic growth with the danger of undermining the local environment and sustainable travel patterns.

Housing is seen by local authorities as critical to their survival. Attempts to plan housing in a more integrated way are met with resistance by local authorities. Thus, there is pressure to disperse housing development throughout the region. During the RSS process, the RA sought to seriously limit housing provision and concentrate it in the urban cores. This policy direction was supported by the conurbations but led to strong political resistance from the County areas Northumberland and Durham; the RA eventually softened its approach.

Similarly, five 'growth points' were recently approved in the North East, but the competition for new housing to support local economies appears to have resulted in a less integrated and focused outcome.

Summary of Key Issues

- The region has a relatively high proportion of journeys to work by car (64%) and rate of traffic growth between 1997-2007 (15%). Transport CO_2 emissions per person are relatively low at 1.92 tonnes per person. Sustainable travel behaviour would represent a real 'trend break' considering current 'business as usual' future trajectories.
- The difficulty, however, is that travel impacts are given insufficient weight as a major priority in relation to the housing and economic development agendas, and wider facilities (health

and education). Potential travel impacts have had minimal impact on the allocation of new growth, which has generally been politically driven, and very much influenced by economic development aspirations.

- The integration of the RTS and RSS into a single document has not led to significant progress on integrated land use and transport planning in the region. However, sub-regional strategic transport planning based on travel to work areas may lead to a limited better integration.
- While there is generally support for regional planning in the North East as well as for the economic development role of the RDA, support for the RDA as a regional planning authority is less evident.
- MAA funding certainly provides the basis for more integrated transport planning (in terms of prioritising funding) but it is not clear as to the extent to which this will influence the spatial allocation of growth or the integration between development aspirations and transport investment.

4.3 Case Study 2: Greater Manchester

The Greater Manchester area, one of 7 metropolitan areas in England, is selected as a case study to illustrate the integration of urban planning and transport in a major urban conglomeration. The following issues are discussed:

- Major planned transport investment through the recent Transport Investment Fund (TIF), including how land use been taken into account in planning for public transport improvements and congestion charging (e.g. supportive higher densities in transport corridors);
- Planners and transport planners working across borough boundaries as part of a city-region;
- The influence of transport in allocating new growth across the conurbation; local design and layout issues within high profile regeneration areas and within the existing urban fabric.

Key Development/Strategy Discussed

The focus of discussion is the TIF bid package which had been submitted by the Association of Greater Manchester Authorities (AGMA) to the Department of Transport and which received approval for Programme Entry status in June 2008[3]. The package was subsequently rejected by a local referendum in December 2008. This contained a congestion charging proposal based on two cordons - one in the vicinity of the M60 (encircling the built-up area of Manchester within the core of the conurbation) and one around the Inner Ring Road around Manchester city centre.

3 More details on the TIF bid can be found at www.gmfuturetransport.co.uk

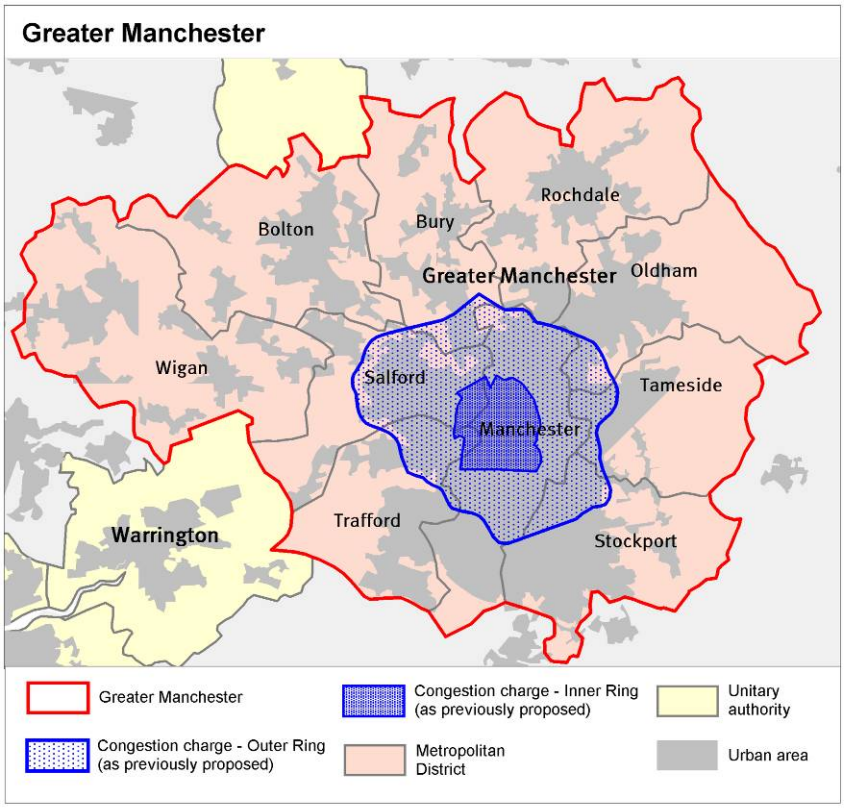
Table 6. Key Statistics for Greater Manchester

Metric	Greater Manchester	England
Resident population size	2,482,328	49,138,831
Population density (people per hectare)	19.45	3.77
Accessibility ranking	82.8%	78.4%
% journey to work by car	65%	61%
% journey to work over 10km	15%	28%
% traffic growth (1997-2007)	14%	14%
Transport CO2 emissions, tonnes per person	1.84	2.25

Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.

The charging scheme would have operated in the morning peak period inbound and evening peak outbound only, reflecting the majority of traffic flow and congestion. Although a charging scheme is a necessary part of the requirements set by DfT for TIF bids, the AGMA strategy was notable for setting this in a much wider context. The scheme was seen as a major opportunity for public transport investment in the conurbation as a whole, which in turn was linked to broader economic, social and environmental objectives. Overall the package represented £2.8bn of investment, with 80% of the public transport component being operational in advance of congestion charging. The public transport investment included additional sections of the Metrolink tram network, capacity increases in local rail services, a restructured pattern of bus services, additional park and ride spaces, plus improved interchange, ticketing and information facilities.

Figure 21. Greater Manchester Case Study Area



Interview Findings: Current Practice and Lessons Learnt

The context for the AGMA proposal was framed by the 'Northern Way' Strategy (Northwest Regional Development Agency, One North East, Yorkshire Forward, 2004) and its emphasis on city regions as drivers of economic growth. Within the Greater Manchester conurbation this had been interpreted a City Region Development Programme (CRDP), which sought to build upon the city region's ongoing process of internal restructuring from a series of separate former industrial towns to an internationally competitive city region drawing on a range of agglomeration advantages. The growth strategy is likely to result in increasing average trip lengths as part of the renewal, notwithstanding efforts to secure local employment opportunities.

Inner Manchester and central Salford are seen as occupying a critical role as the regional centre and a representative proportion of the transport strategy was directed at serving (and managing) radial movements to and from its commercial core. The strategy embodied a corridor planning approach based on 15 radials, each of which contains a major public transport facility – rail, tram or bus rapid transit. These together with ancillary improvements in feeder routes, interchanges, etc., would have provided a marked change in the alternatives available to people faced with the congestion charge.

However AGMA's strategy was not based solely on congestion management in order to further economic prospects within the conurbation core. Local practitioners highlighted a degree of tension in this respect between DfT and local authorities' aspirations. AGMA's strategy reflects local

planning priorities over a wider area as part of a holistic approach (Note also that political support for the TIF proposal was also needed from all parts of the conurbation – see below). These priorities include improving accessibility from areas of significant deprivation as well as pursuing secondary economic benefits through a new focus on the conurbation's town centres. For example additional sections of the Oldham/Rochdale Metrolink line to take the service into the respective town centres are seen as an important statement of public commitment to these places which will support initiatives in economic regeneration and housing market renewal and help counter the imbalance which has set in over the last 10-15 years between the north and south of the conurbation.

The way in which the Greater Manchester package had been formulated resulted from the application of four tests:

1) There must be significant investment in public transport improvements where the charging scheme is proposed, and implemented prior to its implementation;
2) The measures must complement the competitiveness and inclusion priorities of the City Region and not undermine the competitiveness of the Regional Centre or the town centres in the area;
3) They must be widely accepted by both the public and the business community;
4) They must be relevant to where congestion exists or where it may emerge in future.

The agreed investment package reflected a combination of national (DfT) and local (city region) interests with £1.5bn being funded as grant from Central Government and £1.2bn as local borrowing set against future charging revenues (i.e. with local authorities taking the associated revenue risk) , with a further £100m then levered in from third party contributions.

Pending a local political decision on the TIF proposal the individual metropolitan councils are preparing Local Development Frameworks on the basis of scenarios with and without the public transport investment package.

Process/Governance

Over the last three years authorities within the Greater Manchester conurbation have come together to work on a development programme for the 'city region', although the commuting area extends beyond the conurbation into Lancashire, the High Peak (Derbyshire) and Cheshire. The core AGMA organisation comprises the 10 metropolitan district councils plus city region joint boards including the PTA. It was described as 'a mature model of cooperative working' with authorities collaborating to advance prospects for inward investment and to exert maximum influence on bodies such as the RDA. The Association's response to the Government's TIF invitation was offered as a further example of the city region demonstrating initiative and 'getting in early' to help shape the detail and reap maximum local benefit.

At a supporting level, AGMA operates through a Chief Executives' Steering Group and a number of Working Groups, including Transport. It has brokered the selection of a series of objectives which underlies a Multi-Area Agreement for the conurbation. There is also an LTP Steering Group (since a single LTP has to be produced for the conurbation) with an overlap of transport and planning officers up to Chief Officer level. In addition there are a number of working forums of planning officers across the conurbation working on LDFs.

Politically however AGMA has no independent authority. The charging proposal and the associated investment package represents an interesting case of a scheme which both in conception and implementation is necessarily conurbation-wide in scope but for which there is no

institution able to exercise ultimate conurbation-wide judgement. Instead AGMA is dependent on drawing together the individual decision-making of its constituent councils.

In developing the Greater Manchester package a transparent process was followed to ensure independent stewardship of the four tests listed earlier. An independent panel – the AGMA Test Review Group – was appointed made up of local business leaders and prominent transport and economic academics to assess options. The advice of this panel was reported in public to the AGMA Executive and the positive conclusion was a critical factor in its decision to submit the bid.

Nevertheless the proposal was finely balanced in terms of political support. For the scheme to have proceeded, this would have required approval by seven out of the ten councils. Three had registered their opposition, and non-binding public referenda were held within each council area a on a common question. The decisive outcome of this referendum in December 2008 ultimately shaped the decision by AGMA not to pursue the TIF bid further.

If the proposal had gone ahead, then it was expected that a series of partnerships would have been established in each of the radial corridors referred to above. These would have included representation from

- The PTA;
- Local council planners and highway engineers;
- Local regeneration agencies;
- Major trip generators.

The partnerships would have considered the detail of the investments to be included in each corridor, with the aim of ensuring that the right mix has been identified so as to secure maximum benefit. They would have also pursue the active promotion of travel plans which were seen as a key element of the TIF tool-kit, preparing organisations for the changing travel environment.

Summary of Key Issues

- The area has a relatively high proportion of journeys to work by car (65%), a UK-average rate of traffic growth between 1997-2007 (14%) and transport CO_2 emissions are also relatively low at 1.84 tonnes per person. Achieving sustainable travel behaviour is a huge challenge, yet the TIF bid and associated urban planning initiatives are illustrating what can be done at the metropolitan scale.
- Greater Manchester is a good example of authorities coming together to establish an administrative structure in which related economic, spatial and transport issues can be considered and responded to collectively across a conurbation.
- The driving force behind this is pre-eminently economic - a belief that common articulation of the area's needs and aspirations under a 'city-region' umbrella is of paramount importance if benefits are to be maximised.
- Nevertheless the coalition appears to be precarious politically and the TIF bid is an example of where, when collective decisions have to be made, the general interest may be threatened by individual authorities seeking to lever political or other specific advantage. The Local Transport Act may lead to more unified transport governance although at present this appears to be confined to the present administrative boundary of the conurbation.
- Within this geographical envelope the perspective of local authorities appears to be more comprehensive than that adopted by DfT or other

individual government departments. The view was expressed that if the overall objectives of the sub-national review were to be realised (in terms of delegating responsibility to individual city regions) this would require a drawing together of sometimes disparate departmental moves in this direction.

- If there is to be a fundamental recasting of governance at sub-regional level then this was suggested as the appropriate time for the planning framework to be modified. However the view was offered (drawing unfavourable comparison with the situation in London) that such changes would be of little value without a consistent, coherent and sustainable approach to the long term funding of transport in the city region.

4.4 Case Study 3: Milton Keynes/South Midlands

The Milton Keynes/South Midlands (MKSM)[4] area is one of four designated Growth Areas in England and comprises six administrative areas: Northamptonshire County Council, Bedford Borough Council, Central Bedfordshire Unitary Council, Luton Unitary Authority, Milton Keynes Unitary Authority and Aylesbury Vale District (in Buckinghamshire County). Buckinghamshire County Council also contributes to transport and highways issues. The area as a whole has been designated by National Government to deliver around 140,000 new dwellings by 2021. Key issues explored in this case study are:

- The influence of transport in allocating new growth across the sub-region;
- How planners and transport planners work together across authority boundaries (e.g. MKSM sub-regional strategy, and inter-regional boards); [Note previous CfIT research on this issue, 2006]
- Influence of transport in allocating new growth within and between towns in North Northamptonshire, including relationships between planners in districts and Local Delivery Vehicles, and transport planners in the Northamptonshire County Council;
- The application of policies when determining planning applications and the role of Members in decision making.

4 More details on MKSM can be found at: www.go-se.gov.uk/gose/ourRegion/growthAreas/mksmGrowth and www.mksm.org.uk

Table 7. Key Statistics for MKSM

Metric	MKSM*	England
Resident population	1,568,424	49,138,831
Population density (people per hectare)	3.26	3.77
Accessibility ranking	81.2%	78.4%
% journey to work by car	70%	61%
% journey to work over 10km	32%	28%
Traffic growth (1997-2007)	16%	14%
Transport CO2 emissions, tonnes per person	2.87	2.25

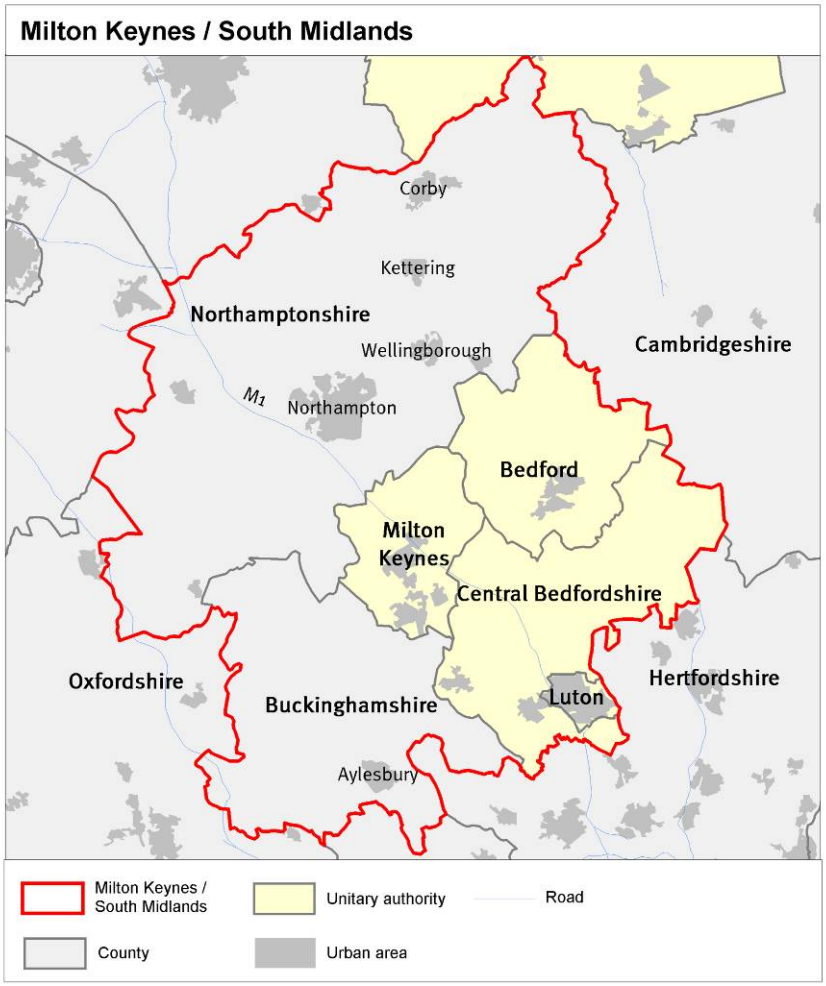
Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.
*Data for Northants/Beds/Luton/MK/Bucks.

Key Development/Strategy Discussed

The major planning strategy in this case study is the development of growth plans for MKSM (GOSE et al, MKSM Sub-Regional Strategy, 2005), but with reference to the North Northamptonshire Core Spatial Strategy (CSS) and the related issue of planning for growth in Northamptonshire.

North Northamptonshire is the adopted name for a sub-region of the MKSM growth area that includes the towns of Corby, Kettering, and Wellingborough and a number of smaller market towns. The Regional Spatial Strategy (RSS8) for the East Midlands that incorporates the Northamptonshire part of the MKSM Sub-Regional Strategy was adopted in 2005. The RSS requires that North Northamptonshire accommodate 52,100 new dwellings between 2001 and 2021, which will lead to a 30% increase in population.

Figure 22. MKSM Case Study Area



Much earlier analysis was carried out in attempting to develop a coherent regional strategy, including the MKSM Growth Study (Roger Tym and Partners, 2002) and a number of individual Growth Area Assessments.

The North Northamptonshire Joint Planning Unit (NNJPU) was established in 2004. The NNJPU is responsible for jointly producing the CSS that sets the framework for housing and employment growth in North Northamptonshire to 2021. A Joint Planning Committee includes member representation.

The broader challenge of planning for growth in Northamptonshire County is compared to the development experience in Luton and Buckinghamshire, and interviews in the three locations are used to assess governance issues across the MKSM growth area.

The North Northamptonshire CSS was adopted in June 2008, the first joint core strategy to be adopted. It sets ambitious targets for levels of economic growth and workforce development commensurate with housing growth, as well as regeneration of urban areas and (green) infrastructure development. A good working relationship has been established between the four local authorities (Corby, Kettering,

Wellingborough, and East Northamptonshire Councils) and the County Council. The West Northamptonshire Area is currently embarking on a similar joint planning process.

Interview Findings: Current Practice and Lessons Learnt

Northamptonshire County has written most of its strategic transport policy internally. Practitioners stated that documents and/or other resources summarising academic and good practice literature and key trends related to integrated land use and transport planning would have been helpful in developing the County's policy. The most helpful information for promoting sustainable transport policies would have been case studies of some depth (i.e. more than one page). Case study visits to other cities or towns in the UK or further afield would also help to educate politicians and practitioners with regards to integrated land use and transport planning. Understanding what has worked elsewhere, and why, and translating this to a particular context is a critical part of the work.

Practitioners in Buckinghamshire cited the Sustainable Travel Towns (STT) initiative as an excellent example demonstrating that significant change was achievable in 'ordinary' towns. Much of the previous good practice derives from historic urban areas and can tend to be less relevant for towns in the Midlands. Policy-making tends to be based on an understanding of good practice elsewhere, usually gathered at conferences (but with a high time cost). Practitioners felt that Government planning policy guidance lacks cross-references, is difficult to 'read across' as there are many competing objectives and tensions. It is also perceived as difficult to keep up with changes in the midst of day-to-day work pressures.

The local delivery vehicle – the North Northamptonshire Development Company (NNDC) - is the Urban Regeneration Company responsible for driving, co-ordinating and managing the delivery of growth in a sustainable manner. It has been important in helping to integrate planning and transport issues. Modal shift targets have been developed for North Northamptonshire and have been incorporated into the CSS. They are based on internal county-level research and are used as the basis for s.106 discussions. Modal shift targets provide good leverage for the County in applying pressure on developers for more sustainable design solutions. Large amounts of funding are being levered into 'smarter choices' and public transport alternatives. The County is in the process of developing sustainable design guidelines that are also expected to raise development standards. Buckinghamshire County is focusing transport modelling efforts and targets on reducing vehicle-kilometres or vehicle-hours rather than car trips or mode shift. This approach emphasises network-wide reduction in congestion and CO_2 emissions, although an emissions model is still under development.

In Northamptonshire, several barriers to sustainable transport initiatives were cited: a historic legacy of development pattern, politics, understaffing and lack of knowledge/capacity, development pressure and the pace of growth, and public apathy. There is a national impetus for North Northamptonshire to accommodate growth; whilst the local political priorities are generating employment and delivering infrastructure. Despite increasing traffic congestion, public apathy toward sustainable transport planning is high. It is very difficult to get sustainable transport initiatives adopted. Conversely, practitioners in Luton said the need for sustainable transport is generally accepted but there is a lack of Government support (mostly in terms of funding) for local transport. For example, it is only recently that rail projects have been included in Regional Funding Allocations (RFAs).

It was acknowledged that once a car-dependent pattern of growth is established, it is extremely difficult to go back and retrofit the urban form. Some initiatives that reflect policy shifts in Northamptonshire and surrounds are the development of dedicated bus lanes/Bus Rapid Transit (BRT). This work looked at road improvements including dual carriageway upgrade, major junctions improvements, and BRT solutions.

In the higher-density Luton/Dunstable, the 'dire' traffic situation is a motivating factor to shift people out of cars by investing in rail mainline links and a new high-speed Busway. The Busway (Translink) provides a frequent, high-quality service linking Houghton Regis, Dunstable and Luton and is seen as integral to the new development areas in Luton.

The difficulty in achieving jobs-housing balance was a recurring theme in MKSM. Practitioners note that it is not just about numbers; but housing that is appropriate to available jobs and vice versa. Some new developments in Northampton are perceived as too 'high-end' and cater to workers from Milton Keynes rather than the local job market, thereby encouraging inter-urban travel. Many developments are also located near to the strategic road network, encouraging car-based travel. There are also perceptions that Milton Keynes has a better employment and facility offer, again encouraging lengthy travel distances. Even within urban areas, jobs and housing are often segregated. In Luton, for example, the jobs are concentrated in the south and housing in the north so there is a need to create another employment hub in the north which could be supported by the new busway. In Aylesbury, the "growth agenda" was perceived to be too focused on housing without considering employment. For example, the South East of England Plan is perceived to have 'uncoupled' the link between housing, employment and infrastructure.

Boundaries need to be chosen carefully in order to achieve sustainable transport outcomes. 'Artificial boundaries' between North and West Northamptonshire (including Northampton) mean that the North Northamptonshire CSS policies to address net commuting flows from Wellingborough, Kettering and East Northamptonshire to Northampton are weak. Sustainable travel is promoted through policies that concentrate new housing and office development in existing urban centres but this does little to address inter-urban travel in the region. This is a key feature of the region – many-to-many origins and destinations, with little identifiable structure to travel. Providing for non car means of travel in such an area is extremely difficult. In Luton the policy direction for discouraging commuting to/from Milton Keynes is to create local jobs.

In terms of cross-authority working, MKSM has an inter-regional board and a strategic transport board (STB). The STB has prioritised the investment strategy. Practitioners in Northamptonshire felt that staff capacity is lacking, in part because the County had not received new resources to manage the growth allocated to the area. Consequently, planners tend to focus on the larger housing development schemes but the cumulative effect of smaller schemes (i.e. less than 500 dwellings) tends to lead to an unsustainable development pattern. There is also a development control 'skills gap' because the most experienced planners are concentrating on large projects.

Process/Governance

MKSM is an 'artificial region' and has little natural cohesion or identity. As such, the mechanisms for decision-making are complex (but potentially no more than other groups of authorities working together) . Numerous parties must work together to develop strategic priorities for the region. There has been competition for resources despite the investment that comes with being a growth area.

The situation is complicated further by two-tiered government in much of the growth area. The East Midlands Regional Strategy significantly constrained the North Northamptonshire CSS site selection process for new development. New settlements had been ruled out so the CSS process focused on the direction of growth around existing towns (i.e. sustainable urban extensions).

The Regional Strategy and CSS processes were driven largely by the availability of developable land in locations that were not perceived to be congested or constrained. There was little dispassionate analysis of the optimum locations for growth in transport terms. Nonetheless, practitioners in Buckinghamshire felt the two-tiered structure generally works fine in that transport does not get marginalised in the Local Development Framework (LDF) process. The county can then take on a 'consultancy role' to the districts on transport issues. However, regaining unitary authority status has meant Luton can obtain better funding through RFAs. In the past, Luton had received some support from the Bedfordshire County Council but now that it has gained unitary status it has an improved ability to deliver transport projects.

In 2005, a strategic policy team was set up at Northamptonshire County to look at transport and growth. Previously, the LTP team had been doing most of the transport strategy work. Practitioners feel that the County started at a low level in terms of sustainable urban structure for transport and that they have moved quickly to improved practice (e.g. grid street systems, massing development around existing urban centres). The County's transport planners got involved in the spatial strategy processes at a late stage in part because the County's transport model was only developed in 2005. The 'sustainable urban extensions' work and transport modelling have been undertaken separately, and have yet to be fully integrated. Some interesting research work has been carried out by consultants considering how new residents feel about transport choices when they move and what would help them make more sustainable travel choices.

Developers have much influence in Northamptonshire. Practitioners felt that they often fall short on providing evidence of transport impacts and on proposals for sustainable transport. Transport Assessments are often open to question. The Highways Authority does not have statutory power to stop development on non-trunk roads and this complicates matters. This is exacerbated by the pressure to meet growth targets. All this favours the developer when planning applications are appealed based on non-decision.

The County is using s.106 agreements to fund public transport. Developers are starting to include bus priority in their schemes. The County received DfT funding to produce individual travel plans for people moving into new developments and developers are contributing through s.106 lump sum payments. In Luton, growth is seen as opportunity (already relatively high density) because an increase in population can support more retail in town centre and create the critical mass to support regeneration initiatives. There may also be some funding for public transport and other investments from s.106 agreements. Sustainable travel behaviour is however a very long way off.

Summary of Key Issues

- The MKSM region is one of the most difficult in the UK to work in with regard to achieving sustainable travel behaviour. The area has a high proportion of journeys to work by car (70%), lengthy average journey to work distances (32% over 10km) and a high rate of traffic growth between 1997-2007 (16%). Transport CO_2 emissions are relatively high at 2.87 tonnes per person. The current travel patterns and particularly 'business as usual'

future trajectories are unsustainable relative to headline national CO2 reduction targets. Many of these patterns are due to the unique nature of the urban structure – with a polycentric network of small and medium sized towns, linked largely by the road network.

- The allocation of growth has been based largely on available land, reflecting the existing urban pattern. New development has been dispersed throughout a number of growth areas, with little consideration of the optimum locations for growth (in transport terms). The adopted strategy is to direct most growth to the larger urban areas and to make these areas as self-contained as possible (i.e. provide employment and services to residents). Self containment however only appears to be a theoretical concept and very unlikely to be realised (this is not unique to MKSM).
- The MKSM growth area is comprised of numerous political entities which make strategic decision making difficult. There are, however, notable examples of good cross-authority and cross-disciplinary working, such as the STB.
- Some innovative ideas are being pursued, such as the Luton Busway, modal shift work, the Kettering A14 package, the Manual for Streets agenda, travel planning, emissions modelling, etc. However the trend-break required in sustainable transport terms will be very difficult to realise.

4.5 Case Study 4: Didcot/Oxfordshire

The Oxfordshire case study examines one of 29 growth points across England - Didcot. Didcot is located 15 km south of Oxford, a city which has adhered to a strict Green Belt policy over the past 50 years (Note that Oxford and Didcot are both growth points, with the former aiming to accommodate growth largely within the urban fabric). Didcot is selected for this case study to explore the following issues:

- The influence of transport in allocating new growth;
- Relative importance of transport against other policy issues (e.g. Green Belt);
- Relationships between planners and transport planners in a two-tier authority area;
- Role of the Highways Agency.

Key Development/Strategy Discussed

The development at Didcot, known as Great Western Park (GWP)[5],comprises a mixed use urban extension together with associated infrastructure. The 180 hectare site is located on the western edge of the existing town and falls mainly within South Oxfordshire District with the remainder falling in the Vale of White Horse District. The development will include 3,300 houses (30 per cent of which will be affordable), two new primary schools, a secondary school, open spaces, local shops and services, play areas, two community centres and a health centre.

5 More details on the Great Western Park proposals can be found at www.greatwesternpark.co.uk

Table 8. Key Statistics for Oxfordshire

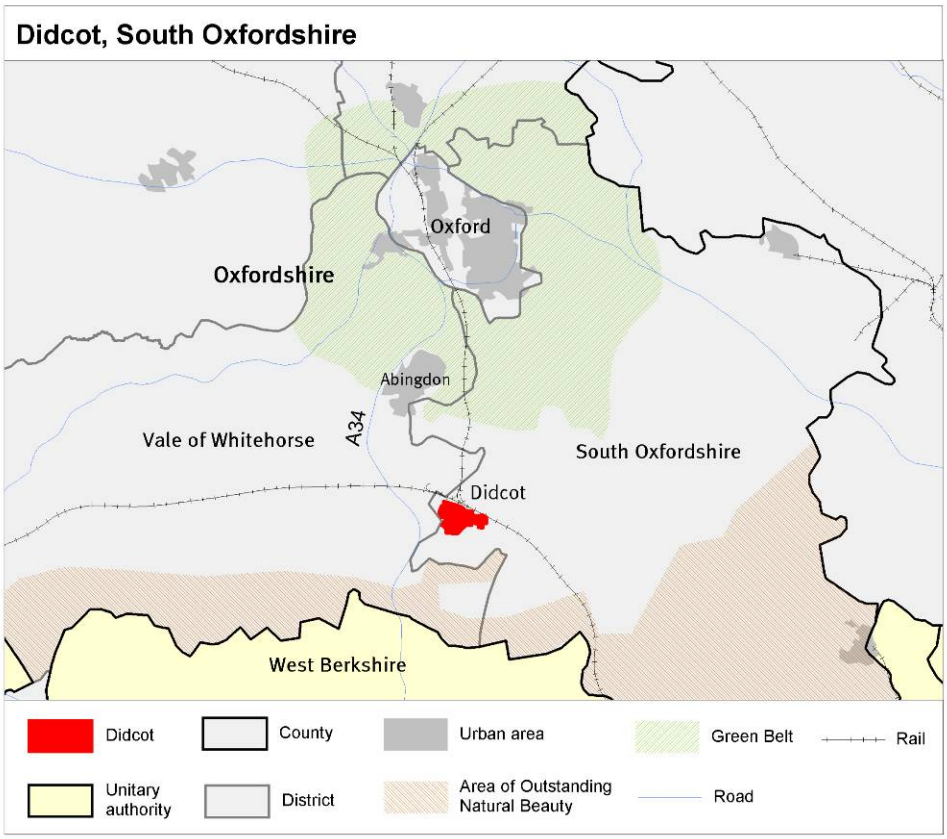
Metric	Oxfordshire	England
Resident population	605,488	49,138,831
Population density (people per hectare)	2.32	3.77
Accessibility ranking	81.2%	78.4%
% journey to work by car	62%	61%
% journey to work over 10km	32%	28%
Traffic growth (1997-2007)	13%	14%
Transport CO2 emissions, tonnes per person	3.35	2.25

Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.

The area to the west of Didcot was identified for major housing development in a local review of the Oxfordshire Structure Plan (completed in 2001) and a first planning application for GWP was submitted a year later. Negotiations on the application continued over a period of six years with permission finally being given in July 2008

The application was considered in the context of the Draft South East Plan (South East England Regional Assembly, 2006), Oxfordshire Structure Plan (Oxfordshire County Council, 2005), South Oxfordshire Local Plan (2006) and Vale of White Horse Local Plan (Vale of White Horse District Council, 2006).

Figure 23. Didcot Case Study Area



Interview Findings: Current Practice and Lessons Learnt

The selection of Didcot as a town for expansion represents the latest phase in the continuation of a strategic policy embarked on by Oxfordshire County Council in the 1970s. As the counterpart to preventing the outward growth of Oxford City the bulk of the county's requirement for new housing development was directed instead to four 'country towns' (Didcot being one). This policy of concentrating new development was designed to utilise and foster the improvement of existing infrastructure and public services in these towns. With complementary employment development the strategy was also expected to achieve relatively high levels of self-containment and thus could be said to anticipate the principles adopted by the Government in PPG13 twenty years later.

In practice a combination of factors have resulted in more and longer-distance out-commuting from the towns than originally envisaged. These include:

- Increasing housing pressures working outwards from London as well as within the Oxford sub-region;
- Changes in the character of local employment with less growth in the smaller towns;
- Large increases in personal mobility resulting from the combined effect of higher car ownership and major investment in the A34, M40 and principal rail services serving Oxfordshire.

The effects of these mobility changes are particularly strongly represented amongst occupants of the major new housing estates

(Headicar and Curtis, 1998; Higgitt and Headicar, 2000).

More recently, strategic policy in Central Oxfordshire has been modified with the final version of the South East Plan (2008) anticipating an urban extension to the south-east of Oxford in response to representations from the City Council over housing availability. However this proposal is dependent on a local review of the Green Belt in the vicinity and is opposed by South Oxfordshire District Council, in whose administrative area the development would lie. Meanwhile the bulk of planned new housing development in the sub-region continues to be allocated to towns outside Oxford, including Didcot – favoured by virtue of its proximity to growing science-based employment in the surrounding area.

The decision to opt for expansion to the west of the town (rather than to the north as originally proposed) was strongly influenced by transport considerations. In this case, extension to the west meant that traffic generated by the development to places outside the town could readily access the A34 junction at Milton Park and would not involve additional movements through the existing built-up area. As a result potential problems with an extension to the north – of generated traffic either passing through the town or using unsuitable rural roads northwards towards Oxford – were avoided. However the preferred location did not offer convenient access to the rail network – one of Didcot's particular advantages – whilst ready access to the A34 (provided capacity improvements were made at Milton Park) would implicitly foster travel outside the town by car.

At a local level the planning officers responsible for negotiating the GWP applications commented that the detailed empirical academic research considered in this study is not well known – certainly not beyond the Newman and Kenworthy/compact city ideals that tend to be reflected in governmental guidance. Much of the wider work is therefore not used in decision making. The 'envelope' for decision making is also often small - for example, in this case, the issue of 'development density' boiled down to a difference between the two planning authorities as to whether the overall density was to be 38 or 40 dwellings per hectare. Although there is a wide variation in density within the site (reflecting the distribution of open space and different housing types) the overall character of the development follows contemporary practice in this and similar small/medium towns within the sub-region. There is certainly no discussion of the more extreme densities which are theoretically possible.

For the GWP application the County Council did attempt some transport modelling; however the main work of this kind was undertaken on behalf of the developer and tended to reflect their perspective. The Council argued for a ring road to be provided to the west of the town (outside GWP) as it was believed this would improve the 'design quality' of the development, and provide access to a further urban extension towards the A34. However for financial reasons the developer preferred a central spine road instead and this view was accepted by the planning authorities (the County Council has no powers to direct district planning authorities on highway matters).

Developer finances also have implications for the 'mixed use' nature of the development. Whilst developers can be 'requested' to allocate areas for retail and other non-housing uses within the site , actual provision will depend on whether they are deemed to be financially viable. This is a perennial problem in masterplanning – implementation is often very different from what is originally envisaged.

Practitioners felt that the helpfulness of governmental guidance differs according to topic. For example, the Manual for Streets (DfT, 2007b) is useful in terms of

incorporating urban design issues into the transport planning arena and, at a detailed level, of illustrating the types of solutions that are 'well regarded'. At the other end of the scale DfT Circular 2/07 had prompted a marked change in approach to major planning applications by the Highways Agency but there was scepticism as to whether this was being exercised within any coherent overall strategy. Any development on the scale planned for Central Oxfordshire (an additional 100,000 population over 20 years) was bound to exacerbate problems on the A34 trunk road which forms the main transport spine through the area.

Although good practice documentation exists on other topics it is perceived as often difficult to access and, given all the constraints, a real challenge to deliver. More training was required in aspects of transport planning for those working in (highways) development control. Good technical knowledge and experience is very valuable, but scarce, and recent changes to management structures in the local authorities had not necessarily helped the situation.

The local planning officers responsible for dealing with the GWP application cited lack of information about other similar developments as a real limitation. Whilst attempts were made informally to engage with practitioners elsewhere these were 'not very successful'. Email contact with a network of planners provided only limited information.

PPG13 itself was considered to be 'out of date' and far removed, or too generic, from the realities of urban planning on the ground. A classic example is the guidance on restricting residential parking provision [although the Government has recently proposed to withdraw this]. The highways officer considered that inadequate provision of parking places is likely to lead to a misuse of other vacant spaces and has an adverse impact on the quality of a development. Instead use of parking provision as a restraint mechanism needed to be focused on the destination end of trips.

Process/Governance

The GWP application was lodged as soon as the strategic principle for development at this location had been accepted (other proposals having been refused during the previous 20 years). This meant that the County and District Councils 'were not ready' with Local Plan policies or specific requirements for the site which might have steered a masterplan. Instead, the local authorities were on the 'defensive' from the outset and were in effect fighting a rearguard action to improve what they perceived as an inadequate proposal from the applicant. The local authorities tend to have much less in terms of resource than the major developers.

The complexity of the negotiations on GWP was aggravated by the site being divided between two local planning authorities, plus a separate local highway authority and the Highways Agency. All parties made extensive use of consultants and this added to the complexity, and often inconsistency in advice. Particular difficulties were experienced when the developer changed consultants and there were added problems of changing personnel more generally (although fortunately the same officers led on behalf of SODC throughout). Local authorities were also at a disadvantage relative to the developers in the scale of resource they could draw on (officers commented that they were 'coping rather than planning' and that 'strategic direction often gets lost in firefighting').

The application took four years to negotiate (with the applicant making and then withdrawing an appeal at three points along the way), plus a further two years to negotiate the main terms of the s.106 agreement. This is despite the planning authorities being under considerable pressure to deliver additional housing by central Government.

A considerable amount of energy is expended on taking account of various interests and objections and coming up with a financial package which is acceptable to both the developer and the different public authorities involved. The most critical point of negotiation at GWP was the amount of affordable housing to be included as part of the development. An independent assessment was conducted – and eventually concluded in favour of the developers. Despite this, the local authorities were able (at the time) to gain agreement to 30% affordable housing.

Summary of Key Issues

- The area has an approximate UK-average proportion of journeys to work by car (62%), but lengthy journeys to work (32% over 10km). The rate of traffic growth between 1997-2007 (13%) is at the UK average. Transport CO2 emissions are high at 3.35 tonnes per person. Sustainable travel behaviour would again represent a real 'trend break' from the current travel patterns and 'business as usual' future trajectories.
- New growth at Didcot meant that the new growth was sited close to the existing road network and far from railway access. Other policy issues such as affordable housing and internal layout and design took greater precedence than transport.
- The need to work across boundaries hinders the process of negotiating the planning application and s.106 agreement, and makes strategic policy making difficult. Practitioners would benefit from easy access to examples of other comparable developments, good (and bad) practice and a stronger network of planners involved in similar issues.

4.6 Case Study 5: Sherford/Plymouth

The Sherford case study examines a second of the 29 growth points across England. Sherford is a planned new settlement, located just over 6km from Plymouth[6]. The case study is selected to illustrate the following issues:

- The influence of transport in the location and design of the Sherford new community (and example of LDF and LTP processes working together);
- Internal design and layout issues (including the involvement of the Princes Foundation); linkages to Plymouth and elsewhere;
- Evidence of joint working across authority boundaries;
- Plymouth and South Hams also actively identifying the need for and cost of future infrastructure requirements in preparation for new funding opportunities such as the Community Infrastructure Fund.

Key Development/Strategy Discussed

Sherford is a planned new community comprising 5-6,000 dwellings, and potentially more in future years. The community will include a primary and secondary school, high street retail, health centre, pool and spa, various community facilities, park, open spaces and other associated facilities. The Princes Foundation ran an Enquiry by Design to help shape the emerging masterplan, this was held in 2004.

Table 9. Key Statistics for Plymouth

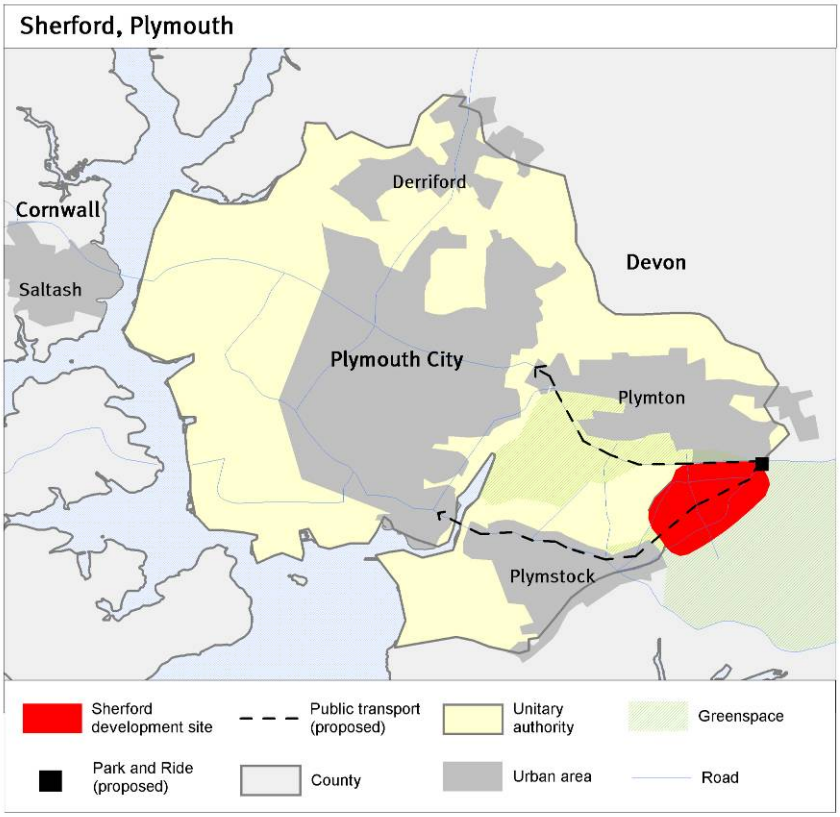
Metric	Plymouth	England
Resident population	240,720	49,138,831
Population density (people per hectare)	30.17	3.77
Accessibility ranking	98.0%	78.4%
% journey to work by car	62%	61%
% journey to work over 10km	9%	28%
Traffic growth (1997-2007)	13%	14%
Transport CO2 emissions, tonnes per person	1.14	2.25

Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.

The developers submitted a planning application to South Hams District Council (the lead authority for the application) and Plymouth City Council in 2006, and again in 2008. Both Councils have considered and conditionally approved the application at Committee in 2008.

6 More details on Sherford can be found at: www.southhams.gov.uk/index/sherford.htm

Figure 24. Sherford /Plymouth Case Study Area



Interview Findings: Current Practice and Lessons Learnt

The objective for the masterplan is that Sherford should be an exemplar sustainable community: "*better than anything that has gone before*". The settlement is conceived as an extension to Plymouth, rather than a standalone site (though the 'new community' is a new settlement rather than urban extension – related to, but separate from Plymouth). The settlement is perceived as a complement to growth within the Plymouth urban area, but offering a distinct housing choice. A high quality public transport system (HQPT) is planned to improve local connections and routes to and from Plymouth, therefore encouraging non-car use. Plymouth itself has distinctive travel patterns – an average car mode share for the UK, but relatively short travel distances (the city is very much the centre of a relatively isolated region). Hence there is potential to continue these patterns of relative containment.

There has been much background evidence building as the backdrop to the policy making. A Vision for Plymouth was launched in 2003 (MBM Arquitectes and AZ Urban Studio with David Mackay) – the key theme within this was Plymouth growing to a city size of 300,000 by 2026. Further studies include the Plymouth Urban Capacity Study (Llewelyn Davies, 2004), Plymouth Eastern Corridor Transportation Study (Faber Maunsell, 2006) and South Hams Transportation Study (Colin Buchanan and Partners, 2004).

The transport package for Sherford includes a major transport scheme bid, with a new Deep Lane junction, a park and ride at Deep Lane junction, and the HQPT link, connecting into Plymouth and also to an industrial site at

Langage. HQPT is viewed as around 12 buses per hour. However, under current funding regimes, this is unlikely. The internal street layout of Sherford has gained much attention. The style is very much one of 'traditional urbanism', based on the Princes Foundation/Poundbury aspirations. The proposed street layout is Manual for Streets compliant, with a high street, grid street network, cycle networks and walkable communities. Car clubs, demand responsive public transport options, personalised travel planning, etc. will also be critical to achieving a level of sustainable travel behaviour.

The Sherford Transport Assessment (TA) (Scott Wilson, 2006), prepared on behalf of the developer, outlines the assumptions behind the transport modelling for the development. The TA assumes that a 61% car mode share will be achieved for all trips. 20% of work trips will be home-based and 50% of retail trips and 80% of leisure trips internal. These are very optimistic based on the location and transport and other facilities provided. This is an important [and quite common] issue, the TA represents current practice in this field – but ambitious future travel patterns are assumed to underestimate the likely impacts on the surrounding transport networks. There is some commitment to monitor the travel generation from the site relative to the TA. This would then act as a trigger to junction improvements. It will be interesting to see whether the mode share and containment assumptions are achieved.

As previously discussed, Plymouth is the centre of the city-region, and dominates the area. There are few competing centres – Exeter and Truro are the nearest major centres. Hence, there is potential for a level of self containment within the Plymouth environs. However, trip generation from Sherford is likely to be car-based. Plymouth has a relaxed traffic demand management regime. Car parking, for example, within Plymouth is over provided. Pricing is around £5.00 per car per day, relative to £2.50 in the 3 park and ride sites. Parking provision within Sherford is also lenient – 1.5 spaces per unit (more than the current South Hams and Plymouth average). Hence the HQPT link from Sherford into town, although representing good practice for the UK, will find it difficult to compete against the car. The perceived relaxation of car parking standards in Draft PPS4 (DCLG, 2007, p.11) do not help matters from the perspective of reducing the demand for travel.

There are some strong advantages in the way that Plymouth is structured. Most of the employment, retail and leisure faculties are in the centre, with few edge-of-town facilities (Marsh Mills is an exception). Radial movements into town can thus be served by public transport options. Public transport provision for the remaining tangential trips, reflecting the inevitable many-to-many origins and destinations, is more difficult. Sherford is also located adjacent to the A38 – ideal for the car-based commute to Exeter.

The comparison with a Vauban or Reiselfeld-type development is instructive (both are extensions to Freiburg – population 214,000). Here public transport provision into the urban centre is of very high quality (a tram) and the route is quicker than by car. Walking and cycle provision is very high quality. In the case of Vauban, car parking is located to the edge of the development, necessitating a longer walk to the car than the tram or bus. Hence, although Sherford represents very good practice for the UK in terms of urban planning and transport integration, it does fall some way behind continental best practice in terms of the level of public transport investment and restriction of parking supply.

Process/Governance

The precedence for the Sherford development was set in the Regional Spatial Strategy (South West Regional Assembly, Draft 2006) and Devon Structure Plan (Devon County Council, 2004), and worked up in detail

through the South Hams Local Development Framework (South Hams District Council, Core Strategy, 2006) and Plymouth Local Development Framework (Plymouth City Council, 2007), supported by the Local Transport Plans. The local authorities have demonstrated good practice in working in a cross-disciplinary manner. The Plymouth LDF team, for example, includes planners and transport planners, and there is some cross-authority working. The local authorities also maintain a good working relationship with the Sherford developer (Red Tree). Practitioners believed these working mechanisms produced 'noticeably higher quality outputs'.

Growth point status has led to a greater level of funding (through Growth Funding Allocations), however this is usually for capital projects only, and was viewed as a 'drop in the ocean' as to what was required. In terms of transport, resource constraints mean it was only possible to develop one major scheme at a time within Plymouth. Resource constraints also affect the level of investment possible, i.e. LRT is not being considered only bus-based schemes. The different funding regimes are perceived as confused, for local authorities and developers. The tariff approach introduced through the LDF will mean that new residential development will need to provide nearly £4,000 per unit. The Community Infrastructure Fund also offers funding possibilities in the future: £200m is available for transport schemes to support housing growth projects across the UK from 2009.

Summary of Key Issues

- The Plymouth city area has a UK-average proportion of journeys to work by car (62%), short journeys to work (9% over 10km), and an average rate of traffic growth between 1997-2007 (13%). Transport CO2 emissions per capita are hence relatively low at 1.14 tonnes per person. South Hams is much more car dependent, with greater car dependency. Achieving sustainable travel behaviour would again represent a 'trend break' from the current travel patterns and particularly 'business as usual' future trajectories.
- Transport again gains only marginal weight in terms of the strategic location of new development. There are potentially better locations for growth from a traffic generation point of view. However, Sherford is being developed to provide a unique South Hams lifestyle as an addition to the Plymouth residential offer.
- There are some very good positives to the development. The layout of Sherford is likely to be exemplary from the internal transport point of view. In process terms, there is some very good practice with cross-disciplinary and cross-authority working. An inherent conflict however remains [and this is certainly not unique to Sherford – it simply reflects very common practice] – 'sustainable transport' is mentioned as a key objective in all of the policy documents, yet in terms of implementation is a secondary objective. Documents such as the TA, although representing current practice, are almost promotional documents for the developer. LTPs have a laudable 'front end' in terms of policy aspiration, yet are not often backed up by the required schemes. Efforts to manage the demand for travel are weak. Despite this, the Sherford development represents very good practice for the UK experience.
- A general issue, found throughout the case studies, is that the recent strengthening of the economic development objective within national planning policy is likely to have an impact upon environmental (and social) objectives, with a direct implication for sustainable travel aspirations.

4.7 Case Study 6: Longbridge/Birmingham

The Birmingham case study considers the development of integrated urban planning and transport planning in the Midlands, with a focus on the redevelopment of the Longbridge site[7]. The following issues are explored:

- Influence of transport on the redevelopment of a large brownfield site on a previous traditional industrial site, the role of transport against other objectives such as economic development;
- The use of higher densities as important for public transport viability;
- The distinction between what good practice might advise and what can pragmatically be achieved.

Key Development/Strategy Discussed

Longbridge is identified in the Regional Spatial and Economic Strategies as a Regional Investment Site and part of a High Technology Corridor. It is a brownfield site that extends over 195 ha, straddling the boundary between Birmingham City Council and Bromsgrove District Council, in Worcestershire. The site includes the former MG Rover factory location, which closed in 2005 with a loss of over 6,000 jobs. The majority of the site is vacant, although Nanjing Automotive Corporation occupy about 20% of the site. Developer St Modwen owns about 95% of the land, with the remainder owned by Advantage West Midlands (the regional development agency).

7 More details on Longbridge can be found at www.future4longbridge.co.uk

Table 10. Key Statistics for Birmingham

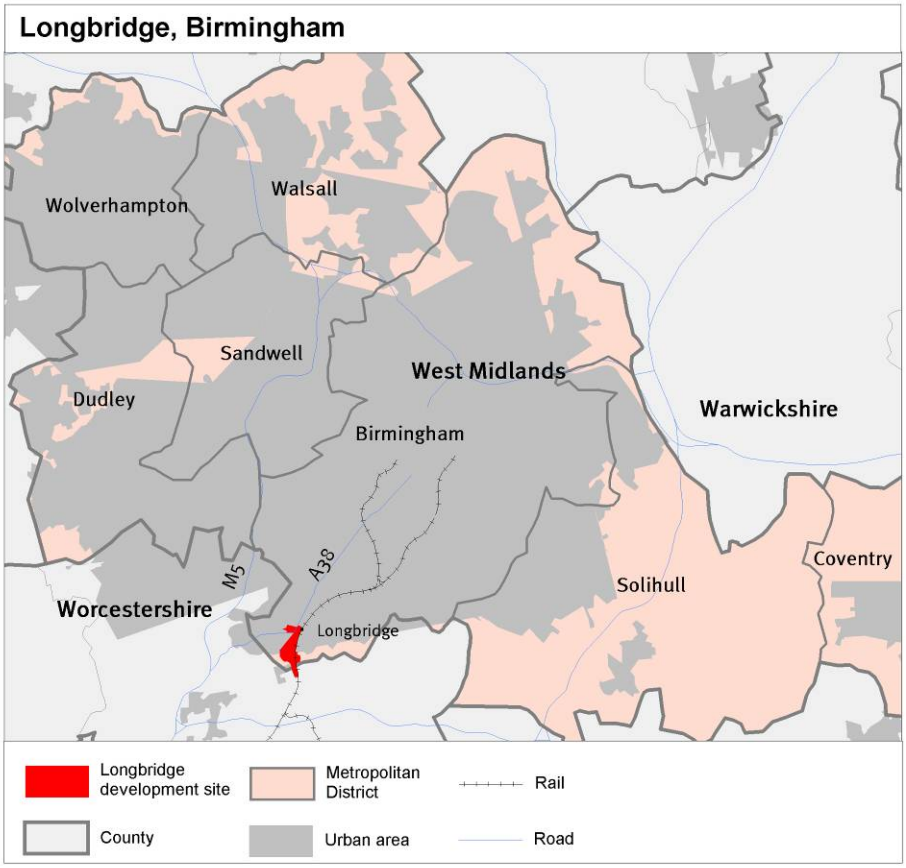
Metric	Birmingham	England
Resident population	977,087	49,138,831
Population density (people per hectare)	36.49	3.77
Accessibility ranking	89.3%	78.4%
% journey to work by car	60%	61%
% journey to work over 10km	18%	28%
Traffic growth (1997-2007)	7%	14%
Transport CO2 emissions, tonnes per person	1.22	2.25

Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.

The development strategy for the site is for a major mixed use development including a new town centre, a regional transportation interchange including 1,000 park and ride spaces, and creation of at least 10,000 jobs, [aspirationally] in high technology, as Longbridge has been designated part of the "Central Technology Belt" running from Aston University in Birmingham city centre down the A38 to Malvern. Birmingham CC lead on the project, though Worcestershire CC and Bromsgrove DC have been party to all statutory processes.

The current status is that Birmingham CC, Bromsgrove DC and Worcestershire CC have unanimously agreed to the Longbridge Area Action Plan, and the local MP Richard Burden (Northfield) is also supportive. An Examination in Public is scheduled for October 2008, and preparations are under way to provide evidence to the Inspector to justify the plans and answer any concerns, including those from the public.

Figure 25. Longbridge /Birmingham Case Study Area



Interview Findings: Current Practice

The interviewees focused mainly on the Longbridge case study rather than theoretical land use and transport interaction issues. Longbridge highlights the difficulties that can occur in implementation even when a large project has broad support. It was questioned why the process was taking so long – concern was expressed that planning system could come into disrepute as expensive and time consuming, and the that the public can get fatigued with the different levels of consultation required. There are serious issues in trying to balance perceived good planning practice with economic viability, from strategy development to implementation, and particularly at the time the applications are made.

Macro and local economic fortunes also fluctuate, making long term planning difficult. The level of negotiated planning gain, for example, becomes difficult in view of changing circumstances. Levels agreed when applications are actually signed may not be the same as when agreements are first discussed, particularly in the current climate of falling property values (Autumn 2008).

There is a clear distinction between what good practice guides advise, and pragmatically what can be achieved. This is always a conflict in transport planning. Worked through case studies hence are useful to practitioners - highlighting how the theoretical optimum strategy is changed in 'real life' application.

Throughout the process, the authorities have attempted to follow an "accessibility led" approach, including using a mode share goal (such as 30% public transport). This is instead of the traditional transport planning approach of simply modelling the additional traffic and catering for it by building and improving roads. The practitioners stressed the importance of having both 'carrots' and 'sticks' to find a balance to ensure sustainability; implementing the sticks was however very difficult.

The general perception was that strategic planning based on best practice tends to be 'watered down' when funding viability issues are considered. Ensuring the developer continues to be involved is critical.

Process/Governance

The main issues concerning the development have involved affordable housing policy, planning gain and the planning process. There has been strong pressure from the local authorities to provide more affordable housing, with a broad policy objective of 35%. There is a strong conflict between developer receipts/profits and affordable housing provision - in order to get major developments to work, planners have negotiated a low affordable housing proportion.

Agreeing appropriate s.106 contributions from the developer has been a major issue. Originally a figure of £90m was agreed, but given the current economic climate and falling property values, this has been revised downwards. A "deeds of variation" is used to do this. This was by far the largest s.106 contribution the council has ever negotiated, hence was breaking new ground.

The Area Action Plan examination process also provides some difficulties. This is a fairly new process for the officers concerned and the level of detail required is very uncertain – providing too little could mean delays to the process, while providing too much could raise issues that otherwise would not be highlighted. Similar issues are found with developments in the city centre and there is some concern about how the process will proceed.

Summary of Key Issues

- The Birmingham area has a UK-average proportion of journeys to work by car (60%), short journeys to work (just 18% over 10km), and a relatively low rate of traffic growth 1997-2007 (7%). Much of this is potentially income (and other socio-economic characteristics-related), though urban structure is potentially important - average densities, for example, are relatively high. Transport CO_2 emissions are low at 1.22 tonnes per person. Achieving sustainable travel behaviour in Birmingham is potentially less of a challenge than elsewhere in the UK; there is less of a 'trend break' required relative to the current travel patterns and future 'business as usual' trajectories.
- Transport again gains little weight in terms of the strategic location of development. The new development is simply a response to regenerating a vacant and strategically important industrial site.
- There are key issues, however, in terms of practical application of the 'theoretical optimum strategy' in view of changing economic circumstances and financial realities; and there are some uncertainties with what is required for the examination process and how it is likely to progress.

4.8 Case Study 7: Northstowe/Cambridge

The Cambridgeshire case study examines the prototype eco-town of Northstowe[8], the planning of which preceded the current eco-town shortlist. The following issues are explored:

- The influence of transport in the choice of location (how important was the potential for a guided bus here against competitors?);
- Design features to influence sustainable travel choice within an Area Action Plan. Were any trade-offs necessary when the planning application was determined?
- Relationships between planners and transport planners in a two-tier authority area.

Key Development/Strategy Discussed

Northstowe is a planned new community and situated about 5 miles from the centre of Cambridge. It will be located in South Cambridgeshire. Northstowe will provide approximately 9,500 dwellings, for up to 24,000 people, and is being promoted as a 'model' for sustainable living. The new town will also include schools, employment areas (around 9,000 job opportunities are expected), open space and a town centre. The development area of 279 hectares is situated on the former Oakington Barracks airfield, adjacent to the existing towns of Longstanton and Oakington. The core area is bounded to the north and east by the Cambridgeshire Guided Busway, currently being developed on a disused railway line between St Ives and Cambridge. The A14 runs to the south-west of the area.

8 More details can be found at: www.northstowe.uk.com

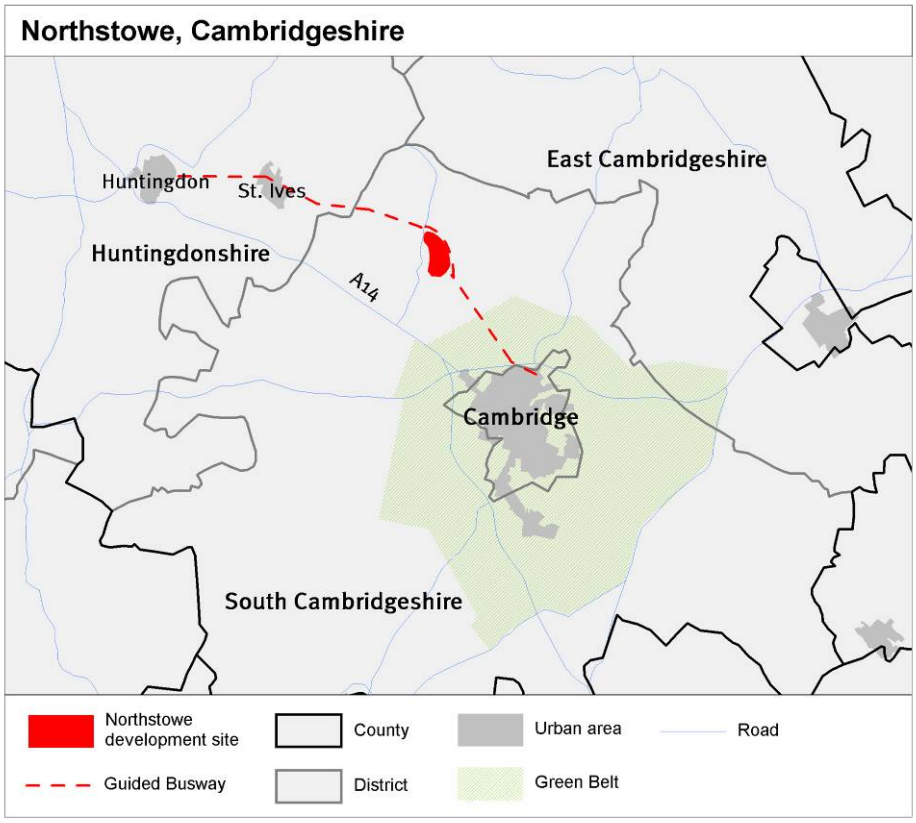
Table 11. Key Statistics for South Cambridgeshire

Metric	South Cambs	England
Resident population	130,108	49,138,831
Population density (people per hectare)	1.44	3.77
Accessibility ranking	58.6%	78.4%
% journey to work by car	68%	61%
% journey to work over 10km	35%	28%
Traffic growth (1997-2007)	15%*	14%
Transport CO2 emissions, tonnes per person	4.61	2.25

Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.
*Traffic growth for Cambridgeshire County

The current status of the proposal is that the joint promoters submitted an outline planning application in December 2007 to South Cambridgeshire District Council. This application is currently on hold pending a number of detailed concerns about the proposal and discussions between the joint promoters on how the development will come forward. A revised planning application is expected to address those concerns and could be made by the end of 2009/early 2010. The planning application will in the fullness of time, be determined by the Joint Development Control Committee made up of members from South Cambridgeshire District Council (SCDC) and the Cambridgeshire County Council (CCC). The application is under discussion with the local authorities and developers, including consideration of the details of the s.106 agreement.

Figure 26. Northstowe Case Study Area



Interview Findings: Current Practice

Regional Planning Guidance 6 (RPG6, 2000, GOE/DETR) originally determined the spatial growth patterns for Cambridgeshire. It specified that potential development sites be prioritised as follows ('best' to 'worst'):

1. Cambridge (infill);
2. Green Belt releases;
3. new towns;
4. new development further from Cambridge.

RPG6 has since been superseded by the East of England Plan (GOE/DCLG, 2008). Practitioners expressed that this sequential approach is important in identifying appropriate locations for sustainable development in Cambridgeshire.

The approach represented a change in approach from 50 years of growth-restricting Greenbelt policies around Cambridge. One of the reasons for a changed approach was the awareness that, [partly] as a result of pushing growth beyond the Green Belt, Cambridge has some of the longest average commuting distances to work in the UK. Towns with their main employment base in Cambridge are located up to 35 miles from the town centre; hence lengthy commutes. This development pattern has also led to issues of housing affordability and congestion within Cambridge. Better public transport improvements are also required to link other towns and employment sites to Cambridge.

RPG6, in general, identified areas of search but then the Cambridgeshire Structure Plan (CCC, 2003) narrowed down the site locations for new towns using 39 criteria to assess sites that developers had put forward. Four

sites were selected with Northstowe as the first priority. Rejected sites will probably reappear through the East of England Plan process. Northstowe scored above the second place site, Waterbeach, because of the potential for sustainable transport. The developers for Northstowe are Gallaghers, with the recent addition of English Partnerships.

Some previous work has examined land use/transport interaction issues in Cambridge, including the Cambridge Futures work, using MENTOR modelling (Echenique and Hargreaves, 1999 and 2003). Much of the detailed work has been developed via consultants. For example (a) the Structure Plan's criteria for assessing development sites, (b) Arup's sustainable living design for Northstowe, and (c) general transport modelling [including the Busway] by Atkins.

Much evidence in support of sustainable travel and integrated land use-transport planning was available for the 2003 Structure Plan. This included anecdotal evidence, a capacity study, and a review of what other cities were doing to deal with imposed growth.

Practitioners perceived that governmental guidance is useful in helping to understand potential routes to achieving sustainable development objectives. However, much the most difficult challenge is to overcome uncertainty, process and funding barriers.

Prior to the 2003 Structure Plan, there had been strong advocacy for some farmland sites to be developed in order to support economic regeneration objectives. These were rejected based on the technical criteria for sustainable development. In short, the technical 'won' over the political/advocacy arguments. Waterbeach was similar to Northstowe in most criteria except the public transport potential and planned A14 upgrade. Because of this Northstowe was given first priority in terms of new town development.

It is important to note that national government funding is necessary to take advantage of the opportunity for integrated land use and transport planning in Northstowe.

The vision for Northstowe in transport terms is a development that is 'highly accessible by sustainable modes of transport, not only within the town but also to surrounding areas. Instrumental in creating the right conditions will be a design approach that allows people to easily walk and cycle within Northstowe and take advantage of the Busway and other local bus services.' The Busway will run regular services (15 buses per hour at full build out) off the main route, through the heart of Northstowe, as well as to Huntingdon and Cambridge.

There is a distinct synergy between the Guided Busway and Northstowe. Practitioners reiterated that the site selection and project are driven by a desire for sustainable transport: 'One could not happen without the other'. The question is whether this is a unique situation that would be difficult to replicate (e.g. disused rail line that also serves other towns, brownfield site, etc.).

The internal street layout is Manual for Streets compliant. All development will be within 600m walk of a Busway stop. The A14 is also to be upgraded, to dual three lanes, with parallel local roads.

Again the Transport Assessment (WSP, 2007) is based on very ambitious targets. The TA assumes a 48.5% car mode share by 2025 (internal and external trips). 20% of inhabitants will work in Northstowe, and also 10% will work at home. The average commute travel distance will reduce by 20% relative to current patterns.

A general point made is that it is easier to build public transport infrastructure for a new town when it can also serve existing towns.

This reduces the problem of low patronage during housing build-out while high-frequency service should be available from the outset so as to attract passengers as they move into their new homes. Transport modelling has shown that the Busway will run at capacity from the outset due to patronage from existing towns on the route and that service will have to be increased to support increased demand once Northstowe is built. Some money will be set aside in order to increase frequency beyond that justified by demand during build-out so as to encourage new residents to use it. Individual travel plans will also encourage residents to use the Busway rather than the A14 to travel to Cambridge.

From reviewing the evidence, practitioners recommended that new towns should be at least 6,000 dwellings to sustain their own facilities and employment centres. Planners also have to be realistic that Cambridge is the main employment focus for the region and so there is a need to provide sustainable transport options. There is a difficulty in that many of the employment 'centres' for Cambridge are located around the edge of town and difficult to serve by public transport.

Sometimes there are 'unintended reasons for getting traffic demand management measures accepted'. For example, opening a new park and ride was related to the closure of a road in Cambridge. An incremental approach to new schemes such as park-and-ride and traffic calming is better in order to gain public acceptance and learn from initial project sites.

An important feature of retailing in Cambridge is that it is mostly located in the centre. Potential edge of centre developments were refused throughout the 1980s and 1990s. The City Council has partnered with John Lewis to develop shopping in the city centre with minimal car access.

Process/Governance

Led by Cambridgeshire County Council, a consensus developed around the development strategy that was included in the Structure Plan. Housing numbers were steered by the Regional Planning Guidance, but a local acceptance of the need for growth supported strategic planning around preferred locations for new development. The local authorities managed to obtain funding for the Busway (£92.5 million out of £106 million required). Implicit in this decision was an offer to develop part of the Greenbelt.

Cambridgeshire Horizons was established as a local delivery vehicle for the growth areas. It is a limited company comprised of six voting members: the five District Councils and Cambridgeshire County Council. Non-voting members include groups with an interest in the delivery of growth areas. It is not really a decision-making body as it does not have any statutory powers but it does appear to be a good mechanism for maintaining impetus, strategic direction and keeping the various players involved in local development together.

Generally, there has been a radical shift in the Conservative authority in support of sustainable transport. Again, the Busway was critical to the acceptance of the Northstowe proposals. Sustainable transport initiatives to reduce congestion, including housing development in the Green Belt, were sold to constituents on the basis that they would help car users by getting unnecessary cars off the road.

In terms of funding issues and macro economic difficulties, viability modelling is being used to inform s.106 negotiations with the Northstowe developers so that expectations are realistic and the process can keep moving forward.

Summary of Key Issues

- The South Cambridge area has a high proportion of journeys to work by car

(68%), lengthy journeys to work (35% over 10km), and a UK-average rate of traffic growth 1997-2007 (15%). Again, there is much wrapped up in these figures: rurality, income, cultural factor, as well as urban structure. Transport CO2 emissions per capita are high at 4.61 tonnes per person. Achieving sustainable travel behaviour in the Cambridge region is hence a huge challenge.

- Transport was important in defining the strategic location of growth in the Cambridge region. Northstowe was selected partly because it was located adjacent to the Busway proposal.
- The internal layout of Northstowe and the Busway link represent very good practice for integrated urban planning and transport planning in the UK. There are remaining concerns, however, in terms of the actual travel outcomes that are likely to be achieved.

4.9 Case Study 8: Rural Areas

The final case study represents the 'generic' rural experience in an attempt to represent the non-urban experience. The level of expected new development is, of course, less of an issue. The following issues are explored:

- The influence of transport in the location of new development (is any level of concentration possible, or dispersal taken for granted?)
- How can land-use influence travel behaviour in an area dependent largely on the car?

Key Development/Strategy Discussed

The case study material is based on an interview with the Commission for Rural Communities and a limited amount of follow up work concerning relevant planning documentation. North Yorkshire is used as a proxy for 'rural' within parts of Table 11 to help illustrate the relative position of transport in rural areas.

Weston Otmoor, Oxfordshire, is used as a case study, again to illustrate some of the issues involved in rural development and transport. Weston Otmoor is the name given to an eco-town proposal submitted by Parkridge Development Land Ltd, adjacent to the existing village of Weston on the Green in Oxfordshire, near the special landscape area of Otmoor. The proposed development is not on the most recent Government shortlist as having the potential for eco-town status (DCLG, 2009).

Table 12. Key Statistics for Rural Areas

Metric	Rural	England
Resident population	9,507,225	49,138,831
Population density (people per hectare)	0.85	3.77
Accessibility ranking	43%*	78%
% journey to work by car	69%	61%
% journey to work over 10km	38%*	28%
Traffic growth (1997-2007)	21%**	14%
Transport CO2 emissions, tonnes per person	4.00*	2.25

Source: ONS Census, 2001; DfT Road Traffic Statistics, 2007; DfT National Core Public Transport Accessibility Indicators, 2004; Defra National Atmospheric Emissions Inventory, 2006.
*North Yorkshire Super Output Areas (SOAs) used as a proxy for rural area. North Yorkshire population density is 0.21 (rural areas only).
**North Yorkshire County

The Weston Otmoor site is located about 3 miles from Bicester and 7 miles from Oxford. It is divided by the dual carriageway A34 trunk road which connects the two towns and has the M40 on its eastern boundary. On its southern boundary is the little used Oxford-Bicester rail line, formerly part of a through route to Bedford and Cambridge, and which is currently the subject of a major investment proposal by a consortium of local authorities referred to as East-West Rail. The site is almost wholly 'green-field' with about 30% within the outer-most part of the Oxford Green Belt. The proposal is for a town of up to 15,000 dwellings and a similar number of jobs with related community and transport facilities.

Interview Findings: Current Practice

The context for travel in rural areas is, of course, very different to urban areas. Traffic on rural roads has grown faster than urban areas in recent years. Rural residents make a similar number of trips to urban residents but these trips are longer and undertaken more often by car. These differentials are growing. Cars dominate travel to services and work; walking is the only other significant mode of transport in small settlements (Land Use Consultants for Countryside Agency, 2004; Banister, 2005; Stokes, 2008). Much of rural life is dependent on car-based mobility. Transport CO2 emissions in [typical] rural areas are very high.

Weston Otmoor

The Weston Otmoor proposal notes that there are two primary components where beneficial change can be instigated in terms of seeking to reduce CO2 emissions. There are buildings and transport. Whereas improved construction and management of buildings can be achieved anywhere, the developers maintain that the objectives of reducing the need to travel and the extent of car use "can only be achieved through proper strategic planning (i.e. identifying the right location) and through a proper integration of land use and transportation at a local level". It is stated that the Weston Otmoor scheme has been promoted substantially because of its location – not only is there a local housing need, there is a context for commercial success. However "primarily and crucially there is the opportunity to effect a dramatic revision to the way transport is designed, managed and operated because of the site's connections to the East-West rail line and the concomitant association with the Oxford-Cambridge arc."

The developers propose a 'fast, free and frequent' public transport system. This is based on a high quality on site tram network linking serving the town's housing and employment areas and linking them via the town's 'High Street' to a new station on the Oxford-Bicester rail line. From there an upgraded rail route as part of the East-West proposal ("funded if necessary by the development") would provide a service to Oxford every 6 minutes, to Bicester every 7.5 minutes and every half hour to Milton Keynes and London (the latter via a new spur at Bicester on to the Chiltern line). A park and ride car park for 6,000 cars would also be provided at the rail station to intercept other motorists travelling to Oxford along the congested A34.

The highway proposals for the town envisage a single point of entry/exit via a redesigned junction 9 onto the M40 and A34. Within the site priority would be given to pedestrians, cyclists and the tram. Demand management of cars exiting the site would be achieved through deliberately holding traffic signals at red whilst a variable toll would be imposed on vehicles leaving or entering the town. A real time information panel installed in each house and workplace would identify current public transport timings, car queuing lengths and toll charges.

It is through these measures that the necessary restraint of originating car trips referred to previously is expected to be achieved: "The combined effect of the free tram and train services and the demand management on the roads will initiate and sustain the transformational impact of the transport solution for Weston Otmoor."

Both Oxfordshire County Council and Cherwell District Council are opposed to the proposal on a number of grounds including

- the detrimental effect anticipated on the development of nearby Bicester, itself an expanding town within the existing development plan;
- the potential impact of additional traffic on the already congested A34;
- non-compliance with the policies contained in the South East Plan;

- breach of the Green Belt;
- major concerns about whether the proposed infrastructure package that underpins the eco-town can be achieved.

Following the Panel report into the draft South East Plan (prepared in advance of the eco-town initiative) the Secretary of State in July 2008 proposed that additional housing provision in the county should be increased from 1,700 to 2,034 dwellings a year. Given the limited opportunities for additional dwellings within existing urban areas it would be necessary to look for other areas to meet future housing requirements, including selective reviews of the Green Belt whilst continuing to ensure that it fulfilled its role in shaping the pattern of settlements. However the proposed changes to the Plan require this review to be focused to the south of the city in an area where the City Council has proposed a major urban extension. The Plan does not refer to the need for new settlements in the region and envisages making best use of previously developed land, protecting the countryside and promoting urban renaissance as a means of delivering the region's future housing need.

In an appraisal of short-listed eco-town schemes (Scott Wilson, 2008), the Weston Otmoor scheme was considered alongside a previously rejected scheme at Shipton-on-Cherwell (about 6 miles north of Oxford, adjacent to the Oxford-Banbury railway line). In addition a new proposal for a sustainable urban extension immediately to the north-west of Bicester, favoured by Cherwell District Council, was also included.

The transport-related strengths of the Weston Otmoor proposal (subject to verification of its feasibility) were assessed as

- its proximity to the Oxford-Milton Keynes railway;
- its relatively large size and employment provision which might facilitate self-sufficiency;
- its internal transport and movement proposals;
- its contribution to the reopening of the Oxford-Milton Keynes railway and to highway improvements at junction 9 of the M40.

The transport-related weaknesses were assessed as

- its proximity to a congested road junction on the M40 and A34 which may encourage commuting and exacerbate congestion.

Issues which required further consideration included:

- traffic impacts on the strategic road network;
- network issues with the railway proposals.

It is notable that the implications of the Weston Otmoor proposal for prospective travel patterns and overall car mileage arising from the combination of its strategic location and package of demand management measures do not appear to have been investigated in any depth. This presumably is a consequence of the limitations placed on the appraisal exercise as a whole given the number and range of assessments which had to be made within a very short timescale. The feasibility and affordability of the transport measures are also central to the town performing in the way its promoters envisage and these were also outside the scope of the exercise.

Overall Weston Otmoor was one of only two proposals which were graded 'C' – signifying "allocation only likely to be suitable for an eco-town with substantial and exceptional

innovation". By comparison, both the Shipton and North-West Bicester proposals were graded 'B' – "location might be suitable for an eco-town subject to meeting specific planning and design objectives".

Summary of Key Issues

- This case study has developed only a cursory examination of planning and transport issues in rural areas. Much closer analysis would be useful here. Rural areas are clearly very different to urban or edge of urban locations and offer a different potential for integrating planning and transport objectives.
- At first hand, rural areas appear difficult in that travel tends to be very car dependent (high share of car in the journey to work, lengthy journeys, low accessibility by public transport and consequent high transport CO_2 emissions per capita).
- The Western Otmoor case study explores some of these issues, noting the large 'gap' between sustainable travel aspiration from the developer's viewpoint, and travel patterns that are likely to be realised on the ground.
- An important issue for rural areas is to reduce the disparity between high levels of mobility and the potential for accessibility by public transport. This will mean a very careful selection of locations for development and greater use of demand responsive services, taxi/car sharing schemes and electronic means of interaction.

4.10 Conclusions

The review of practitioner experience has thus provided some illuminating experience. There is much good practice that can be transferred; there is some that is less impressive. There is much more that could be done if there was a greater knowledge and awareness of the current state-of-the-art in terms of theory and practice.

There is no great familiarity with academic work (beyond Newman and Kenworthy, Headicar/Banister). Hence the work is not used in decision making. Instead practitioners follow "conventional wisdom of contemporary practice". Often there is a serious lack of capacity for strategic planning rather than lack of individual knowledge.

It seems there is a clear difficulty in implementation across many of the case studies. Practitioners constantly reflect that 'good intentions' [concerning integrating land use and transport planning, or sustainable travel behaviour] are modified in view of the difficulties of practical applicability.

The main findings from the case studies are reported under the following headings:

- Interpretation of sustainable development in relation to land use /transport integration;
- The relative importance of transport in local policy-making;
- The treatment of land use/ transport interaction within strategic planning;
- The treatment of land use/transport interaction within local development planning processes.

1. The interpretation of sustainable development in relation to land use /transport integration

A key finding from the case studies is the extent to which politicians and professionals in a wide range of situations accept and seek to apply the principles contained in PPG13, notably concerning:

- The concentration of new development in urban areas;
- Regard for the availability of employment and issues of housing/jobs balance;
- Opportunities to access jobs and facilities by modes other than the car;
- The design of developments to facilitate and encourage the use of non-car modes.

In fact these appear to have become so far absorbed as 'conventional wisdom' that direct reference to PPG13 itself is rare (and any research evidence underlying it even more so).

At the same time, however, the concerns and aspirations of practitioners appear to be limited by what is contained in the guidance. In itself this is unsurprising – most spatial planners do not claim any special expertise in transport matters and their job is difficult enough trying to fulfil the many different dimensions of policy guidance whilst securing deliverable development.

It is important therefore to highlight a fundamental difference between the presumptions on which the policy guidance is based and those which characterise research in this field. The guidance seeks to 'reduce the need to travel' and to offer a 'choice of modes'. It is expected that this will lead to some reduction in the volume of car travel, but this is not an explicit objective and local authorities are under no obligation to pursue this or to demonstrate achievement. By contrast the research is typically concerned with exploring the extent to which particular land use patterns or transport interventions do or might deliver less travel and modal shift. Implicitly therefore the research adopts as goals the *minimisation* of travel and the *maximisation* of modal shift -

but these are not goals which planners are required to pursue.

This might appear to be a case of semantics – but the limitation of the PPG13 aspiration has led to constraints in practice. Planning authorities do not have to demonstrate that a particular development proposal is optimised in these respects (or even the extent to which sub-optimal arrangements are being accepted in the interests of other objectives), only that the principles of the guidance noted above are being followed. As a result there is a large area for local discretion (the difference between an optimised land use/transport arrangement and alternatives which satisfy PPG13 principles). The extent to which this is exploited in particular situations (i.e. the extent to which 'sustainable travel' as a stand-alone objective is compromised) depends on the relative importance attached to transport and other policy objectives. TAs written on behalf of developers, or even the policy section of LTPs or other strategies, can tend towards the 'greenwash' end of the spectrum.

2. The relative importance of transport in local policy-making

A remarkable feature to emerge from the case studies is the extent to which transport has come to be seen by local authorities as a means of delivering other, primarily economic, objectives (in many case this includes the delivery of additional housing numbers). One of the interviewees expressed the relationship succinctly as the 'economic strategy determining the spatial strategy, which in turn determined the transport strategy'. However the way this manifests itself varies considerably depending on local circumstances (see Box A). Certainly financial viability is very important, particularly to the internal design of developments, mix of use etc.

Box A. Examples of economic considerations as drivers of spatial strategies

In Greater Manchester there are separate initiatives directed to improving radial accessibility to Manchester as the regional centre, as well as securing investment to district centres in the north of the conurbation as part of an overall objective of 'economic re-balancing' (relative to the higher growth recently achieved in the south).

In the North-East and in the MKSM sub-region options for concentrating development have been moderated in order that smaller settlements receive a share of the housing growth allocation (with local stakeholders hoping that this will advance their prospects for infrastructure investment).

Luton/Dunstable has accepted major housing growth within MKSM in the belief that this will help the urban area achieve 'critical mass' and a claim on major transport investment which it had previously been 'denied'; a new strategy for Plymouth has a similar foundation.

In Birmingham the closure of the car factory at Longbridge prompted a high profile local planning exercise to restore local employment opportunities. This resulted in one of the country's first Area Action Plans, which included abandonment of a previous proposal to reopen a local rail branch in order to facilitate commercial development proposals in Longbridge centre.

In Cambridgeshire the rapid growth of the city as a 'high tech' employment centre had prompted a review of the strategy for the sub-region. This led to both release of former Green Belt land at the city periphery for employment and housing as well as a proposed new settlement (Northstowe) close by instead of a continued scattering of housing growth throughout a wide area.

In Newcastle (Great North Park, Gosforth) and Plymouth (Sherford) 'greenfield' land had been allocated for housing on the edge of the respective cities, notwithstanding physical brownfield opportunities within the built-up area. In both cases this was in order to secure provision of 'executive' housing, under-represented in the existing housing stock, and thereby contribute to wider employment objectives. Since local market

conditions rendered brownfield sites insufficiently attractive, these allocations were viewed as a 'lesser evil' than the alternative of private housing developments in free-standing settlements further afield which would inevitably have fostered longer distance commuting.

Alone amongst our case study areas Oxfordshire is distinct, in that local councils other than Oxford City continue to press for a spatial strategy which gives primacy to protection of the Oxford Green Belt (Box B). However because of favourable conditions this is seen to be compatible with economic objectives, although arguably the transport implications are adverse.

Box B. The situation in Oxfordshire

Oxfordshire County Council is notable for having pursued a policy of 'urban concentration' since its first Structure Plan in the mid 1970s. This coupled the imposition of a tight green belt around Oxford city with the bulk of new housing being directed instead to the expansion of four smaller freestanding towns elsewhere in the county – the so-called 'country towns' strategy. A combination of limited success in attracting new employment to these towns, the continued growth of Oxford itself as a sub-regional centre and increased car ownership within the population has resulted in substantial longer-distance car commuting. Traffic levels within the city have been contained by a long-established policy of demand management including extensive parking controls within the inner city and Park and Ride sites at the periphery.

A more recent focussing of housing growth on two of the four freestanding towns (Bicester and Didcot) is open to question on account of the additional traffic demands placed upon the already congested A34 trunk road which links these with the city and forms the movement spine of Central Oxfordshire. A package of road improvements incorporating bus priority measures is planned for access to Oxford itself, linked with a policy of developing 'premium' inter-urban bus routes. However, although this can be expected to further high levels of bus use to the city centre, the ability to secure substantial mode shift to other areas of employment in the city and Central Oxfordshire more generally (where equivalent demand management does not prevail) has yet to be demonstrated.

Following the recent examination of the Central Oxfordshire element of the South East Regional Strategy the Government has proposed accommodating a proportion of the county's new housing requirement by means of release of green belt land on the southern edge of the city, which offers ready access to the city itself and to major areas of local employment. Currently this proposal continues to be opposed by the county council and by South Oxfordshire – the district council within whose boundaries the land is located.

The relative importance attached to economic considerations, especially in the context of housing growth or regeneration initiatives, is a relatively recent phenomenon and its implications for major transport investment are only starting to emerge. Long-standing schemes in the Highway Agency's programme for trunk roads and local authority schemes, included as candidates in the initial RFA (Regional Funding Allocation) exercise conducted in 2005/06, typically reflected traditional traffic and highway engineering concerns. The process of transition is a difficult one since locally the traffic and related safety and environmental concerns do not go away and competition for available public funds is if anything increased. The clear tension with environmental objectives, including CO_2 reduction targets, means that practitioners struggle to reach a balance in strategy-making, but particularly in investment and implementation terms.

Within the case study areas the changing context is well illustrated by controversy surrounding the proposed dualling of the A418 between Aylesbury (a growth area within the MK/SM sub-region) and Leighton Linslade as part of the route linking it with Milton Keynes. This long-standing scheme, discredited in the eyes of some as a legacy from an outdated highway engineering era, has acquired new significance in the context of the current spatial strategy.

Buckinghamshire County Council and business interests in Aylesbury tend to view the scheme as an improvement in the town's connectivity and necessary to foster local employment and complement planned housing growth. On the other hand, as with regional transport investments in an earlier epoch, such improved connectivity is a two-way process and may only exacerbate economic concentration *within* the region and associated longer distance car trips from smaller urban areas such as Aylesbury.

Mainly for economic reasons therefore what might be viewed as optimal spatial strategies from a transport perspective are moderated. The degree of compromise appears to be least where development is concentrated in freestanding towns and cities which occupy a dominant position in their sub-region - such as Plymouth, Cambridge, and to a lesser extent Luton/Dunstable, where relatively high levels of 'self-containment' prevail. A similar observation applies to the economic development focus adopted for Manchester within its city region. It cannot be a coincidence that in all the cases quoted there are advanced plans for high quality bus or tram-based transit systems on one or more corridors reflecting the concentration of relatively short-distance movements. The antithesis of this is the complex web of movements within the MKSM sub-region where, aside from a few rail-served links, there are limited public transport connections between even the centres of the constituent towns.

Although there will be environmental benefits from the particular transit routes referred to, it is important to report that in none of our case study areas was 'sustainable travel' (in the sense of a specific a goal to contain or reduce actual car use) presented as an overarching strategic priority. In view of the comments made earlier about the prevailing national policy context this may not be surprising but it does contrast quite sharply with contemporary government and media interest in environmental issues, particularly climate change.

3. The treatment of land use/transport interaction within strategic planning

Noted above was the divergence between the objectives set in national planning policy guidance and those implicit in research in this field. There is also a divergence between the research evidence (which points to the significance of strategic decisions in development location as a factor conditioning the amount of car use) and the limited attention which this aspect of decision-making receives in practice. In principle one would expect an 'inverted pyramid' approach to be followed in which greatest attention was given to strategic decisions and progressively less as one moved towards local and site planning where the differential impact between available options becomes more marginal. In practice the opposite appears to be the case with more time and resources being spent investigating the impacts of individual developments. There are several reasons which may explain this anomaly:

a) Strategic decision-making in spatial planning appears to be driven by contestation between local authorities and other stakeholders in terms of desire to attract (or resist) employment and housing and by competition for the associated 'infrastructure' investment that is expected to accompany this;

b) The issue of overall travel and traffic growth is not one which, at the strategic level, falls directly within the constituency of interest of most of the main stakeholders (with the exception of environmental pressure groups). The growth is dissipated over time and space, and impacts on overall environmental conditions are remote and seemingly intangible (including

CO_2 emissions). By contrast, at the local and site specific levels the prospective volume of motorised traffic generated by development proposals arouses great concern amongst those who may be expected to suffer directly from its adverse consequences. In particular highway authorities are concerned to identify impacts on local traffic conditions (as the basis of securing developer contributions for works to ameliorate them) whilst parties acting for land owners and developers will be seeking to challenge these in order to minimise their liabilities.

c) The volume and complexity of technical work required to explore the full travel and traffic implications of strategic spatial options is much greater than that associated with a particular development proposal. Modelling tools are not especially effective in dealing with and illustrating interactions (the range of interactions between urban structure, other socio-economic factors and travel are complex). The manner in which strategic planning is progressed does not normally allow for this scale of work to be undertaken. This was highlighted in the case of the Oxfordshire Structure Plan where even the relatively local issue of the 'direction of growth' to be planned for in Didcot had to be deferred to a Supplementary Review in order to avoid delaying adoption of the Plan itself.

d) The statutory planning process at strategic and local levels proceeds on the basis of reviews every five years or so with a time horizon of 10-15 years. The degree of land use change anticipated during such a period is small relative to established development patterns and this implicitly encourages an incremental ('muddling through') approach to spatial planning. Hence the fundamental reappraisal of development trends and the systematic review of available options of the kind undertaken as part of the Cambridgeshire Structure Plan [also South Hams/Plymouth over Sherford] are rare exceptions. Even these were not conceived over a time-frame long enough to allow for the investigation of 'second-order effects' (i.e. of the land use change consequent on the transport response to the first round of land use change). A sub-regional exercise of this kind exploring land use /transport interaction was undertaken recently as part of the East Midlands RSS but this was not included in our case studies. The default position for strategic planning tends to be an ad-hoc growth based on the existing development pattern, with little strategic differentiation by urban area (MKSM and the majority of other places where growth is allocated). Indeed this is what is encouraged within PPG13 – little differentiation by urban area.

Interestingly the recent set of 'eco-town' proposals – whilst open to criticism that they have not emerged from a systematic consideration of options within the statutory planning process, and the majority are in poor locations in transport terms – have the advantage that they may enable the full implications of the proposed developments to be considered.

The absence of detailed assessments of the transport implications of spatial strategies has two important consequences:

- There is no sense of scale as to the transport disbenefits which arise from giving primacy to economic or any other objective. This does not invite careful discussion of the trade-offs which are in fact implicit in decision-

making. The transport element of the strategic location process is largely ignored;

- In the absence of detailed quantification, debate will tend to be conducted around arguments of principle over transport implications. This begs the question of where such principles come from. Apparent plausibility and compatibility with conventional wisdom are currently important. For example, the presence of a rail station is often quoted in support of development at a particular location without any close analysis of what proportion of trips may expect to be made by train, what the implications are for car travel arising from development there rather elsewhere, and what the net effect is likely to be on overall car mileage. As previously discussed, there is no differentiation by urban area in terms of which is the optimum location for growth.

It is unlikely that the manner in which strategic options are debated will change markedly – the resources for intensive modelling of different growth options are not likely to be available. However, this points to the importance of publishing guidance which affirms or clarifies widely held beliefs about land use and travel behaviour relationships. This would include reference to some of the debate that is occurring in academic circles, up-to-data analysis (using various datasets that are available or can be commissioned), selected case studies and good practice examples. There would be particular value in registering the applicability of various principles in different geographical contexts so that, if a detailed assessment is not being undertaken, it is at least possible for planning professionals to have an 'off-the shelf' resource which is tailored to their type of situation and which does not rely on [potentially misguided] intuitive interpretation.

4. The treatment of land use/transport interaction within the local development planning process

The planning process, in practice, does not always follow the neat trajectory implied in legislation and guidance. For example, developers often 'jump the gun' by submitting applications in advance of the emerging development strategies, and local authorities are put on the 'back foot', often 'planning' via prolonged haggling with applicants rather than advance master planning, etc. This has changed to some extent in recent years with the focus on local development frameworks and masterplanning of local areas. Developers however still try to act prior to document adoption. Local authorities are often threatened with appeals, for example, with some vulnerability to maintaining at least five years supply of deliverable housing land supply.

There is also strong evidence throughout many of the case studies of skill shortages. With regard to the more complex working processes, e.g. s.106 negotiations, this can be a real hindrance to progress. Local authorities are still on a steep learning curve, learning how to extract funding and guarantee delivery in the phasing of implementation. There is a need for the sharing of knowledge and dissemination of best practice. This could very usefully be hard copy and web-based.

There are additional difficulties associated with the uncertain role of agencies such as the Highways Agency (HA). At times they appear to deem development as affecting 'their' network (e.g. extensive challenges in Plymouth); also uncertainty over their response/strategic direction ('a mess' Oxfordshire). There is certainly a mismatch between the HA's ability to intervene and potentially direct the local authorities' decision-making (even over relatively minor developments) whereas County highway authorities have no such leverage, even in

the case of very substantial developments (Northamptonshire).

The apparent relaxation in national guidance concerning residential parking standards poses difficulties in practice (though there is some professional consensus that restraint at the origin is impracticable anyway, certainly beyond the main urban centres).

More generally in transport planning terms, there appears to be little appetite or encouragement for serious residential travel planning/demand management (PPG3) except perhaps in inner city locations. There is [at times] a reliance on demand management at the destination end instead, but there are concerns as to how realistic/geographically extensive this can be (Oxfordshire, Cambridgeshire, Plymouth). In almost all cases the level of public transport investment is not sufficient to result in the mode shares and trip distribution patterns required (and as assumed in many of the Transport Assessments developed).

There is an issue with public resistance to contemporary 'best practice' concerning higher residential densities, design of streets etc. (with implications for siting/organisation of parking provision, violation of intended arrangements leading to clogging of streets with cars, etc.). Also there is some uncertain practice over how to 'plan' for traffic volumes implied by proposed major developments. For example, practitioners stated that the local authorities acknowledged they, at times, 'had their cake and ate it', i.e. where developers were required to accommodate full projected traffic effects AND institute a travel plan, but the effects of the latter in reducing traffic were deemed unreliable and therefore regarded as a 'bonus'. A contrasting approach was the more strategic/longer term approach developed in some areas where it is seen as impracticable to accommodate projected traffic demand within the town as a whole and hence there is serious exploration of the scope and cost-effectiveness of 'smarter choices', drawing on results from the Sustainable Towns programme.

Note that in all these examples transport planning is still driven essentially by traffic forecasting – restraints on traffic growth only arise by what is deemed physically or financially practical, i.e. there is no application of environmental/sustainability limits, or use of approaches such as backcasting – where sustainable futures are designed and a pathway developed back from this in terms of implementation.

A final issue is the intensity of the technical work at particular locations, illustrating the significance and randomness of geographical context (and the 'chance' presence of a single particularly experienced officer). Certain interviewees acknowledged that they were able to give close attention to the planning of the town – and focus funding – as they had only one (and a small/medium size town at that) with significant growth in the county.

5 Synthesis

5.1 Revisiting the Study Objectives

A series of study objectives and issues were set within the study brief. These are addressed below, drawing on the literature review, data analysis, practitioner interviews and previous team experience on this topic.

The central theme is to assess how a better application of the evidence might be achieved in practice. In the past local authorities, in the main, adopted spatial allocation policies that followed the inherited distribution of population, reinforcing the existing settlement hierarchy (Oxford Brookes and WS Atkins, 1996).

In recent years this pattern has been overlaid with growth areas and growth points designated under the Government's Sustainable Communities Plan (with further additions envisaged as part of its Eco-towns initiative). Increasingly the selection of these growth locations has come to be driven more by the prospects for delivery – specifically the interest shown by local authorities and developers in providing the increased housing numbers sought by the Government.

From a sustainability perspective neither the traditional incremental approach nor the more recent market-led initiatives offers the prospect of locating housing where it will contribute to less car travel [in line with the aspirations of PPG13, but consistent with wider policy goals].

5.2 The Current Evidence Base

Q1 (a). How extensive is the current evidence base on the inter-relationships between land use and transport?

Chapter 2 and the Annex summarise much of the literature available on this topic. Individual travel behaviour is the product of a combination of spatial, socio-economic and attitudinal factors. These operate within a wider context of established land use patterns, infrastructure provision, travel costs and cultural norms which are distinctive to particular countries. The direct transferability of much of the research evidence which derives from the US is therefore questionable, however there is much to be learnt from the detailed research carried out, including the empirical techniques employed. The extent of evidence derived from British sources is much more limited and this is a major evidence gap for policy makers and practitioners.

Much of the British research has been conducted using the National Travel Survey as its data source. This is potentially very powerful but unfortunately is constrained in the one dimension that is of particular relevance to spatial planning, namely the origin of the data. As a result only the locational attributes which NTS identifies (e.g. settlement size or distance from a rail station) can be utilised in analysis. This is important since – with the exception of the settlement types which are explicitly identified (London and the individual metropolitan areas) - it is not possible to disaggregate the national data in a way which relates to the circumstances of spatial planning at sub-regional and local levels. The dataset also becomes unreliable below the Government Office Region and county scales (depending on type of analysis, e.g. level of further disaggregation employed).

1. The value of NTS in informing planning exercises is lessened by two further factors: The large variability in socio-economic characteristics within and between the regions of the UK. This is evident in the travel data at regional and 'county' level reported earlier (the issue of socio-economic variability more generally is documented in Dorling and Thomas, 2004). This variation is reflected in contextual factors such as such a housing markets, job opportunities, traffic levels and even local policies towards

transport demand management. It means that in practice it is almost as difficult to translate 'national' GB evidence to particular localities as it is to translate US evidence to GB. There is therefore a need for empirical research at a range of scales, including the more local scales, e.g. at residential estate level.

2. The narrow range of circumstances which are relevant to the main debates in spatial planning. As the data analysis has demonstrated, the large differences in travel behaviour which can be identified spatially from NTS relate to London and the metropolitan areas at one extreme and rural areas at the other. By contrast most of the debate on the location of development focuses on cities and towns of various sizes and settings in between and to different places in and around these urbanised areas (i.e. the mid range of the settlement size scale).

Much of the literature in the UK is also concerned with 'design issues' at the street level (e.g. DfT, 2007, Manual for Streets). Whilst these are not unimportant their significance for overall travel needs to be put into perspective. Travel within a new community is small relative to the external travel. Only around 15% of all car mileage is undertaken on trips of less than five miles. Although there may be other reasons for wanting to reduce this type of car use (e.g. in limiting traffic volumes in particular localities) the overall economic and environmental gains from reduced mileage itself will be low.

NTS data demonstrate a similar amount of mileage undertaken on these short-distance journeys in all settlement types. This is not surprising since a large proportion of trips are essentially local in nature (e.g. everyday shopping, escorting children to school and even many work trips) and will be made to destinations in the home settlement or to places close by. However the corollary is that it is longer distance (essentially 'inter-town') trip-making on which attention deserves to be focused in seeking to reduce overall car mileage, particularly from smaller urban areas in the 3-25k category.

In terms of practical application of the evidence on density as a factor in car use, rather than a generic, "one size fits all", overall densification, a more appropriate policy would be to promote differential densities in different urban centres, but particularly on the main public transport nodes and corridors. This principle may have additional value in terms of house type and price in catering for people who do not have personal use of a car. Analysis of NTS using data on proximity of local facilities suggests that this has a positive effect on modal choice but more so on car ownership, particularly multiple car ownership (Dargay and Hanly, 2004). Hence there are likely to be benefits in coordinating efforts to increase density with mixed use provision focused along public transport corridors.

Returning to the issue of 'inter-town' travel the almost identical levels of car mileage reported from the NTS for towns within categories from 25k to 250k seems counter-intuitive. Larger towns offer a much wider range of jobs and services, implying less need for residents to travel outside the home town in order to access workplaces and other more specialised services. One would not expect the greater volume of external travel by residents of smaller towns to be offset entirely (on a per capita basis) by longer average trip lengths of internal trips within the larger towns. This issue merits further consideration, especially since it is between such towns that strategic planning choices for additional development typically have to be made.

Further insights can be derived from the local studies undertaken in Oxfordshire (Headicar and Curtis, 1994, 1995, 2000) and Surrey

(Hickman and Banister, 2007a, 2007b). It is evident that there can be very wide variation in trip making (by distance and mode) between similar residents living in places of the same size and character. This variation is not evident from the aggregated manner in which NTS results are reported by settlement size. The apparent reasons for these differences are outlined below:

i) the relationship of a particular settlement to other (larger) settlements within its sub-region

No settlement functions in isolation and the extent of external travel by its residents will depend on the relative size and proximity (or more strictly accessibility) of others in the vicinity – particularly the next largest in the settlement size hierarchy where jobs and facilities are likely to be available which are not found in the home town. The NTS does not differentiate between settlements in this respect – a freestanding city like Norwich for example is included in the same category as Coventry which is adjacent to a large conurbation. For smaller towns the relationship to larger ones is particularly important, not simply because the latter will tend to reduce the 'self-containment' of the former but because people working in the larger towns are more likely to see nearby smaller towns as potential options for home location.

The extent of self-containment on the one hand and the distance to larger towns on the other have offsetting effects as far as overall travel volumes are concerned. All other things being equal, relatively remote towns will have a low proportion of external trips but the average trip length of these external trips will be high. Conversely small towns close to larger ones will have a higher proportion of external trips but the average length of these trips will be much lower. [The travel patterns of Banbury and Abingdon in Oxfordshire exhibit these features]. The net difference in overall travel volume will depend on the relative size and proximity of the settlements concerned and on a number of additional factors outlined below.

ii) the accessibility by road and rail to these larger settlements

As noted above, accessibility and physical proximity are influential factors in external travel. For example, commuting by train or motorway from a freestanding town some distance from a city may involve no more travel time than from a dormitory village located much closer. In terms of minimising total travel through out-commuting, locating residential development in towns not served by the main inter-urban routes would therefore be desirable. Where significant out-commuting is inevitable this principle would ideally be modified so as to favour places where the relative accessibility by public versus private transport is high. In general this principle can only be brought into play around London and other cities where good rail options are available, although there could be opportunities for developing similar road-based connections elsewhere (e.g. the proposed bus-way from Northstowe in Cambridgeshire or the bus priority corridors in the Greater Bristol area).

Although there is empirical evidence (from Bicester and Didcot in Oxfordshire, and Guildford and Woking in Surrey) of large differences in the volume of out-commuting by road and rail consequent on such accessibility differentials it is questionable how far this arises from the spatial features themselves as opposed to characteristics of the people responding to them. Again, the issue of self selection needs testing for in the data (this has yet to be researched in Britain). In the example just quoted it is clear that people whose workplace is served by rail and who are predisposed to commuting by rail will seek home locations which have good rail connections. Conversely people whose workplaces are accessible by car – and perhaps whose vehicle is paid for by their employer – will seek home locations served by the strategic road network which enable

them to maximise the trade-off between commuting time and housing preference.

Ideally research would be undertaken into the 'pre-disposition' of people moving to new development concerning their commuting behaviour and the extent to which this influenced their choice of home location. Limited evidence is available of the variation between new developments in the extent to which occupants who commute by car have considered, and would regard as practicable, travelling by other means (Curtis and Headicar 1997) and in the difference in travel behaviour between 'in-movers', 'outmovers' and 'stayers', using longitudinal analysis in Surrey (Hickman and Banister, 2007b).

iii) the relationship of jobs to workers in the 'home' settlement (quantitative and qualitative)

In recent decades there have been divergent development trends at the sub-regional level with employment tending to concentrate in a few main centres whilst housing continues to be spread amongst a range of smaller towns. This is reflected in the differing jobs/worker ratios which characterise settlements at different levels within the settlement size hierarchy and the greater proportion of out-commuting which takes place from smaller settlements. The objective of a 'jobs/housing' balance is nevertheless a traditional tenet of planning and is reiterated in PPG13 (para 30).

Independent of the numerical relationship between jobs and workers the volume of out-commuting can also be affected by qualitative factors, i.e. by how well a town's housing stock (accumulated over many decades) matches the preferences of people currently employed in its workplaces – or vice versa in terms of job suitability for local residents. The effects of qualitative mismatch are well illustrated by Swindon which actually possesses a good numerical balance. Radical change from the town's traditional industrial character has resulted in a large proportion of the current 'white-collar' workforce living in smaller settlements at varying distances outside the town whilst its relatively inexpensive older housing is utilised disproportionately by people commuting long distances to workplaces in the Thames Valley and Bristol areas.

iv) the spatial profile of house prices, in particular its consequences for 'enforced' inter-town commuting

The effects of job/worker imbalance – quantitative or qualitative - in a single town may be compounded by imbalances at the regional level which define the broader context in which housing choices are made. These imbalances are reflected in a 'house price gradient' (for similar properties) which declines with distance from the main centre, especially London. Both effects are particularly pronounced in situations where Green Belt policies have been applied. Green Belts can extend the house price gradient outwards in two ways;

- by severely restricting housing supply within the Green Belt itself and thus forcing overspill demand from the principal city further out;
- by vesting properties in the Green Belt itself with a premium value in terms of accessibility and amenity (including safeguard from further development) thereby creating a 'rise' in the house price gradient.

Evidence from Surrey and Oxford demonstrates these effects. In the Outer South-East regional and sub-regional house price gradients may overlap in many towns creating a 'cascade effect' in terms of commuting flows. Hence London workers may be 'displaced' to commute from somewhere like Reading, whereupon workers in Reading are further pushed out to places such as Swindon. In these pressured areas the extent of out-commuting from individual towns (and resulting average trip lengths) will

be much higher than the spatial features of the towns themselves would imply.

Q1 (b). How influential is it (this evidence) in decision-taking?

There is no distillation of evidence of the kind presented above which is readily available to British planning practitioners. The most public sources are the original ECOTEC report (1993) and the 'PPG13 Guide to Better Practice' DoE, 1995). Both these sources are therefore more than a decade old and it is doubtful whether they are still commonly referred to. In any case they obviously cannot embody the insights derived from the more recent local studies which are particularly important in translating the general principles into appropriate policies at specific locations.

Studies of planner's response to the 'PPG13 agenda' were undertaken for the Government in 1996 and 1999 (Ove Arup) and this evidence was used to inform the 2001 revision of the PPG. Actual outcomes in terms of changes in the location of new development were studied further in 2004 (WSP and Arup). However these studies demonstrated the extreme difficulty in isolating planner's awareness of land use/transport relationships and the significance of this in influencing their decision-making. This is because of:

- The multiplicity of other factors which bear upon decision-making;
- The extent to which PPG13 reinforces traditional policies of urban containment and complements other more recent (and more obviously 'visible') policies favouring urban densification and use of brownfield land (PPG3) and the siting of commercial development within established centres (PPG6).

Although 'PPG13' is quoted in relation to a large proportion of planning decisions the impression gained is that this widely takes the form of 'supplementary argument' to back up decisions which are driven primarily by other criteria. To identify the degree of genuine understanding and significance attached to land use/transport issues it would be necessary to identify cases where these pointed to an outcome which was different from that implied by other policies. However because of the complementarity between policies noted above such cases are inherently unlikely.

The unique contribution of PPG13 is therefore less likely to be found in relation to the 'big' issues of settlement size, location and density and more in relation to the finer detail over matters such as the layout of developments, local facilities, parking provision, level of bus service, and any associated infrastructure provision and management arrangements included in a section 106 agreement. Contemporary practice in relation to these matters has been the subject of separate research. However the general message is that, consistent with the tenor of PPG13, these issues are addressed pre-eminently in terms of the provision of 'travel choice'. It is rare for these policies to be pushed to the point at which significant restraint in car ownership (in residential developments) or car use is implied – notably in relation to parking provision – except for employment and residential uses in or close to major centres. Such action would run counter to developer (and occupier) preferences – and hence threaten the delivery of development itself. If pursued unilaterally by individual planning authorities it would also be perceived as threatening the competitive economic position of the town concerned.

A further reason for the low profile of PPG13 issues in practice is the relatively generalised manner in which the guidance itself is articulated. In purely physical terms (coupled with its ready 'fit' with other main policies) it is therefore not difficult for its requirements to be fulfilled. Much more difficult is for

these requirements to be interpreted in particular local circumstances in a way which contribute to an actual reduction in car use. This subject is explored further in discussing existing guidance in Q3 below.

5.3 Policy Levers and Guidance Available?

Q2. What are the levers that the planning system can use to influence travel patterns at different spatial scales?

In principle the levers available to planning authorities can be considered at three main spatial scales as follows:

Regional (via policies and proposals within Regional Spatial Strategies)

- The volume and spatial distribution of new housing development as between different parts of a region and in particular as between its main settlements;
- The areas in which new employment and other major non-residential developments is to be concentrated, having regard to public transport accessibility criteria;
- The relative importance of different settlements as service centres;
- The main locations or routes for improvements in highway infrastructure* and for public investment more generally (e.g. in regeneration);
- The standards to be adopted for parking provision and (in theory) the policies to be followed in the application of local road user charging and demand management more generally.

*Note however that although most major highways technically require planning permission the main instrument of control in practice is funding approval, i.e. via the Regional Funding Allocation (RFA). At present the RFA is mainly used for highway schemes. The RFA also represents only a small proportion of transport spending.

Urban (via policies and proposals within Local Development Frameworks)

- The location of the main areas of new residential development, particularly in relation to established employment and service centres and to transport routes and nodes;
- Suitable locations for non-residential development, having regard to public transport accessibility criteria;
- Identified locations for public facilities;
- The density of new development;
- The delineation of specific areas in which sub-demand parking standards and other forms of demand management are to apply;
- The identification of main routes to form part of a town's bus, cycling and pedestrian networks;
- Locations for transport improvements to be made by highway authorities (as identified in the Local Transport Plan).

Individual sites (via development briefs and development control, including the negotiation of elements secured through planning obligations)

- The land use mix and the spatial distribution of land uses and development densities within the development site, including sites reserved for affordable housing;
- The provision of safe and convenient access and distribution routes within the site for the various transport modes and their connection to networks in the vicinity;
- The design and management of these routes so as to give priority to non-car modes and to facilitate their use by disabled people;

- The design of development layouts (buildings and routes) in ways which promote personal security;
- The amount of car parking provision, its spatial distribution and allocation between private and public spaces, including suitably designed provision for disabled drivers;
- Provision for cycle parking and storage;
- Provision and siting of local facilities to be included as part of the development (through developer contributions);
- Arrangements for the management of travel and parking on the site (via a Travel Plan secured as a planning obligation). These may include support for provision of bus service, public transport information, car club etc. and measures to ensure appropriate prioritisation/ utilisation of available parking space.

Q3. How effective is the existing guidance on the ways in which transport issues should influence planning decisions at the regional, sub-regional and local scale?

There appear to be three aspects to this question:

3a). How well does the guidance embody the available evidence?

The guidance does not fully reflect current understanding of land use/transport relationships in the following respects:

1. PPG13 advocates that additional housing this should be focussed on 'existing towns and cities' (para 13). It does not discriminate in any way between different urban settlements. However the evidence suggests that (in terms of settlement size) – and with all other things being equal – there should be a presumption in favour of settlements with a minimum of 25,000 population and, if possible, larger than this.

   This is of practical importance, because in many shire counties there are few towns of this size (perhaps only the county town). Whilst there may be other factors which would justify development in smaller towns it would be better if this were acknowledged as an exception. Otherwise the PPG can be interpreted as 'legitimising' a scattering of development within a number of smaller towns. In situations where there are few larger towns this change would also emphasise the importance of scrutinising green belt or similar urban containment policies around the larger town (i.e. to avoid a situation in which the search for new housing sites is 'automatically' displaced to smaller towns).

2. The evidence indicates that the volume of car travel amongst residents of smaller towns is greatly influenced by their spatial relationship to larger ones in the sub-region, in particular their accessibility by car using high standard roads. These factors are not highlighted in the guidance.

3. The significance of this broader spatial relationship is compounded by additional factors relating to the sub-regional jobs and housing market which can result in extensive 'involuntary' longer distance commuting in some areas. Other than the general reference of aiming for a 'broad balance at the strategic level between employment and housing' (para 30) the importance of these additional factors is not highlighted in the guidance.

4. The evidence demonstrates the over-riding importance of car ownership and wider socio-economic/attitudinal factors in influencing the volume of car travel. Although the good accessibility by non-car modes emphasised in the guidance can be considered a pre-requisite for

people choosing to opt for lower car ownership levels this is a relatively weak influence in the face of social norms favouring car ownership and the strength of car reliant (behavioural) and car dependent (attitudinal) traits.

Logically policy guidance would encourage planning authorities to promote the circumstances in which it was attractive for people to possess fewer cars than they would otherwise. This would require a combination of 'stick and carrot' measures at both the home and destination ends of trips. The guidance is especially weak in that it makes no acknowledgement of the scope for such measures within housing development (i.e. via control of parking and by positive promotion of alternatives including car clubs and car share). The current version of PPS3 merely states that:

"Local Planning Authorities should, with stakeholders and communities, develop residential parking policies for their areas, *taking account of the expected levels of car ownership*, the importance of promoting good design and the need to use land efficiently" (para 51, emphasis added)

The previous requirement that authorities should seek an overall average of 1.5 spaces per dwelling (itself too crude to be practicable) has simply been removed rather than revised and no mention is made of the desirability of securing residential travel plans [on which DfT has issued Best Practice guidance!]

5. The 2001 revision of PPG13 introduced specified maximum standards for non-residential parking provision. It observed that "*the availability of car parking has a major influence on the means of transport people choose for their journeys*" (para 49) and that "*reducing the amount of car parking in new development is essential, as part of a package of planning and transport measures, to promote sustainable choices*". Draft PPS4 proposes to remove these national standards, to be replaced by policies developed at the local level (para 25). This appears to ignore the reasons why national standards (which could be enhanced by regional planning bodies) were introduced – namely to prevent individual planning authorities being subject to 'pressures' to allow greater parking provision in order to 'capture' developer investment.

   PPS4 does not remove the following statement in PPG13 concerning non-residential parking provision:

   '*While greater opportunities exist to reduce levels of parking for developments with good access by non car modes local authorities should be cautious in prescribing different levels of parking between town centres and peripheral locations*...' (para 51)

   (This is for fear of creating 'perverse incentives' for development to locate away from town centres). Whilst there may be individual towns which are especially vulnerable on this score as a general principle this advice appears to undermine the overall policy thrust of this part of the PPG in using parking policy as an instrument of demand management Such a policy should not be threatened by the implied inability of planning authorities to control development at peripheral locations.

6. In relation to larger office development draft PPS4 reaffirms the preference for sites in or on the edge of town centres given in PPS6 but adds the caveat: "*whilst recognising that market demand will influence office location*" (para 18). This appears to be a hostage to fortune as firms may well 'prefer' non-central locations as being less expensive and having better car accessibility and parking

availability. If the implication is that planning authorities should alter their decision-making in response to such preferences then the whole principle of favouring central locations and applying the sequential test is undermined. The relevance of 'market forces' in this context is especially questionable in the absence of economic road user charging and any obligation on employers to ensure accessibility for people without the use of a car.

3b). How well does it (the guidance) communicate intended policies (i.e. in ways likely to result in appropriate interpretation by individual practitioners)?

In addition to the substantive limitations noted above there are several examples where, if not actually misleading, the guidance is expressed in a way which does not encourage effective implementation.

1. The fundamental intentions of PPG13 are expressed in an ambiguous manner. This reflects the political sensitivity surrounding car use and 'travel choice' but also weakens the effectiveness of the guidance. Paragraph 3 quotes the role of land use planning in reducing the need to travel, reducing the length of journeys and making it easier for people to access facilities by non-car modes. It states that these will contribute, amongst other things, to the reduction of congestion and pollution. However these outcomes will only materialise if there is actually less car travel. Unfortunately the PPG does not register this point and implies that reduced car use will come about automatically.

   This mis-represents the reality of the situation. Because of the manifestation of car use it is necessary to address this directly if significant change is to be achieved (merely creating the opportunities for less car ownership and use is a necessary but not sufficient condition). The central weakness of the PPG is that it invites planning authorities to secure a particular set of physical outcomes rather than exploring whether these will actually result in less car use or whether alternative locations and/or additional measures (e.g. through travel plans) could be taken to bring this about.

2. Although the term 'accessibility' is of central importance to land use/transport relationships (and is used many times within PPG13) it is not defined at any point. The implied meaning differs from place to place and the ambiguity is compounded by substitution of the term 'access' on occasions instead, which is generally used to refer simply to a physical connection to a site or facility.

3. Authorities are asked to consider the 'accessibility of sites to jobs and services by modes other than the car' (para 14). In itself this is sound and safeguards the interests of people without use of a car. However, in terms of minimising car travel, it fails to add the caveat that, without complementary measures, such accessibility will not lead to any significant reduction in car use amongst those who have this as a travel option.

4. In relation to non-residential uses the guidance asks planning authorities to ensure that "*development comprising jobs shopping, leisure and services offers a realistic choice of access by public transport*" (para 6). Again there is ambiguity surrounding the term 'realistic'. Does this mean that access by non-car modes should be within a reasonable time threshold for the type of facility in question? Or that the journey should be sufficiently convenient relative to the same journey made by car that people with the option of car use would consider it a viable alternative? In other words is accessibility to be interpreted in an absolute or relative sense? From a social inclusion perspective it is the

former which is relevant; from the perspective of reducing car travel it is the latter.

5. For land uses which function as 'attractors' of trips, it is also necessary to ask 'accessible for whom?' The relevant point is that they should be accessible from places where people have need of them. The size and configuration of this catchment will depend on the nature of the facility concerned and on alternative opportunities for the same type of trip within the surrounding area. Thus, say, a supermarket which mainly serves a particular neighbourhood or town may reasonably be located at some accessible point within it. However if it also serves a surrounding rural area, including possibly one or more smaller freestanding towns then it will be important to select a location in or close to the town centre, since it is normally only here that there will be a 'realistic choice' of accessing it from these other areas by public transport.

3c). How effective is it (the guidance) in actually influencing planning decisions?

The effectiveness of PPG13 and related policy guidance in influencing development location was studied by WSP/Arup as part of their research for DfT in 2004. The general conclusion was that a more sustainable pattern of new development was beginning to emerge (Para 3.20). However there were several factors which made it difficult to elaborate on this:

- Interpreting change over a period as short as a decade is made difficult by the lead times involved in the planning and development processes. Many of the development completions recorded since 1994 reflect planning decisions made before that time.
- The research was confined to parts of four city-regions. It is difficult to generalise from these over a relatively short period of time because of different rates of development activity and because of the distorting effect of large individual developments which happen to be completed in particular areas at particular times.
- As with socio-economic influences on travel behaviour it is necessary to classify areas in some way in order to interpret development outcomes on a like-for-like basis. The research piloted a particular area-type classification but experience suggested that some revision in this would be appropriate.

Arguably, given the passage of a further five years since 2004, there is a strong case for revisiting and updating this research, confining it to development completions over the last decade.

A more general difficulty in judging the effectiveness of a particular set of planning policies is the yardstick against which their outcomes should be compared. The WSP/Arup exercise explored the changes in the pattern of development completions taking place during the period in which PPG13 policies were being implemented. This could record whether a 'positive' trend appeared to be emerging but not whether more might reasonably have been achieved.

A separate aspect of the effectiveness of PPG13 (other than development location) is the amount of parking space which has been permitted. An early exercise conducted on the application of parking standards in South-East England (Llewellyn-Davies and JMP, 1998) indicated that the intended switch from minimum to maximum standards asked for in PPG13 had been achieved in many cases simply by relabelling the previous standards! These standards often exceeded the levels of demand which were observed after development completion – in other words they were having no discernable restraint effect in practice.

Another aspect of effectiveness is the extent to which Travel Plans have been secured through the planning process (and the quality and impacts of these). Some evidence on this can be gained from the research which has been conducted on the different types of Travel Plan, since these typically identify the sources from which they have been derived (the planning process being only one). However, although it is easy to report cases where travel plans have been secured in this way, it is much more difficult to identify those where one might have been, but wasn't. In any case the mere production of a Travel Plan is a weak indicator of effectiveness since they are very variable in quality and judgements on quality would need to take account of travel impacts and the context (opportunities and constraints, socio-economic and attitudinal baseline) surrounding individual cases.

Both development planning and travel planning research tends to focus on outputs (i.e. the characteristics of the development or the travel plan) rather than outcomes measured in terms of travel behaviour. This makes judgements on overall effectiveness virtually impossible. Even where travel data is available the question arises, as with development completions, of the base against which they should be compared (by definition there is usually no 'before' situation to use as a yardstick). To explore these questions would require a very carefully targeted research exercise – for example, comparing employers with similar workforces in the same area, but at different locations, or in the same location but with/without a travel plan, and probably including some form of multi-variate analysis.

5.4 Barriers and Obstacles to Effective Practice

The interviews conducted as part of the case studies provided further useful insight into the relationship between research and practice and in particular the role of formal guidance.

A clear distinction needs to be made between the understanding of spatial planners involved in either policy-making or development control and that of transport planners working as technical 'consultants' (either within or for a local highway authority) giving advice on the transport implications of proposals.

For spatial planners transport in general, and 'sustainable travel' in particular, are but one of many policy fields on which Government guidance is issued and to which they are required to have regard. Reconciling often conflicting objectives in relation to a particular area or site is extremely difficult in a purely technical sense. Not only does this stretch the understanding of the various subjects by the individual professionals involved it also implies that they are unlikely to attempt to do more than satisfy the basic policy requirements, which are typically expressed in a generalised manner anyway. These efforts in turn have to be reconciled with local political and stakeholder aspirations on the one hand and with the opportunities and constraints represented by particular local property markets, sites and developers on the other.

In the extended discussion, negotiation and formal examination which occupies much of the way land use/transport issues are considered reflects an accepted discourse amongst the professionals involved. Only exceptionally, and at particular points in the process, is detailed technical evidence invoked. Hence the 'received wisdom' represents a very powerful influence on planning practice.

Because of the attention given by planning practitioners to Government guidance the presentation and implied understanding of land use /transport interaction it contains (3a and 3b above) has a critical role in influencing prevailing beliefs. It is no coincidence, for example, that PPG13 is written in terms of the planning of individual urban areas (and that this is how the subject

is viewed by most practitioners), notwithstanding evidence of the relationship between settlements in influencing overall travel behaviour. Likewise, being written as national guidance, PPG13 does not encourage practitioners to recognise the wide variety of spatial contexts to which it is being applied and to highlight the widely differing scope and nature of appropriate interventions within these contexts – i.e. there is a difference between urban areas. This would require additional 'practice' guidance which is not currently available.

The advice offered to local practitioners by transport specialists is different in nature. Much of this follows traditional highway planning practice in attempting to forecast what the traffic implications of a particular spatial planning scenario or development proposal are likely to be. Any alternative assumptions which might moderate these forecasts are regarded as tangential and uncertain. Hence the research literature which surrounds this subject is essentially 'out of scope' of normal practice. One very experienced practitioner in our case studies commented that he was unaware of the material in the research summary we had circulated but that he concentrated his efforts on trying to keep up with advances in modelling practice in order to improve his authority's forecasting capability.

These observations illustrate the different 'frames of reference' (Rein and Schön, 1993; Tennøy, 2008) which are being applied by professionals in a given situation. These will influence their interpretation of a set of 'objective' conditions and the meaning they attach to national and local policy statements. These differences can lead to misunderstanding and contradictions in practice, even amongst professionals who are nominally working to the same agenda.

Table 13. Frames of Reference

Framing of Problems	Experience in the Case Studies
Differences in opinion as to the importance/desirability of 'traffic reduction' as a policy objective	Widespread evidence of conflict between political and professional espousal of 'sustainable development' as an over-arching objective and confronting its transport implications when placed in competition with economic and other local aspirations
Differences as to the realistic possibility of reducing traffic – resulting from the combination of 'certain' growth factors on the one hand (affluence and increasing population) and uncertain reduction factors on the other (political resolve and whether, if implemented, restraint measures would actually work)	Scepticism over the efficacy of soft measures in particular continues to be rife in English practice (not helped by evident ambivalence of DfT on the subject). Clear difference between realistic options available for intra-urban trips and impotence in the face of dispersed/inter-urban trips
Differences over the relative significance of public transport as a factor in influencing traffic/emission levels	Exacerbated by the diversity of settlement sizes/spatial contexts
Differences over the efficiency of land use planning as a factor in influencing traffic/emission levels	Almost certainly replicated in England because of the recognition of land use planning as a necessary but not sufficient condition to reducing car travel, and because development control only acts on a margin of land use activity during any one planning period
Intention/action mismatch over approach to road capacity: conflict between universal view that 'we can't and shouldn't build our way out of traffic congestion' with actual decision-making which increases road capacity	Nominally 'predict and provide' has been repudiated as a policy position but with development proposals predicted traffic generation is the focus of attention (because of fear of local consequences of inadequate provision and use of

	forecasts as a means of securing developer funding of highway schemes)
Differences in belief as to consequences if additional road capacity not provided	Contrasting situations – some development examples where full extent of traffic generation is perceived as 'inevitable'; others where unrealistic mode split assumptions are employed to scale down traffic forecasts (and developer funding liability)
Conflict between assumptions built into traffic forecasting models and policy aspirations re traffic reduction; dominance of the former and inability to adapt to new agenda	Applies in local exercises but variable demand modelling now required by DfT in assessing major transport options. Traditional modelling tools unable to represent behavioural changes adequately.

These points reinforce the case in England for better practical guidance to reduce uncertainty/ misunderstanding over the 'facts' of travel behaviour in different locational contexts (i.e. the base situation), the range of possible local interventions and realistic assessments of their efficacy in these contexts; and clearer policy guidance, ideally nationally, but certainly sub-regionally, over the scale of potential traffic growth to be planned for – thus reducing uncertainty/disparities between the work of practitioners in different but related implementation fields (e.g. the HA and LA highways, traffic management, land use planning, development control, parking, public transport, travel plans, etc.)

5.5 Best Practice Examples

To assist in the development of a best practice guide concerning the integration of settlement structure and transport [to be confirmed by CfIT], an initial selection of best practice examples are discussed below. These can be further discussed and, alongside the case study material, form the basis of any future guide. The examples are drawn primarily from the UK, continental Europe and North America.

The best practice examples are categorised by dominant theme as follows: (1) urban extensions/new settlements; (2) infrastructure-led developments; (3) integrated development and transport, particularly aimed at reversing the trend of urban dispersal; (4) integrated transport planning; and (5) process/government structure.

(1) Urban Extensions / New Settlements

The Upton, Northampton urban extension enquiry by design process improved street layout and design. Design code played an important role in the planning process, as did public transport and connections with surroundings. It is debatable whether full outcomes were achieved – including the external links to the site.

The Newcastle Great Park urban extension benefited from an innovative management board, and residential as well as commercial green travel planning. Developer contributions were made to on and off site non-car infrastructure, and low car dependence was an objective from the outset.

The South Woodham Ferrers, Essex new settlement is road dominated, impermeable, and has poor public transport. However, the delivery mechanism – 30 years ago – is interesting: Essex assembled the land and provided basic infrastructure in advance of development plots.

The Caterham Barracks, Surrey urban extension involved a community planning weekend to get local buy-in and involvement was very successful. s.106 contributions to transport including bus vouchers for new residents. A new bus route extension was introduced but the effect on reducing car mode share is uncertain (as with most developments, monitoring is poor).

For more information on these cases see the best practice urban extensions and new settlements guide published by DCLG/TCPA.

(2) Infrastructure-Led Sustainable Development

The Utrecht, Netherlands expansion areas are mostly focused on rail stations. Examples are Niewegein, served by a light rail line, and the free-standing new town of Houten, focused on a mainline rail station. The latter is conceived and organised as a cycle town, whereby cars can enter the town neighbourhoods from a peripheral ring road. They cannot pass from one neighbourhood to the next, or pass through the town centre. A second phase of the town (not originally envisaged), has broken this principle to some extent, but the new area is linked to the original by a tram service. The lines around Utrecht were quadrupled specifically to allow this to happen, as part of the growth strategy.

In Hammarby Sjöstad, Stockholm, the new urban extensions were supported by the extension of the tram system to serve the new development. Reiselfeld and Vauban, Freiburg are similar cases.

Transit Oriented Development (TOD) has found favour in many cities in the US (Baltimore, Sacramento County, San Jose, San Diego, San Francisco for example) and Toronto and Vancouver (Skytrain) in Canada. However, experience has tended to show that three conditions are necessary for such development to occur successfully: (1) favourable zoning policy, (2) sites attractive to developers, and (3) a strong development market. Where one or more of these does not apply, development may not follow transit provision, with Cleveland being an example.

In the UK, many 'transport development areas' are identified in public transport accessible locations.

In the Vauban new development, buses were available from an early stage, but trams came later. The proposed rail station is still not built. However, the development plan ensured from the start that a good quality public transport route could be provided (unlike most new housing areas with loops and culs-de-sac layouts in the UK, which are typically difficult to serve by bus).

(3) Integrated Development and Transport

At Canary Wharf, London, high density office and residential development have evolved with the DLR and Jubilee line. Although this was not pursued as a coherent strategy, the development process occurred as follows:

- Phase 1 – get the (relatively inexpensive) DLR to attract initial investors;
- Phase 2 – high take-up of sites and dense employment puts pressure on DLR, which has insufficient capacity for major intensification;
- Phase 3 – Jubilee Line planned to serve Canary Wharf and (fairly small) developer contribution to its implementation. (Political decision to prioritise Jubilee Line, compared to London Transport priority for Chelsea-Hackney at the time). Also direct DLR link to Bank implemented in this phase;
- Phase 4 – Further employment and retail growth spurred by Jubilee Line so that Canary Wharf becomes a major and more diverse centre attracting shoppers and leisure seekers, not just office workers. Peripheral retail project (away from stations) largely fails – Tobacco Dock;
- Phase 5 – The increased intensity leads to upgrades of DLR capacity.

In short, transport-led and land-use-led growth take it in turns and car use remains very low.

Portland, Oregon has strong policies for TOD and also a defined urban growth boundary to limit sprawl. Intensification is slowly occurring around tram stops, but the later lines to the west of the city centre serve very low density suburban sprawl, and they will find it a challenge to create sufficient density. They have sound "new urbanism" policies, but they are not backed by restrictions on unsuitable development. Developers are often reluctant to go into TOD areas because of the various density and parking rules and design codes that they are asked to comply with. It is easier for them to choose sites without these requirements. This is true even of developers who are committed to more sustainable development.

A more recent new suburb of Utrecht, Netherlands (Leidsche Rijn) is not based on rail, but is linked to the city with a new cycle route including a new bridge across the Rhine. It also has a substantial travel plan element funded by the developers. Early residents of this major new urban extension are encouraged to adopt "car-light" travelstyles by the provision of the "Pioneer" smartcard. This gives residents up to the value of about €1,000 to spend on: free buses from Vleuten (nearby existing settlement), free or discount on taxis from Central Station, free cycle parking at Central Station, and free car club membership and reduced hire rates.

In Horsham, Sussex, a pedestrian/cycle link via a bridge over the by-pass into pedestrian priority town centre combined with attractive bus access supports the vitality of the pedestrian centre. This is an improvement over pedestrian centres that are cut off from their catchment by a ring road that is difficult to cross (e.g. Redhill, Chatham; Ashford, Kent; Harlow, Essex).

In Barcelona, the regeneration of a former industrial area involved the rebuilding of the "Diagonal" to incorporate tram, cycle and pedestrian modes on the boulevard with high density office and residential along the route. Also a new "Rambla" connection was created via an established mixed use street to the beach. A new park was created as part of the scheme and existing ugly road infrastructure is to be demolished (2008).

In The Hague, accessibility criteria is used to determine the development around three main stations, in terms of office and other development. Tram and rail multi-level interchange was created with major new development at Den Haag CS, which has also linked HS to the city centre with a new pedestrian spine.

In Birmingham, the ring road has been bridged over to create a new pedestrian link to Symphony Hall. The ring road flyover has been demolished at Masshouse Square to create at-grade crossings and more pedestrian friendly environment, which will now allow regeneration of the areas on the other side of the ring road from the city centre. Feared traffic problems have not materialised.

In Tubingen, social housing development Franzosisches (former barracks) regenerated the area and good bus links terminate at a mixed use community hub. The development includes a highly successful scheme dealing with "problem" households in an inclusive way. Local employment was also encouraged.

Other good practice examples of integrated development and transport include:

- Wateringsveld – major suburban development with tram extension operational within occupation date of first 300 homes;
- Karlsruhe and Kassel – tram-trains knit together suburban and remote communities with city centre;
- Fitzroy (Melbourne), Commonwealth Avenue (Boston) – successful mixed use, tram based medium density suburbs;

- (Historic) London suburbs – Ealing, Chiswick, Richmond, Hampstead are all built along the Underground network, at relatively high densities and to a high quality;
- Strasbourg, Montpelier and Grenoble, France – tramway system combined with development densities, reduced traffic capacity on some roads, park and ride, no traffic zones, and cycle parks near stops; Strasbourg and Montpelier in particular prioritised tram lines to socially deprived and remote estates with high immigrant population demonstrating a strong social component to the transport-land use planning;
- Montpellier, France – has planned both new residential quarters (e.g. Malbosc) and high tech employment, and leisure venues (also Malbosc) at intermediate stations, thus helping to make the tram more viable with balanced and all-day passenger traffic;
- Toronto, Canada – high density suburban development around stations on the underground network; also network of underground shopping streets in city centre with intensifies retail densities served by tram and subway.

(4). Integrated Transport Planning

Space within cities for low emission vehicles, such as:

- La Spezia, Italy – city-wide use of bioethanol vehicles;
- Brazil – 30% of cars are powered by ethanol;
- Bogotá – a high percentage of cars are to be removed from the city centre;
- London – congestion charge linked to emissions; London low emission zone charges polluting goods vehicles;
- London Boroughs of Westminster and Richmond – parking concession for electric vehicles;
- Berlin, Cologne, Hanover – environmental zones restricted to vehicles meeting emissions standards;
- Germany – solar charging facilities for electric cars that are driven in to the city for the day.

Cycling is encouraged and supported in Copenhagen where an extensive cycle track network is complemented by the provision of city cycles for public use. A key aspect is the integration of cycles with public transport. Suburban stations in Copenhagen are primarily cycle and ride and sometimes have integrated bus interchanges, for example Ballerup. In Munster, Germany cycle parking is sheltered and guarded cycle parking is available at intermodal stations with adjacent cycle repair shops. Comprehensive cycle lanes and paths exist for both transport and recreational use, and cycles are integrated with trains and buses through carriage of cycles in special spaces.

Other cycling good practice examples are found in:

- Paris, Lyon, Seville – Vélib programme;
- Barcelona – free bikes (not Vélib) introduced in 2008 (“Bicing”);
- Freiburg – central station cycle park/café and cycle hire;
- Stevenage and Milton Keynes – demonstrate that cycle infrastructure (better in those towns than almost any other UK town) is insufficient to achieve high mode share (by itself).

Streetscape improvements encourage walking in:

- Strasbourg – town centre integration of low speed tram and pedestrians;
- London – World Squares enhance public realm and benefits of streetscape improvements evident on High St Kensington;
- Newcastle –shared space solution to pedestrians and buses on Blacket Street;
- Bristol – legible city signing;
- Bilbao, Spain – pedestrian entrances to the metro and very impressive regeneration from cultural investment and public realm;
- Melbourne – waterfront improvements.

Public transport investments are fundamental to integrated transport planning in:

- London – major schemes include Crossrail, Overground network (orbital services), Docklands Light Railway, and suburban trams (Croydon);
- London – bus priority network is more advanced than other UK cities, and almost certainly a product of the unified political responsibility for and control of buses and highways (i.e. progress was much slower when London Transport was under central control, and highways rested with GLC and successors);
- Heathrow, London – proposed Ultra system (ultra light rapid transit);
- Manchester – tram;
- Nottingham – tram now leading growth directions and applauded for tram-bus integration;
- Montpellier, Strasbourg, Grenoble, Orleans, Bordeaux, Nantes, Nice, etc – French modern tram phenomena is an object lesson in how to use high profile infrastructure to regenerate the economic and other fortunes of once moribund cities, and competition fostered between cities has also been a positive by-product;
- Ottawa (Canada), Brisbane (Aus), Nancy and Caen (France), Padova (Italy), Curitiba high capacity system (Brazil), Transmileneo (Bogota), Cambridge Busway (UK) – guided bus/bus rapid transit best practice;
- Paris – RER;
- Eurostar, London-Paris/Lille/Brussels – long distance travel substitution from air to high speed train.

Quality public transport interchanges are especially critical to achieving integrated transport in:

- London – Canary Wharf Jubilee stations/some DLR, St Pancras, Paddington;
- France - TGV Méditerranée stations;
- Portugal, Lisbon – Oriente Expo station;
- Gothenburg, Sweden – Nils Ericson bus station;
- Yokohama, Japan – ferry terminal.

Demand management and pricing is an integral component of transport planning in:

- Central London – congestion charging scheme;
- Singapore – electronic road pricing in Singapore;
- Vancouver – downtown parking supply restricted.

Flexible mobility services are an emerging component of integrated transport planning in:

- Lincolnshire – Interconnect;

- Hampshire – Cango;
- Wiltshire –' Wigglybus';
- Ireland – Rural Transport Initiative provides on-demand bus services;
- Ystrad –Taxi Bus;
- Wales – on-demand bus service.

It would also be exciting/very useful to find an example of city-based demand responsive transport, particularly for application in suburban areas.

An example of broader integration, intermodality, and good organisation of transport is Lund, Sweden where the reconstruction of the railway station offers transfer possibilities between all the public and private transport modes and included provision of increased park and ride capacity, connection of two sides of the city, with the construction of a bicycle bridge, increased bike and ride capacity, and improved connections with city and regional bus networks.

Best practice examples of traffic and parking management measures are found in:

- Gdynia, Poland – intelligent transport system has equipped trolley buses with computers that prolong the duration of green lights to enable more efficient public transport movement;
- Vauban, Freiburg – regulation and location of parking (parking on the edge of Vauban, further distance than tram stop), shared use of road surface;
- Reiselfeld, Freiburg – underground parking within residential extension;
- London – congestion charging scheme;
- Surrey – parking strategy linked to accessibility;
- Southampton General Hospital, Orange in Bristol - parking cash out schemes.

Car-free and car-reduced housing is a means of traffic and parking management that is found in Amsterdam' s Westerpark and in various small schemes in London, including covenants preventing residents from owning a car (e.g. Camden, Islington).

(5). Process/Government Structure

In Barcelona, the regional government has had a minister in charge of both planning and transport since 2003. This has led to the development of a more integrated approach to development and infrastructure planning. There is a design code that gives the local authorities power to require developer contributions for transport connections (similar to s.106 in England).

During planning for the Beaulieu Park, Chelmsford development highway staff from the County were seconded to Chelmsford BC and sat alongside planning colleagues (as a general arrangement, not just for the development). This enabled much closer integration and negotiation of planning and transport aspects of the development, resulting in a much higher standard than usual. This to an extent overcame some of the friction that sometimes arises due to planning and highways/transport responsibilities being split between county and district levels (however, this arrangement was terminated in 2006, and the highway engineers have returned to the County).

The Walsall unitary authority has 'development team' meetings with developers pre-application. The meetings are attended by officers covering highways, planning, pollution, housing, building control, development control and ecology, landscape, plus if needed leisure, education and Environment Agency. This enables developers to get an early response to

proposals and can avoid time wasting alterations and refusals. It is also efficient for council officers, who can avoid endless one to one consultation with colleagues and uncoordinated responses (Manual for Streets - DfT, 2007 p24).

Finally, rail investment is organised differently in continental countries. Regional bodies (usually directly elected) have control over or can raise funds and can allocate these to rail investment according to approved regional plans. High speed rail usually falls outside this system and is dealt with under national programmes. In the UK Scotland is perhaps the nearest equivalent, but elsewhere rail investment is heavily centralised. This may be seen as a barrier to integration, to add to that of deregulated bus services. By and large, local and even regional authorities in England may identify strategies for growth based on public transport provision, but these bodies can provide no guarantees to developers that it will ever materialise, and certainly not in the timescale developers are working to.

6 Recommendations

This study provides a thorough review of the current international literature on settlement patterns and travel, and some initial data analysis using the NTS dataset. It has also developed an understanding of current practice in England using a series of practitioner interviews.

Based on this analysis, a number of recommendations are made which we would see as contributing to better practice in integrating land use and transport planning. These are conceived as suggested changes to guidance which may help practitioners in the field, additional evidence/research to further understand particular topics or trends, and key procedural changes. The recommendations are summarised in Table 14, including reference to spatial scale, actors and timescales.

Improved Guidance

1. PPG13 needs revisiting and updating as a Planning Policy Statement: this can be given renewed vigour, particularly in light of climate change issues, and various sections can be brought up-to-date and/or tightened up (i.e. rendered less ambigious /incomplete). Areas in need of updating include the strategic imperative (climate change), greater emphasis given to traffic demand management, 'smarter choices' and the psychology of travel. Other topics include the differentiation of development focus between urban areas (i.e. considering the transport impacts of different locational choices), the use of an index of urban structural variables rather than [mainly] density, wider definitions of density, parking standards, etc. The case for at least 'updating' the PPG seems to be universally acknowledged (and this was an important issue in the interviews carried out during this study), and practitioners are starting to question the use of what was viewed as a very useful and original guidance note. Whatever overarching national policy stance is taken on the issue of car traffic growth itself, the present extensive 'wriggle-room' which allows the letter to be observed, but not the spirit (whether exploited knowingly or otherwise), deserves to be reduced.

Improved Evidence/Research Base/Tools

2. Extensive aggregate level empirical analysis: using NTS and the Census, including consideration of the self selection and causality issues, and covering land use, socio-economic and attitudinal characteristics and their association with various travel indicators. UK and regional analysis can be carried out, with a temporal dimension. This work will give an up-to-date understanding of the current aggregate patterns trends and build on the initial work developed in this study and earlier academic studies.

3. Extensive but selected local case study empirical analysis: again this would include consideration of the self selection and causality issues, and cover land use, socio-economic and attitudinal characteristics and their association with various travel indicators. This would necessitate use of bespoke surveys (at new housing and other developments). It would include cross-sectional and longitudinal analysis. This would build on the initial approaches developed in Oxfordshire, Surrey, Kent and Tyne and Wear and give some UK-based analysis comparable to that found in the US. The value of developing work specific to the UK is that the context in urban structure (and price of travel/public transport infrastructure/attitudinal) terms is very different to north America, hence there is likely to be a greater association between settlement structure and travel.

4. Before and after empirical analysis: to test behavioural responses to certain interventions, including higher density developments, mixed uses, jobs-housing balance, development at certain location typologies, and integrated planning/transport infrastructure/smarter choice/ streetscape design packages. The current evidence base here is weak beyond the Sustainable Travel Town Initiative (which has a specific and different focus). This could also include some reference frame analysis based on the UK experience, potentially using the case studies developed in this study. This would further explore the actual application of knowledge in practice and potential for improving progress towards sustainable transport outputs. There is also potential to link this type of research with wider analysis on the psychology of travel.

5. Benchmarking research: particularly in terms of understanding relative good practice and travel behaviour indicators (mode share, average travel distances, trip distribution) and likely applicability to the growth areas. The development of and assumptions within TAs can, for example, be much enhanced by a more thorough knowledge and dissemination of what mode shares/trip distribution patterns can be expected in certain locations based on an assumed investment strategy. This may include improved and/or new decision support tools useable by urban planners and transport planners to assist with site selection and assessment of impacts.

6. Improvements to the NTS by development and incorporation of transport attitudinal and lifestyle related individual questions. This would support improved and consistent analysis of the inter-relationship between attitudes, lifestyle and travel. In addition, the incorporation of additional spatial form variables attached to the household level dataset would prove invaluable for future ongoing NTS based analysis. Such spatial form variables may be introduced by capturing the spatial coordinates or postcode at the NTS respondent's residential address as part of the survey programme and releasing the information for selected studies. Alternatively, if this does not sufficiently address privacy issues, this information can be captured but released only to internal DfT professionals who then, through geospatial analytical techniques, can append a variety of detailed spatial form variables for the survey year to the NTS household level dataset.

7. Improvements to the robustness and ease of use of accessibility planning in the UK, including use of the DfT's national core public transport accessibility indicators: there is a need to develop the methodology, including improvements to the underlying local and national datasets, repositories, data collection, data auditing, data cleaning, indicator definition and implementation procedures. The formal transition of the DfT's national core accessibility indicators from an experimental statistic to a formal national statistic by the Office of National Statistics (ONS) may follow the previous improvements together with enhanced links and search functionality of the Neighbourhood Statistics website.

Improved Process

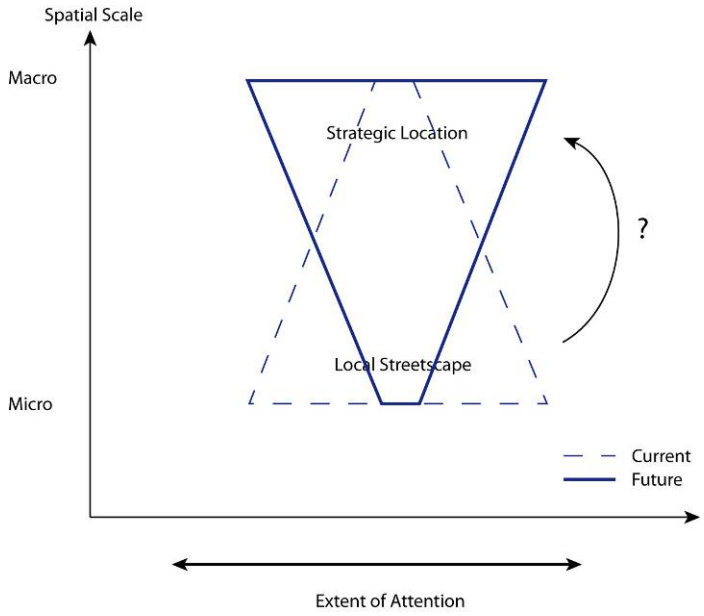
Beyond the recommendations for improved guidance and evidence, the most important 'barrier' to be overcome is the uncertainty which currently surrounds land use/transport planning with respect to the volume of prospective demand that is being (or should be) catered for in different areas.

The present 'pyramid' nature of contemporary practice whereby the greatest attention to

land use/ transport integration (including in Transport Assessments) is given at the lowest level (site/development) in the spatial hierarchy needs to be inverted, or at least revised. A more thorough assessment at the strategic level would give visibility to traffic generation/growth considerations [rather than being submerged within generalised arguments] and demonstrate the scale of the economic and environmental trade-offs which are being made in subordinating transport to employment, investment, housing delivery and localist agendas.

A strategic framework would then set clear parameters for the planning and management of local transport and development being undertaken by many different professionals in a variety of settings instead of the present rather random cumulative outcome. Figure 27 demonstrates the thinking here – the need for a greater emphasis on the strategic issues. Although the Manual for Streets and the local streetscape design agenda has been a very useful progression in recent years in transport planning (mainly in terms of integrating urban design issues with transport planning) it has led to a focus on local, internal layout issues.

Figure 27. The 'Inverted Pyramid' – Strategic Analysis Deserves Greater Attention



Hence, we also suggest:

8. The development of transport futures scenario studies, at the regional-level: covering urban integrated planning and transport investment and with a focus on achieving future optimum end states. Backcasting study approaches may be very useful here (see Hickman and Banister (2007c, Hickman et al, 2008c). These could be conceived as much improved 'strategic and forward looking' versions of the 'Road Traffic Reduction' reports prepared by local highway authorities 10 years ago. These were not necessarily geared to traffic reduction but did at least require authorities to identify and acknowledge projected traffic growth and its effects and what, if anything, they intended to do to mitigate them. Given the changed strategic (climate change) and institutional context of 2008, much-improved versions of such analysis could be required as part of Regional Transport Strategies, wherever sub-regional insets

were being prepared as part of the RSS (e.g. MKSM, Central Oxfordshire, South Hampshire etc). It is suggested that these do not follow the traditional forecasting transport planning methodologies but instead follow a backcasting methodology. These would identify a future image(s) of sustainable/integrated development and transport to be worked towards (for 2025 and 2050) and develop policy pathways and implementation priorities back to the present day. These would therefore necessarily operate within a longer time horizon and reflect and feed into the sub-regional spatial strategy. They would help conceptualise the pathways towards deep reductions in transport CO2 emissions, and feasibly other objectives. They would be prepared collectively for functional areas across individual LA boundaries; reflect the scale and nature of public transport, road and other transport investment envisaged in the area through the RFA; embrace trunk roads and rail/bus investment where applicable; and identify the type, scale and incidence of demand management measures needed. The backcasting methodology would allow a strong monitoring mechanism to be developed, with the strategy and investment programme altered if agreed pathways were not being achieved (e.g. ensure progress towards headline CO2 targets). The analysis might form part of the evidence base for the RSS, or even Single Integrated Regional Strategies.

Also, the interests of land use/transport integration (and of effective stakeholder involvement) are not best served by the two separate statutory processes of LTPs and LDFs at local authority level (and progressed by separate authorities in non-unitary areas). The reform of LTPs envisaged in the current Local Transport Bill presents a major opportunity to bring these processes closer together, if not into a common exercise. Hence, we would also suggest:

9. LTPs should be prepared with a much closer integration to the LDF process. The LTP should include a policy approach and programme which is developed to implement the development strategy. This would more strongly reflect the approach taken at the regional level, where the RTS is prepared as part of the RSS. The removal of LTP's previous standardised five year timetable is timely in that it allows transport strategy work and the associated public consultation to be synchronised with that of the emerging LDF process. LTP's can be conceived as forward looking documents, with a greater focus on strategic goal achievement, as well as local problem solving.

Table 14. Study Recommendations

Recommendation	Spatial Scale	Actor	Timescale
1. Suggested PPG13 update as PPS13	Strategic	DfT/DCLG	A matter for DfT/DCLG, and potentially DECC (Department of Energy and Climate Change)
2. Aggregate level empirical analysis	Strategic	Various – DfT/DCLG/CfIT/ academic funding bodies	2009-10
3. Local case study empirical analysis	Regional/local	Various – DfT/DCLG/CfIT/ academic funding bodies	2009-10
4. Before and after empirical analysis	Regional/local	Various – DfT/DCLG/CfIT/ academic funding bodies	2009-10
5. Benchmarking research, including some reference frame analysis	Regional/local	Various – DfT/DCLG/CfIT/ academic funding bodies	2009-10
6. NTS enhancements	Strategic	DfT/DCLG	2009-10
7. Public transport accessibility planning	Strategic/regional/ local	DfT/DCLG	2009-10
8. Transport futures scenario studies	Regional/local	DfT/DCLG/DECC/Regional bodies	A matter for regional /local bodies (2009-10)
9. LTPs integrated with LDFs	Strategic/regional/local	DfT/DCLG/regional bodies/local	A matter for DfT/DCLG/regional and local bodies

The end objective in further integrating settlement structure and transport is in enabling more sustainable travel patterns. Greater regional and/or sub-regional analysis appears important. There is a current lack of data/evidence at these levels. This should help place settlements in their wider context of labour market catchments and capture the long distance commuting problem (a large growth area, accounting for a disproportionate amount of energy and emissions).

The public, of course, are a critical factor here. There needs to be a much greater focus on participatory approaches to decision-making, illustrating the choice of future lifestyle options in a more transparent manner.

Only through such processes, will the awareness and ownership of the debate improve, and sustainable travel patterns more likely to be achieved. Strategic thinking – for the longer term – is critical. Development location and transport investment decisions made today will influence travel for many years to come.

Annexes

Annex 1: Acknowledgments

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The views expressed in this report are, of course, from the authors and CfIT and do not necessarily reflect those of any of the local authorities or practitioners interviewed.

Annex 2: Detailed Literature Review

A detailed review of the urban structure and travel literature is presented below. The review is presented in a systematic manner – with discussion against a series of urban structure, socio-economic and travel variables. Comments are made against the location of analysis, and method and type of empirical or theoretical treatment. All of these factors can influence the research findings.

Table A2.1. Detailed Literature Review

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
Urban Structure Variables and Travel				
Literature Review and Meta Analysis				
The evidence in either direction is mixed and messy. Numerous studies report that higher densities, a thoughtful mixture of land uses, more open circulation patterns, and pedestrian 'friendly' environments are all associated with less car travel. Others argue that results are either difficult to either confirm or interpret (Crane, 1999).	Various urban and socio-economic variables-	Various travel variables	Various locations, mostly from US or Canada / Literature review	T
Urban planning is well placed to coordinate the variety of factors which individually and collectively are able to influence more sustainable travel patterns … combinations of several land use measures may have significant effects on travel by creating synergies between measures, and land use policies may be complemented by the effects of other, non-land use measures (Stead and Marshall, 2001; Stead, 2000).	Various urban and socio-economic variables-	Various travel variables – number of trips, trip length, mode share	Various, including UK and north American / Literature review	T
Trip frequencies differ little, if at all, between built environment types – auto-orientated or transit-orientated. Some studies showing differences in trip rates fail to control for income or household size differences, which could easily account for the lower rates. Trip rates are likely to be higher in traditional urban areas as destinations are more accessible (Ewing and Cervero, 2001).	Auto orientated and transit orientated area structure	Trip rates	Various locations, mostly from US or Canada / Meta analysis of previous literature	T

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
Urban Structure Variables and Travel				
Literature Review and Meta Analysis				
Trip lengths are shorter in traditional urban settings – the central locations, fine land use mixes, grid-like street networks produce shorter trips. Walking and, to a lesser degree, public transport is more prevalent. This holds for both the home end (residential neighbourhoods) and non-home end (activity centres) of trips (Ewing and Cervero, 2001).	Auto orientated and transit orientated area structure	Trip lengths, mode share	Various locations, mostly from US or Canada / Meta analysis of previous literature	T
It is tempting to look for a simple answer to the question, does the built environment influence travel activity? The problem is that there is not one answer to the question, but many … this depends on the type of physical activity, the aspect of the built environment, the characteristics of the individual (Handy, 2004).	Various urban and socio-economic variables- including population size, density, jobs-housing balance and mix of use, and location	Various travel variables – number of trips, trip length, mode share	Various locations, mostly from US or Canada / Literature review	T
Modest results from scenario testing of different urban forms can be attributed to a number of factors: the slow pace of land use change; scale (the increment of new development against the totality of existing development); the significance of established trip ends in suburban and peri-urban areas (the concentration of new development may lead to lengthening trip lengths); travel is a function of desire, not need (people's propensity to utilise the nearest suitable destination for a particular journey purpose is very weak) (Headicar, 2004).	Urban form, development change	Generic travel	Various locations, mostly UK / Review of previous scenario testing analysis	T
Although the polarisation in the debate is interesting … much of the available empirical analysis has tended to be rather simplistic in its approach. The data is open to several interpretations and causality is usually unproven. The complexity, in the physical sense of the built environment, revolves around at least four separate themes – population size, density, jobs-housing balance and mix of use, and location – all of which are under the control (to a greater or lesser extent) of urban planners. Nearly all analysis is based on cross-sectional data, showing just one 'snapshot' of results in time (Banister and Hickman, 2006).	Various urban and socio-economic variables- including population size, density, jobs-housing balance and mix of use, and location	Various travel variables – number of trips, trip length, mode share	Various UK and international / Literature review	T (Review)
Almost all 38 empirical studies find the built environment has a significant influence on travel behaviour even after accounting for self-selection. The relative strength of the built environment's effect (vs. self-selection) is often not quantified but reported results range from 52% to nearly 100%. 9 statistical approaches are reviewed; longitudinal structural equations modelling with control groups is the	Various urban and socio-economic variables	Various travel variables	Various locations, mostly US / Review of previous analysis that accounts for	T

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
recommended approach (Cao et al, forthcoming 2009)			self-selection	
A review of only those empirical studies that explicitly include attitudinal variables and related theories on attitudes and travel behaviour yields 5 recommendations: longitudinal structural equations modelling is the preferred approach to built environment and travel behaviour analysis; built environment, attitudes, and travel behaviour should all be measured at the same level of specificity; it is important to include variables that describe perceptions; items chosen to measure attitudes should be efficient and contribute to the reliability of the measure; and, questionnaires on attitudes and travel behaviour should be shortened and standardized (Bohte et al, 2008).	Various urban and attitudinal variables	Various travel variables	Various locations, mostly US and some European / Review of previous analysis that explicitly includes attitudinal variables	T
Resident Population Density and Travel				
The more dense the population of a city is the less are the distances that have to be covered. The moral, therefore, is that we must increase the density of the centres of our cities where business affairs are carried out (Le Corbusier, 1929).	Density	Travel distance	Paris Right Bank, France; and later Brasilia, Brazil; Chandigarh, India; and elsewhere	T
Broadacres is a new freedom for living in America. The traffic problem has been given a special attention, as the more mobilisation is made a comfort and a facility, the sooner will Broadacres arrive. Every Broadacre citizen has a minimum of one acre of land per person, and a car. Multiple lane highways make travel safe and enjoyable. The basis of the whole is decentralisation and privacy on one's own ground for all (Wright, 1935).	Decentralisation	Mobilisation	Hypothetical US city of independent homesteads / Theoretical	T
Increasing population and employment densities reduces energy consumption by transport – hence a strong inverse relationship between density and travel. There is a strong increase in petroleum consumption when population density falls below 29 persons/ha. Cities with strong centres and intensively used suburbs are more suitable for better quality public transport and more walking and cycle use (Newman and Kenworthy, 1989).	Residential population density	Transport energy consumption, gasoline use per capita, mostly journey to work data	32 cities around the world / Bi-variate correlation analysis	E
There is no clear relationship between the proportion of car trips and population/employment density in the USA. 'Co-location' of firms and households can reduce journey times and decentralisation can reduce city centre congestion (Gordon et al, 1988) "The idea of planners turning our lives upside down in pursuit of a single-minded goal is as horrible as it is alien. Newman and Kenworthy's world is the Kafkaesque nightmare that Hayek always dreaded, a world where	Residential and employment population density	Car trips	US nationwide Personal Transportation Study / Descriptive analysis, theoretical	E/T

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
consumers have no choice, relative prices have no role and planners are tyrants … Newman and Kenworthy have written a very troubling paper. Their distortions are not innocent, because the uninformed may use them as ammunition to support expensive plans for central city revitalisation and rail transit projects or stringent land use controls in a futile attempt to enforce urban compactness … perhaps Newman and Kenworthy would be well advised to seek out another planet, preferably unpopulated, where they can build their compact cities from scratch with solar powered transit." (Gordon and Richardson 1989a).				
The assumption that counter urbanisation, which has been the dominant urban force since 1945 in most western countries, can suddenly be halted and even reversed, is naïve. Proposals that promote the compact city in its extreme form are unrealistic. Urban containment policies should continue to be adopted, alongside various forms of 'decentralised centralisation' based around single cities or groups of towns (Breheny, 1992c).	Counter urbanisation, urban containment	Generic 'travel'	Generic 'UK' / Literature review	T
[The literature] shows fairly unambiguously that, as urban density increases, energy use for transport falls. The key variables in this relationship are density and the degree of mixing of different land uses. There are however concerns regarding concentrating development in urban areas such as the potential loss of urban green space and 'town cramming'. An alternative way to reduce the physical separation of activities is to decentralise some jobs and services and relate them to residential areas – 'decentralised concentration'. (Owens, 1992).	Urban density, land use mix	Energy consumption	Generic 'UK' / Literature review	T
With increasing population density, the proportion of trips by car decreases, whilst the proportion of trips by public transport and walk both increase. Car trips account for 72% of trips in low density areas (less than 1 person/ha) but only 51% of trips in high density areas (>50 persons/ha). There are many variables apart from density that influence these figures, but the pattern still exists if socio-economic variables are controlled for (Ecotec, 1993).	Settlement size	Travel distance and mode share	UK National Travel Survey / Descriptive analysis, regression analysis	E
Transit and walk share of work trips is greater at higher employment densities; transit and walk share of shopping trips is higher at higher population and employment densities (Frank and Pivo, 1994a)	Population and employment densities	Mode share	Seattle area, Washington / Regression analysis	E
Work trip distances and times are shorter with higher population densities, higher employment densities and greater land use mix (Frank and Pivo, 1994b)	Population, employment densities and mixed use	Work trip distance and time	Seattle area, Washington / Correlations	E
Vehicle miles travelled is lower at higher net household	Household	Vehicle miles	San Francisco	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
densities (Holtzclaw, 1994)	density	travelled	Bay Area, California / Regression analysis	
Transit share is greater at higher densities and in transit-orientated neighbourhoods. The effect of density is compounded by transit-orientated design (Cervero and Gorham, 1995)	Residential density, neighbourhood type	Mode share	Southern California and San Francisco Bay Area / Regression analysis	E
Share of work trips by single occupancy drivers is greater at high densities, controlling for workplace location (Kockelman, 1995)	Gross population density	Share of work trips that are not single occupancy	San Francisco Bay Area, California / Regression analysis	E
Vehicle trips and vehicle miles travelled are less frequent, and transit and walk trips more frequent, at higher densities (Dunphy and Fisher, 1996).	Gross population density	Trips per person, vehicle/transit/walk trips per person, vehicle miles travelled	US nation-wide survey / -	E
Residential densities exerted a stronger influence on commuting mode choices than levels of land-use mixture, except for walking and bicycle commutes. For non-motorised commuting, the presence or absence of neighbourhood shops is a better predictor of mode choice than residential densities (Cervero, 1996).	Residential density, mixed land use	Mode choice, commuting distance, vehicle ownership	United States (11 Metropolitan statistical areas) / Logit and regression analysis	E
An unresolved issue is co-variance - whether the impact of density on travel patterns is due to density itself of other variables associated with density – e.g. central location, good transit (Handy, 1996a).	Density and co-variant variables	PMT, VMT, mode share	San Francisco Bay Area and others / -	E
Density is the most important physical variable in determining transport energy consumption. Although it is difficult to take full account of short walk trips, as the data sources are sparse, it does seem that about 1,000 trips, on average, are made per person per year. Lower densities (1-5 persons per hectare) result in a slightly higher number of trips (+6%) and higher densities (›50 persons/ha) have slightly lower numbers of trips. But it is probably in the higher density areas that there is most under reporting of shot trips, particularly if they form part of a trip tour (Banister et al, 1997; Banister, 1997).	Density	Trips per person	UK National Travel Survey / Descriptive analysis	E
As people move from big dense cities to small less dense towns they travel more by car, but the distances may be shorter (Hall, 1998).	Generic 'urban form'	Journey distance, mode share	Various locations, mostly UK	T

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
			Literature review, theoretical	
Increasing densities reduces energy consumption by transport (Newman and Kenworthy, 1999).	Residential population density	Transport energy consumption	An updated and enlarged dataset relative to the 1989 work – 16 new cities are added Bi-variate correlation	E
Before major commitments to compaction are made, some serious questions should be asked of the approach. [These include] the veracity test, which asks if claims about the merits of urban compaction are true; the feasibility test, which asks whether it can be delivered; and the acceptability test, which asks if the approach is likely to be welcomed by the people who will be most affected (Breheny, 2001).	Compaction	Generic 'travel'	UK Literature review, theoretical	T
The decentralisation of jobs has continued, with a subsequent, continuous rise in commuting among suburbs. Average highway speeds have increased, offsetting a modest increase in trip lengths … hence automobile dependence has not resulted in more traffic congestion. The answer to this 'commuting paradox' is that there are enough 'rational locators' who move house or change job location to keep the average commuting time constant (Richardson and Gordon, 2001).	De-centralisation	Highway speed, trip length, congestion	US National Personal Transportation Study Comparative analysis Meta analysis of previous literature	E
Commuter distance per head travelled by car is strongly related to the density of settlement at the resident end (WSP and Arup, 2003).	Population density, various socio-economic factors	Travel distance and other travel indicators	UK National Travel Survey and Census data Comparative and regression analysis	E
This research assesses the role of density in affecting mode choice decisions in home-based work tours, while controlling for confounding factors. The results confirm the role of density after controlling for the confounding factors; in particular employment density at work exerts more influence than residential density at home (Chen, Gong and Paaswell, 2007).	Density	Mode choice	New York Metropolitan region regression analysis	E
People opt for higher-density living in part because they are concerned about the environment and want to reduce their auto travel and because higher-density living makes it	Intensity of land use	Mode choice	San Francisco Bay area	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
easier to benefit from commuting to work. Lower-density living is chosen in part because it is better geared to fast, flexible, and comfortable auto travel and makes it easier to display cars as status symbols (Schwanen and Mokhtarian, 2007).			-	
It usually requires a fairly high level of density, often estimated at 10,000 people per square mile, to support a substantial transportation system, and even then this system only works well where trip origins and destinations are tightly clustered. The majority of urban territory in the affluent western world falls well below this threshold and increasingly the dominant position central cities held as a centre of jobs for an entire region is being eroded with the growth of regional sub-centres. The new high density, mixed use centres proposed by Smart Growth advocates would not result in any substantial increase in transit use or reduction in automobile use (Bruegmann, 2008)	Density, mixed use	Mode share	Various locations, US / Theoretical	T
Resident Population Size and Travel				
The most energy efficient settlement in the south Oxfordshire data is the larger town (Henley) where there is a high trip generation rate but low energy consumption rate per person and trip, reflecting a good provision of local facilities and services. The least energy efficient settlement is the small, remote settlement (Ewelme) with limited services and facilities. The settlement is too small to be self sufficient and travel by car is essential to reach work and facilities. The intermediate settlement sizes produce a confused picture – population structure, distance from employment and other facilities, levels of car ownership are all important (Banister, 1980 and Banister, 1992).	Settlement size, distance from employment centre, car ownership	Trip generation, trip length, mode share, energy consumption	South Oxfordshire / Descriptive/ comparative analysis	E
No correlation between urban population size and modal choice in the USA (Gordon et al, 1989).	Residential and employment population size	Mode choice	US nationwide Personal Transportation Study / Descriptive analysis	T
There is greater use of the car in rural areas than in urban areas (›25,000 population) in terms of total travel distance per person and average trip length. London residents average higher travel distance and journey length than other urban areas (but not rural). Journey length is closely correlated to mode, with the more energy intensive modes [private car and others] being used for the longer journeys (Banister, 1992).	Settlement size	Travel distance, trip length	UK National Travel Survey / Descriptive/ comparative analysis	E
The largest settlements (›250,000 population) display the least energy consuming travel behaviour. Dispute remains	Settlement size	Travel distance and	UK National Travel Survey	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
as to whether lower travel distances and less by car (Ecotec, 1993).		mode share	Descriptive analysis, regression analysis	
The most energy efficient settlement in terms of transport is one with a resident population size of 25-100k or 250k plus (Williams, 1998).	Settlement size	Travel distance, mode share	UK National Travel Survey, Gloucestershire modelling / Descriptive analysis, regression analysis, scenario modelling	E
The search for the ultimate sustainable urban form perhaps now needs to be re-orientated to the search for a number of sustainable urban forms which respond to a variety of existing settlement patterns and contexts (Jenks et al, 1996).	Urban form	Generic 'travel'	Various international / Theoretical	T
With increasing settlement size, distance travelled per week increases. Adults residing in an urban area of 25,000 to 50, 000 population typically travel 33 miles a week less than those living in rural areas; those in the 3-25,000 population band typically travel 17 miles a week less than those living in rural areas (WSP and Arup, 2003).	Settlement size, various socio-economic factors	Travel distance and other travel indicators	UK National Travel Survey and Census data / Comparative and regression analysis	E
Provision and Mix of Land Uses, Jobs-Housing Balance and Travel				
Suburban workplaces with severe job-housing imbalances tend to have low share of workers making walking and cycling trips and high levels of congestion on connecting freeways (Cervero, 1989a).	Job-Housing balance	Mode share	Metropolitan Chicago and San Francisco / Correlation analysis	E
Communities with approximate jobs-housing balance see a majority of residents working in their home community. Walk, bike and transit shares are greater where retail uses complement office uses. Effective balance is defined as the cohort 0.75-1.50 jobs per household (Cervero, 1989b).	Jobs-housing balance, site intensity, floor space by office and retail use	Carpool share, mode share	Suburban centres across the US / ANOVA, regression analysis	E
Having more people close to their jobs will reduce vehicle miles travelled, freeway traffic and tailpipe emissions (Cervero, 1996a).	Jobs-Housing balance	Level of self containment	San Francisco Bay Area, California / Correlation	E
Use of transit and walk/bike is more likely where commercial uses are nearby; and mixed uses are as important as density (Cervero, 1996b).	Commercial and other non-residential use within 300 feet of residence	Probability of using transit/ walk/cycle, trip length	11 Metropolitan areas in the US / Regression analysis	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
Walking to the station is more likely where retail uses predominate around stations (Loutzenheiser, 1997).	Uses around station – predominance of retail/office/ mixed land use	Probability of walking to station	San Francisco Bay Area, California / Logit analysis	E
Much research advocates 'contained', compact, urban layouts with a mix of uses in close proximity, i.e. a move away from functional land use zoning (Williams et al, 2000).	Various	Generic travel	UK / Descriptive	T
Some features of built environments, including dwelling density and land use mix, have varying degrees of influence on vehicle ownership levels, thus they would be useful in addressing auto-dependency concerns in low density urban development through spatial planning (Soltani, 2005).	Intensity of land use, mixed land use	Vehicle ownership	Metropolitan Adelaide, Australia / Logit modelling	E
Which land-use strategy yields greater reductions in vehicular travel: improving the proximity of jobs to housing or bringing retail and consumer services closer to residential areas? Data from the San Francisco Bay Area, shows that jobs-housing balance reduces travel more, and by a substantial margin (Cervero and Duncan, 2006).	Job-housing proximity Proximity to retail / consumer services	Vehicle Miles Travelled (VMT)	San Francisco Bay Area, California / Regression analysis	E
Within Surrey, households located within areas with jobs-housing balance are associated with low energy consumption in the journey to work: for example, households located in the 1.25-1.5 jobs-housing cohort are 25% less energy consuming than the sample average (Hickman and Banister, 2007a)	Jobs-housing balance	Energy consumption, journey length, mode share (all journey to work)	Surrey, UK / Descriptive, correlation and regression analysis	E
Access to destinations is positively associated with transport-related walking but some types of destinations contribute more to total walking and socio-demographic characteristics are significant. Proximity of workplace is the most significant contributor to walking, especially for women. Relationships between walking and access to destinations are only partly explained by neighbourhood self-selection (Cerin et al, 2007)	Land use mix and proximity to destination types	Minutes of transport-related walking	Adelaide, Australia / Regression analysis	E
Location and Travel				
Self containment in the UK new towns has declined from 1951-1981 based on use of an 'independence index' (ratio of residents working in a town divided by the sum of residents working outside and workers in the town residing outside). The new towns however remain more self contained than other comparable towns, especially with increased distance from London (Breheny, 1990).	Self containment	Journey to work containment within urban centre	UK new towns / Comparative analysis	E
Location of new housing development outside existing urban areas, or close to the strategic transport network, or as free-standing development increases travel and	Accessibility and location (proximity to	Journey distance, mode share,	Botley, Kidlington, Bicester,	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
influences mode split. Whether location exerts an influence by constraining residents once they have moved, or alternatively on the people who choose to move there, discouraging those anticipating high work-related mileage [self selection] is not well understood (Headicar and Curtis, 1994).	Oxford)	trip type	Didcot, Witney; Oxfordshire / Comparative statistical analysis	
Commute distance in London, Manchester and Birmingham increases with distance from urban centre. London experiences a linear increase in commute distance up to 20km from the centre; in Birmingham a plateau is reached at 7km, and then decreases; in Manchester a plateau is reached at 5km (Spence and Frost, 1995).	Distance from urban centre	Commute distance	London, Manchester, Birmingham / Comparative analysis	E
Local provision of facilities (e.g. schools, supermarkets) associated with local use of facilities, shorter average journeys and increased walking. Car based trips are shorter except to schools (Winter et al, 1995)	Local provision of facilities	Average journey length, mode share	Avon, UK / Descriptive analysis	E
Development close to existing urban areas is associated with lower levels of car ownership and less car travel (Headicar, 1996).	Location	Car ownership	Oxford (Botley, Kidlington, Didcot, Witney and Bicester) / Survey and Correlation	E
The main reasons for differences in household travel at urban locations in Oxford appear to be differences in accessibility characteristics and socio-economic attributes of the sample. Proximity to Oxford as an employment source influences trip length and trip mode. The location characteristic reflects a number of components, e.g. journey distance, relative journey speed by mode, restraint of car parking supply in Oxford, priority for buses and cycling. Location accounts for + or – 15-20% to the study average travel distance per week (Headicar and Curtis, 1998).	Accessibility and location (proximity to Oxford)	Journey distance, mode share, trip type	Botley, Kidlington, Bicester, Didcot, Witney; Oxfordshire / Comparative statistical analysis	E
Deconcentration of urban land use to suburban locations and new towns almost certainly promotes the use of the private car for all purposes and leads to less use of public transport as well as cycling and walking. Distance to work however does not necessarily increase (Schwanen et al, 2001).	Residential environment Level of urbanization	Modal choice Distance travelled	Dutch national database	E
Another policy in vogue is to force development into existing built up areas, with the idea of encouraging shorter journeys. But this may also lead to reduced economic growth, as prices increase through lack of competition. Greater mobility has increased the efficiency of households and firms as they obtain cheaper products, services and	Built up areas, economic growth	Generic 'mobility'	UK	T

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
housing by extending the area of potential suppliers. Emissions should be lowered through technological improvements and congestion through capacity increases and infrastructure pricing (i.e. congestion tax) (Echenique, 2001).			Literature review, theoretical	
Concentrating development near rail stations produces an appreciable ridership bonus (Cervero, 2006).	Intensity of land use	Mode share	Greater Charlotte (San Francisco Bay Area exurb), south St. Louis County / direct or off-line modelling of rail and transit-oriented land use proposals	E
Households located close to the strategic highway network in Surrey are associated with high energy consumption patterns: the A31 (in particular), A3, M25 and M3 all contribute to lengthy commutes by car. Better access to the strategic road network in Surrey extends the distance that can be travelled in a fixed time of around 45 minutes (Hickman and Banister, 2007a).	Distance to strategic highway network	Energy consumption, journey length, mode share (all journey to work)	Surrey, UK / Descriptive, correlation and regression analysis	E
Travel impacts of neighbourhood type are measured taking into account self-selection bias: 90% of the difference in travel between neighbourhood types can be explained by different locations rather than self-selection (Zhou and Kockelman, 2007)	Urban, suburban or rural neighbourhood type and various socio-economic variables	Vehicle miles travelled	Austin, Texas, US / Latent index model estimation	E
Regional Structure and Accessibility and Travel				
Shopping trips are shorter at locations with high local or regional accessibility (Handy, 1993).	Local accessibility (commercial employment within the same zone); regional accessibility (access to particular regional centres)	Average trip length, number of trips and VMT on shopping trips	San Francisco Bay Area, California / Correlations	E
Vehicle hours time is lower at more regionally accessible locations. Accessibility to regional activities has much more effect on household travel patterns than does density or land use mix in the immediate area; accessibility has as much effect on the frequency and length of trips as the mode of travel; and these relationships can be best understood in terms of multi-purpose trip making (Ewing, 1995).	Regional accessibility	Trips lengths Trip frequency	Palm Beach Country, US / Regression analysis	E

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Criticizes simplistic and "Draconian" views of urban containment. The compact city is only one factor in reducing energy consumption and it may achieve other outcomes: reductions in CO_2 emissions and lower traffic growth. The trend toward increasing mobility and dispersal is due to many complex factors; urban containment is only one element in achieving sustainable travel (Owens, 1995).	Compact city	Energy consumption, sustainable travel	Generic UK / Response to Breheny (1995b)	T
The availability of vacant and developable land is an important predictor of whether land-use changes occurred near stations. Bay Area Rapid Transit (BART), in and of itself, has clearly not been able to induce large-scale land-use changes, though under the right circumstances, it appears to have been an important contributor (Cervero and Landis, 1997).	Vacant land availability	Land use change	San Francisco Bay Area	
Polycentric development is associated with differentials in suburban and urban commute trip times: commute trips made by employees of suburban centres are shorter in duration than commute trips made by their counterparts in larger and denser urban centres. Lower density, outlying employment centres averaged far higher rates of drive-alone automobile commuting and insignificant levels of transit commuting (Cervero and Wu, 1997).	Urban structure	Trip times	San Francisco Bay Area	E
Total vehicle miles travelled is lower at locations of higher regional accessibility (Cervero and Kockelman, 1997).	Regional accessibility	Vehicle miles travelled by household	San Francisco Bay Area, California / Logit and regression analysis	E
Total household vehicular travel (VMT and VHT) is primarily a function of regional accessibility to jobs and/or households. The effects of local density and mix are small in comparison. Dense, mixed use developments in the middle of nowhere hence may offer only modest regional travel benefits (Kasturi et al, 1998; Pushkar et al, 2000).	Regional accessibility, density, mixed use	Trip rate, VMT, VHT, mode share	Portland; Toronto metropolitan areas / Analysis of variance, regression analysis	E
The principle of urban concentration needs to be applied more strategically – allocating most new development to places in the vicinity of the largest urban areas or in corridors where closely spaced settlements provide for similar employment concentrations in aggregate. By permitting, even promoting, the dispersal of new residential development throughout regions (albeit largely concentrated), existing planning policy is … making its own contribution to the exploding city region (Headicar, 2000).	Urban concentration	Travel behaviour	UK urban areas; Oxfordshire / Comparative analysis	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
Within Surrey, energy consumption reduces with improved public transport accessibility. Energy consumption is lower for households located close to the town centre and higher for those located further away. But again there are caveats to this, as the 25-30 minute isochrone is associated with the least energy consuming patterns (13% less than the sample average in 1998). Perhaps, counter intuitively, households located closer to the urban area are associated with long journey lengths, due to the tendency to commute longer distances by rail (Hickman and Banister, 2007a).	Accessibility to town centres	Energy consumption, journey length, mode share (all journey to work)	Surrey, UK / Descriptive, correlation and regression analysis	E
Local Street Layout /Neighbourhood Design/Parking and Travel				
Parking subsidies greatly increase solo driving. When employers reduce or remove parking subsidies, a significant number of solo drivers shift to carpools and/or transit. The studies reviewed here show that 19 to 81 percent fewer employees drive to work alone when they pay for their own parking (Willson and Shoup, 1990).	Parking subsidies	Carpools, Transit	US / -	E
Parking supply discourages transit commuting and walk/bike access modes to rail stations (Cervero, 1994).	Parking supply	Rail transit mode share, mode of access to rail stations	3 Californian metropolitan areas / Regression analysis	E
Walk/bike share and trip rate are higher in transit neighbourhoods; transit and trip rate are generally higher in transit neighbourhoods (Cervero and Gorham, 1995).	Transit neighbourhood	Mode share, trip rate	Southern California and San Francisco Bay Area, California / Neighbourhoods paired by income	E
Frequency of walk trips to stores is higher in traditional neighbourhoods (Handy, 1995).	Traditional neighbourhood	Mode share, frequency of trips	San Francisco Bay Area, California / Analysis of variance	E
The greater proportion of walking and public transport trips in traditional urban settings substitute longer automobile trips (Cervero and Radisch, 1996).	Traditional, mixed use grid and separated, curvilinear neighbourhoods	Mode share, trip rate	San Francisco Bay Area, California / Neighbourhoods paired by income , binomial logit	E
Transit share of work trips is lower in downtowns with more parking spaces per employee (Morrall and Bolger, 1996).	Parking spaces per employee	Transit share of work trips	21 central business districts, US / Regression analysis	E
Vehicle miles travelled for non-work trips is lower where	Street	Vehicle miles	San Francisco	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
street connectivity is higher (based on proportion of four-way intersections) (Cervero and Kockelman, 1997).	connectivity (proportion of four-way intersections) Blocks with sidewalks	travelled for non-work trips	Bay Area, California / Logit and regression analysis	
The results strongly support the hypothesis that, when holding other variables constant, the urban versus suburban difference in route directness and completeness of pedestrian facilities (namely, block size and sidewalk length) affects pedestrian volumes. The research also questions the common belief that people do not walk in the suburbs. Given appropriate land use conditions, pedestrian facility improvement programs in suburban areas can support pedestrian travel and have a significant influence on mode choice (Moudon, Hess, Snyder and Stanilov, 1997).	Neighbour hooddesign (sidewalks)	Pedestrian volume	Central Puget Sound region, Washington / Quasi experimental	
Frequency of walk/bike trips is higher where sidewalks are present in a neighbourhood (Kitamura et al, 1997).	Presence of sidewalks, bike paths	Walk, bike and cycle trips and mode share	San Francisco Bay Area, California / Regression analysis	E
Urban sites with small blocks and extensive sidewalk systems were found to have, on average, three times the pedestrian volumes of suburban sites with large blocks and short, incomplete sidewalk systems. There are, however, many suburban pedestrians, with volumes varying between 50 and 103 people per hour walking into the suburban commercial centres studied. The majority of suburban pedestrians use streets with sidewalks where available. These findings point to the importance of providing facilities to improve pedestrian safety for people who cannot or do not want to drive in such areas (Hess, Moudon, Snyder and Stanilov, 1999).	Sidewalk systems	Pedestrian volumes	Central Puget Sound region, Washington / Quasi experimental	
The policy variables that help influence mode choice decisions for commuters are the parking cost and the travel time by transit. The results suggest that raising the cost of parking at work sites and decreasing the transit travel time (by improving service and decreasing headways) will reduce the drive alone mode share. The results provide little support for the contention that land use is a significant factor in mode choice decisions (Hess, 2001).	Parking charges	Mode choice	Portland, Oregon / Mode choice model	
Within Surrey, energy consumption in the journey to work is lower in neighbourhood locations with neo-traditional grid street patterns (5% lower than the sample average in 1998); and higher in locations with cul-de-sac style street patterns. This is especially so when the cul-de-sac streets are remote from the village/town centre (Hickman and Banister, 2007a).	Grid style street layout/cul-de-sac style street layout	Energy consumption, journey length, mode share (all journey to work)	Surrey, UK / Descriptive, correlation and regression analysis	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
Composite Indices				
Use of transit and walk access to transit are more likely in zones with higher transit serviceability indices (Repogle, 1990).	Composite transit serviceability index (sidewalk conditions, land use mix, building setback, transit stop amenities, bicycle conditions)	Probability of using transit and accessing transit on foot	Montgomery County, Maryland, US / Subjective weights to component variables	E
Vehicle trips and vehicle miles travelled per household decrease as the pedestrian environment factor increases (Parsons Brinkerhoff Quade Douglas, 1993).	Composite pedestrian environment (ease of street crossing, sidewalk continuity, topography)	Vehicle trips, trip length	Portland, Oregon / Equal weights to component variables	E
Use of non-auto modes for non-work trips is more likely in areas with higher walking quality factors (Cervero and Kockelman, 1997).	Composite walking quality factor (sidewalk provision, street light provision, block length, flat terrain)	Vehicle miles travelled, mode share	San Francisco Bay Area, California, US / Factor analysis	E
People who prefer to walk or use public transport may choose to live where the opportunities for these modes are greater, however those locating to areas with higher neighbourhood accessibility decrease their vehicle miles travelled, person miles travelled, and number of trips per tour (start and end at home) but increase the number of tours (Krizek, 2003).	Composite neighbourhood accessibility factor (density, street pattern, and land use mix)	Vehicle miles travelled, passenger miles travelled, number of tours, number of trips per tour	Central Puget Sound, Washington, US / Regression model using panel (longitudinal) data	E
Socio-Economic and Attitudinal Characteristics and Travel				
Socio-Economic				
Population density and public transport provision are far less important influences on energy consumption than car ownership, and it follows that economising energy consumed per car [improved vehicle efficiency] is far more important than policies concerned with decentralisation or public transport service levels. Usage of cars appears to be limited by time budgets of individuals, such that higher speeds in the outer suburbs are largely offset by the longer distances travelled (Mogridge, 1985).	Population density, household income, car ownership	Median daily travel time, energy consumption	London and Paris / Comparative statistical analysis	E
Travel distance, proportion of car journeys and transport	Various socio-	Travel	Norway	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
energy consumption increases with car ownership (Naess, 1996).	economic	distance, mode share		
Income differences are not the primary source of the differences in work-related car travel between urban areas. Car availability is important, however there appears to be an inherent link between location itself and car ownership (and hence travel) (Headicar and Curtis, 1998).	Accessibility and location (proximity to Oxford)	Journey distance, mode share, trip type	Botley, Kidlington, Bicester, Didcot, Witney; Oxfordshire / Comparative statistical analysis	E
Trip frequencies appear to be primarily a function of socioeconomic characteristics of travellers and secondarily a function of the built environment (Ewing and Cervero, 2001).	Socio economic and built environment characteristics	Trip frequencies	Review of international studies / Meta analysis	T
The variation in travel patterns often owes more to socio-economic reasons that to land-use characteristics. However, land-use planning may still have a significant effect on influencing travel patterns (Stead, 2001).	Socio economic	Travel patterns	UK NTS data / Comparative and regression analysis	E
The price of travel has an important impact on travel. The long-run price elasticity of demand for fuel falls between –0.6 and –0.8, and the short-run elasticity between –0.2 and –0.3 (Graham and Glaister, 2004).	Price of travel/fuel	Demand for fuel (travel)	Review of international studies / Meta analysis	T
If the real price of fuel rises by 10% and stays at that level, the result is a dynamic process of adjustment such that the volume of traffic falls by 1%, building up to a reduction of about 3% in the longer run (about 5 years or so). Also the volume of fuel consumed will fall by about 2.5% within a year, building up to a reduction of over 6% in the longer run (Goodwin et al, 2004).	Price of travel/fuel	Volume of traffic, volume of fuel	Review of international studies / Meta analysis	T
Both individuals' socio-economic characteristics and the built environment appear to play a role in explaining travel behaviour. A probably more important factor in explaining people's time use behaviour is the interrelationship between activities and trips, and between different types of activities (Chen and McKnight, 2006).	Household size, income, ethnicity	Travel, Mode choice	Manhattan area and suburbs, US / Structural equation modelling	E
The local labour market's geographical structure is important. Overall, most individuals commute within their locality of residence and women commute shorter distances than men do - a pattern that has been relatively stable since the beginning of the 1990s (Sandow, 2008).	Urban structure (labour)	Trip distance	Northern Sweden (Umea, Ornsko, Ldsvik and Lycksele) / Binary logistic regression	
Socio-economic variables contribute around 30% of the variation in transport energy consumption in the journey to work for new households in Surrey (Hickman and Banister, 2007a).	Various urban and socio-economic variables,	Energy consumption, journey distance,	Surrey, UK / Descriptive, correlation and	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
	including density, settlement size, jobs-housing balance, location, accessibility, streetscape layout, household income, car ownership, etc.	mode share, occupancy (all journey to work)	regression analysis	
Household life-cycle stage, socio-economic factors, mixed density at the traffic analysis zone level and land-use diversity within walking distance from the place of residence influence households' decision on how many vehicles to own (Potoglou and Kanaroglou, 2008).	Socio-economic factors, mixed land use	Vehicle ownership	Hamilton, Canada	
Attitudinal and Cultural/Market Segmentation				
If rising energy costs or policy restraints restrict mobility, a 'decentralised concentration' [settlement structure] will be energy efficient because people will tend to use the jobs and services that are close to them. If travel costs pose only a minimum deterrent, such a pattern is likely to be more energy intensive than centralisation, because of the potentially large amount of cross-commuting and other travel. Reducing the distances which people need to travel may be a necessary but not a sufficient condition to reduce energy (Owens, 1992).	Urban structure – decentralised concentration, travel cost	Energy consumption	Generic 'UK' / Literature review	T
Car dependence is a process and there is a spectrum of levels of car dependence among population segments. Policy interventions must distinguish between car-dependent people and car-dependent trips because it is easier to reduce car travel at the margin (i.e. car-dependent trips). Alternative modes are necessary but not sufficient to reduce car dependence (Goodwin, 1995).	Societal attitudes	Car dependence	Generic / Editorial based on theoretical and empirical evidence	T
Attitude to travel is more strongly associated with travel behaviour than land use characteristics; land use policies may not significantly alter travel demand unless attitudes are also changed. Attitude to travel is more strongly associated with travel behaviour than land use characteristics. In many cases, balance, mix, and accessibility were found to be more relevant (as measured by elasticities) than several household and traveller characteristics that often form a basis for travel behaviour prediction. In contrast, under all but the vehicle ownership models, the impact of density was negligible after attitude was controlled for (Kitamura et	Attitude to travel Land use characteristics	Travel behaviour	San Francisco Bay Area / Factor analysis and regression analysis	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
al, 1997).				
One third (33%) of car drivers surveyed indicated they would like to reduce their car use 'over the next 12 months', but only 7% thought they were likely to. One third (34%) of car drivers would like to use public transport (PT) more, but only 5% thought they were likely to. While over one third anticipated changes in their transport mode usage, and 1 in 5 (19%) would like to both decrease car use and increase PT use, only 3% thought this combination likely. Effectiveness ratings of pull and push policy measures showed motorists would rather be pulled than pushed from their cars; that the old, the poor and urban dwellers would be more susceptible to push measures; and that those residing out-of-town, driving medium and large cars, driving high annual mileage and required to drive as part of their work are less likely to be persuaded to reduce their car use by either type of measure. Other social psychological research suggests that sustainable changes by individuals that can be integrated into individual patterns of life will be more readily achieved by facilitation and support than by coercion (Stradling et al, 2000).	Segmentation by propensity to change travel behaviour	Propensity to change mode or reduce travel	UK postal survey Comparative analysis	E
Not all travel is a derived demand. The traditional view that travel is only undertaken because of the benefits derived at the destination being higher than the associated costs is no longer generally applicable. Substantial amounts of leisure travel is undertaken for its own sake and the activity of travelling is valued positively (Mokhtarian and Saloman, 2001).	Attitudinal value of travel	Travel demand	San Francisco Bay area Case studies	E
In terms of both direct and total effects, attitudinal and lifestyle variables have the greatest impact on travel demand among all the explanatory variables. By contrast, residential location type has little impact on travel behaviour. This is perhaps the strongest evidence to date supporting the speculation that the association commonly observed between land use configuration and travel patterns is not one of direct causality, but due primarily to correlations of each of those variables with others. In particular, the results suggest that when attitudinal, lifestyle, and socio demographic variables are accounted for, neighbourhood type has little influence on travel behaviour (Bagley and Mokhtarian, 2002).	Attitudinal measures, job location, residential location	Travel demand	San Francisco Bay Area -	E
The theory of planned behaviour [psychological theory] is used to segment the travel market into 6 distinct psychographic groups – malcontented motorists, complacent car addicts, die hard drivers, aspiring environmentalists, car-less crusaders, reluctant riders- each	Attitudinal segmentation	Travel behaviour, propensity to change modes	Dunham Massey and Quarry Bank Mill, Manchester, UK	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
with varying degrees of mode shift potential (Anable, 2005).			Factor analysis, cluster analysis	
Neighbourhood type dissonance is the mismatch between a commuter's current neighbourhood type and preferences regarding physical attributes of the residential neighbourhood. Neighbourhood type dissonance is statistically significantly associated with commute mode choice: dissonant urban residents are more likely to commute by private vehicle than consonant urbanites but not quite as likely as true suburbanites. However differences between neighbourhoods tend to be larger than within a neighbourhood indicating that physical neighbourhood structure has an impact on commute mode choice (Schwanen and Mokhtarian, 2005).	Attitudinal measures, neighbourhood design	Mode choice	North San Francisco / Multinomial logit analysis	E
Past studies have not identified the direction of causality—in particular, whether neighbourhood design influences travel behaviour or whether travel preferences influence the choice of neighbourhood. A multivariate analysis of cross-sectional data shows that differences in travel behaviour between suburban and traditional neighbourhoods are largely explained by attitudes. However, a quasi-longitudinal analysis of changes in travel behaviour and changes in the built environment shows significant associations, even when attitudes have been accounted for, providing support for a causal relationship (Handy, 2005).	Neighbourhood design	Vehicle miles	San Francisco Bay area / Multi-variate analysis, quasi-longitudinal analysis	E
Multi-Variable Analysis/General Scenario Testing				
A comparative study of Almere, Netherlands and Milton Keynes, UK demonstrated the extent to which land use and transport planning can influence the demand for motorised transport. Milton Keynes demonstrated a much higher percentage of trips made by car and the much lower level of bicycle use when compared to Almere (66% of trips by car compared to 43%, 6% of trips by bicycle compared to 27% respectively) (Roberts, TEST, 1991).	Generic 'land use planning'	Number of trips, mode share	Almere, Netherlands and Milton Keynes, UK / Comparative analysis	E
Using a simulation of an archetypical town, even quite radical variations in the location of new development, at the urban scale, have only slight implications for fuel use in passenger transport – most journeys tend to be short and by car. The regional scale [is more impressive] indicating that 10-15% savings in fuel use for passenger transport might be achieved through land use changes over a 25-year period. This is the result of shorter journey lengths resulting from high densities (Rickaby et al, 1992).	Various scenarios – containment at various locations, peripheral expansion	Fuel use, mode share	20 UK towns and an archetypical town / Scenario testing	E
The physical characteristics of the urban settlement are important (density, size, availability of facilities and services, public transport), but this basic relationship is	Density, size, availability of facilities and	Generic 'travel'	Various UK and international / Literature	T

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
modified by the socio-economic characteristics of the population as different people have different propensities to travel (Banister, 1992).	services, generic 'socio-economic' characteristics		review	
Pedestrian/bicycle modal shares and trip rates tended to be considerably higher, in some cases five time as high, in transit-oriented than in the paired auto-oriented neighbourhood. Transit neighbourhoods' also averaged around 70 more daily transit work trips per 1,000 households than auto-oriented neighbourhoods, though trip rates varied considerably among neighbourhood pairs. Higher residential densities were also found to have a proportionately greater impact on transit commuting in transit-oriented than in auto-oriented neighbourhoods (Cervero, 1996).	Proximity to transit	Modal share	San Francisco Bay Area / Binomial logit model	E
Density, land-use diversity, and pedestrian-oriented designs generally reduce trip rates and encourage non-auto travel in statistically significant ways, though their influences appear to be fairly marginal. The elasticities between each dimension of the built environment and travel demand are modest to moderate, though certainly not inconsequential (Cervero and Kockelman, 1997).	Intensity of land use, mixed land use	Trip rates, non-auto travel	San Francisco Bay Area / Factor analysis	E
Vehicle kilometres travelled is significantly associated with population density, jobs/housing ratio and distance to CBD; but not trips per worker (Miller and Ibrahim, 1998).	Gross population density, jobs/resident ratio and employment, distance to CBD and employment centre	Vehicle kilometres travelled, trip rate	Greater Toronto area, Ontario / Regression analysis	E
Average auto ownership is primarily a function of the neighbourhood's residential density, average per capita income, average family size and the availability of public transit. Similarly, the average annual distance driven per car is a strong function of density, income, household size and public transit, and a weaker function of the pedestrian and bicycle friendliness of the community (Holtzclaw et al, 2002).	Residential density, per capita income, household size	Vehicle ownership Distance travelled	Chicago, Los Angeles, San Francisco / Regression	E
Scenario testing in Bristol estimates that a continuation of present land use and transport policies in Bristol would result in an increase of 47% in travel distance from 1990-2015; a "compact city" scenario, centralising employment and population, together with traffic restraint measures including city centre road pricing, would, in comparison, reduce this to 42% - very modest results for extreme scenario options (Simmonds and Coombe, 2000).	"Compact city" scenario relative to business as usual	Travel distance	Bristol, UK / Scenario testing	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
Socio-economic determinants of travel behaviour change are more important than land use factors, accounting for some 21%-58% of the variation in distance travelled at the individual and ward level. Land use factors are still important, accounting for up to 27% at the survey area level (Stead, 2001).	Socio-economic factors, land use factors	Distance travelled	National Travel Survey, UK / Regression analysis	E
Spatial characteristics and traffic management have a significant impact on trip frequency and mode choice for shopping, social and recreational trips. Socio-economic characteristics tend to determine commuter travel (Meurs and Haaijer, 2001)	Home type, street design, neighbourhood characteristics, and various socio-economic	Total trips, mode, trip purpose	Netherlands (national panel survey) / Regression analysis, scenario testing	E
Intensities and mixtures of land use significantly influence decisions to drive-alone, share a ride, or patronize transit, while the influences of urban design tend to be more modest (Cervero, 2002).	Intensity of land use, mixed land use, urban design	Mode choice, distance travelled	Montgomery county, Maryland, US / Ordered probit modelling	E
The impact of urban structure on travel behaviour is mixed. Deconcentration of urban land uses encourages driving and discourages the use of public transport and walking and cycling. However in some cases the households and firms may relocate to suburban locations resulting in less commuting (Schwanen et al, 2001).	Urban structure	Mode choice, trip length	Netherlands / Logistic regression analysis	E
For most travel and transportation outcomes, sprawling regions perform less well, than compact ones. The exceptions are average commute time and annual traffic delay per capita, which do not favour compactness over sprawl (Ewing, Pendall and Chen, 2003).	Urban structure, sprawl, compaction	Trip time, traffic delay	Aggregate data from the United States / Multiple regression analysis	E
Cross-sectional data shows that differences in travel behaviour between suburban and traditional neighbourhoods are largely explained by attitudes. However, a quasi-longitudinal analysis of changes in travel behaviour and changes in the built environment shows significant associations, even when attitudes have been accounted for, providing support for a causal relationship (Handy, Cao and Mokhtarian, 2005).	Various neighbourhood characteristics, socio-demographics, attitude to travel	Mode share, number of trips	8 neighbourhoods in northern California / Multi-variate analysis, probit modelling (cross sectional and longitudinal data)	E
Urban dissonant residents are far more likely to commute by private vehicle than consonant urbanites, but not as much as suburbanites. At least for commute mode choice, in suburban neighbourhoods, the conditioning influence of the environment prevails over travellers' preferences regarding their residential environment, i.e. neighbourhood type does impact on travel behaviour, even after attitudes are	Various spatial structure indicators, socio-demographics, attitude to travel, neighbourhood type dissonance	Commute mode choice	San Francisco Bay Area / Descriptive, factor, multinomial logit analysis	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
accounted for. This is particularly so in suburban areas (where residents who prefer higher density neighbourhoods drive to work as often as those who like lower density neighbourhoods) (Schwanen and Mokhtarian, 2005).	(mismatch between current location and preference)			
An international comparative analysis of relationships between car ownership, daily travel and urban form shows that differences in travel between US and Great Britain are explained by (1) differences in demographics between the two countries; (2) lower household income in Great Britain; (3) country specific differences in costs of car ownership and use, transport supply and other variables. Metropolitan size affects travel only in the largest metropolitan areas of the US. Daily travel distance is inversely related to local population density, but the effect is much stronger for the US than Great Britain. Higher transport costs in Great Britain promote economising behaviour, which in turns leads to more consumption of local goods and services and more use of alternative transport modes (Giuliano and Dargay, 2006).	Urban form, car ownership, household income	Daily travel distance	US and Great Britain / Comparative analysis	T
Land use attributes and travel time considerations are important in explaining the variation in mode choice for medium and longer-distance travel when controlling for the socioeconomic characteristics of travellers (Limtanakool, Dijst, and Schwanen, 2006).	Generic 'land use'	Journey distance, mode choice	Netherlands	E
Traffic volumes and energy consumption from the transport sector continue to rise, yet the potential role of urban planning in contributing to reduced transport energy consumption continues to be largely underplayed. Urban form variables explain around 10%, socio-economic variables around 30%, and attitudinal variables around 5% of the variation in transport energy consumption in the journey to work for new households in Surrey (Hickman and Banister, 2007a).	Various urban and socio-economic variables, including density, settlement size, jobs-housing balance, location, accessibility, streetscape layout, household income, car ownership, etc.	Energy consumption, journey distance, mode share, occupancy (all journey to work)	Surrey, UK / Descriptive, correlation and regression analysis	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
The temporal effect and type of resident appear to be important factors in the land use, socio-economic and travel behaviour relationship. Residents who stay at the same household [based on a survey at two points in time over a 3-year period] are the least energy consuming, with an increase (4%) in transport energy consumption over time, reflecting reduced journey distance (-4%) but increased car mode share (4%); outmovers are the most mobile in terms of distance travelled, have the highest car mode share and account for more (8%) in transport energy consumption than the stayers; inmovers are more mobile than the stayers, but less mobile than the outmovers, and have the largest increase (8%) in transport energy consumption over time. The 'co-location' effect hence does occur in Surrey within the stayers data, but only marginally in terms of journey distance. At the same time car mode share increases, meaning that composite energy consumption increases (Hickman and Banister, 2007b).	Various urban and socio-economic variables, including density, settlement size, jobs-housing balance, location, accessibility, streetscape layout, household income, car ownership, etc.	Energy consumption, journey distance, mode share, occupancy (all journey to work)	Surrey, UK Descriptive, correlation and regression analysis, matched pair analysis (longitudinal)	E
Electronic Social Interaction Rather Than Physical Travel				
"There will be a day, not far distant, when you will be able to conduct business, study, explore the world and its cultures, call up any great entertainment, make friends, attend neighbourhood markets, and show pictures to distant relatives, without leaving your desk or armchair" (Gates, 1995)	Digital/electronic social interaction	Generic 'travel'	International Theoretical	T
"The emergence of a space of flows dominates the historically constructed space of places" (Castells, 1996).	Digital/electronic social interaction	Generic 'travel'	International Theoretical	T
The digital means of communication is making the world a smaller place as the geographical boundaries are removed from our personal lives and our workplaces. Business may be conducted by and with individuals across the world as though they were in the same city (Negroponte, 1996).	Digital/electronic social interaction	Generic 'travel'	International Theoretical	T
The death of distance will mean that any activity that relies on a screen or telephone can be carried out anywhere in the world" Cairncross (1995). The importance of technological change is absolutely enormous, and the current wave of technological change is the fastest the world has ever seen. It is nothing short of a revolution. It has the potential to make the concept of geographic distance obsolete (Cairncross, 1999).	Digital/electronic social interaction, communication	Generic 'travel'	International Theoretical	T
While telecoms undoubtedly have some potential to	Digital/electronic	Generic	International	T

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
substitute for journeys and more routine interactions there is considerable evidence that the relationship between transport and telecoms is more complex (Graham and Marvin, 1996). Rather than simply substituting, telecoms have highly complementary relationships with physical travel. This, we would argue, can actually result in new forms of traffic growth (Graham and Marvin, 1999).	social interaction, communication	'travel'	Theoretical	
The primary impact of ICT on leisure is to expand an individual's choice set; however whether or not the new options will be chosen depends on the attributes of the activity, as well as those of the individual. The potential transportation impacts when the new options are chosen are ambiguous. (Mokhtarian et al, 2006).	ICT	Leisure Travel	Not location specific / A conceptual exploration	T
Measures such as teleworking and teleconferencing implemented within a supportive context, could reduce national traffic levels by 11%, with greater effects in certain circumstances, including, for example, a 21% reduction in urban peak traffic (Cairns, 2004).	Teleworking Teleconferencing	Travel Car use	UK / Case studies	T/E
There is substantial scope for reducing some types of (less valued) travel demand, like the journey to work, but equally it may encourage other (higher valued) longer distance travel, like leisure travel (Banister, 2005).	ICT	Work trips, leisure trips	Literature review	T
A new phenomenon is emerging in the most highly urbanised parts of the world: the polycentric mega-city region. It is a new form, a series of anything between 10 and 50 cities and towns, physically separate but functionally networked, clustered around one or more larger cities. Most residents work locally … but are connected by dense flows of people and information carried along motorways, high speed rail lines and telecommunications cables. The space of flows is the emerging urban form at the start of the 21st century, with major implications for sustainable development (Hall and Pain, 2006).	Digital/electronic social interaction, communication	Generic 'travel'	International / Theoretical	T
Internet use at home and in the workplace is associated with a reduction in travel times (Vishwanath and Goulias, 2001).	Internet use	Trip rates and lengths	Central Puget Sound region, Washington / Regression analysis	E
Results suggest that people substitute home teleshopping time for shopping travel time and that teleshoppers take fewer shopping trips and travel shorter total distances for shopping purposes (Ferrell, 2005).	Teleshopping	Trip rates and lengths	San Francisco Bay Area	E
Despite increases in ICT use, people are likely engaging in multiple forms of shopping and banking that require physical travel and doing so in ways most convenient to	ICT	Retail trips	Central Puget Sound region, Washington	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
them. Preferences for store shopping, a human bank teller and fear of online transactions may limit observable changes in past growth and the future potential of ICT to replace physical trips (Wilson, Krizek and Handy, 2007).			Descriptive and bi-variate analysis	
Institutional Use of the Available Evidence				
There are difficulties in identifying prospective land use change over the period to 2030 (as sought by Dept Transport) because of limited time horizons of approved local policies and even shorter horizons of development commitments. No evidence that prospective greater congestion is influencing thinking of planning authorities or developers. Scepticism amongst planning practitioners that change in policy rhetoric (PPG13) would exert independent influence on physical outcomes, especially in absence of complementary transport policies (Oxford Brookes University and WS Atkins, 1996)	Land use planning policies	-	UK case studies in functional regions / Examination of planning documents; interviews with practitioners	E
PPG13 objectives are having an increasing influence on the preparation of plans and outcome of appeals. However there are significant differences, particularly between urban and rural areas; also perceived difficulties in implementing policies because of concerns about inter-authority competitiveness and lack of information about likely impacts of policy change (Ove Arup and Partners, 1996)	Land use planning policies and development decisions	-	UK local authorities / Study of local planning policies; questionnaire of practitioners	E
PPG13's intended switch from minimum to maximum car parking standards in non-residential development has not led to any change in level of provision sought by many planning authorities; this is also typically in excess of actual demand levels (Llewellyn-Davies and JMP, 1998)	Non residential car parking standards	-	Local planning authorities in SE England / Study of planning documents; interviews with practitioners	E
The combination of changed planning policies (PPG13) plus complementary transport policies envisaged in the 1998 Transport White Paper is likely to contribute to a minimum 2% reduction in overall traffic levels by 2010 compared with NTM forecasts. Variability in outcome between NTS area-types because of interplay between a) changed distribution of population and employment and b) changed trip rates within these areas (WS Atkins, 1999).	Land use planning policies and local transport policies in1998 Transport White Paper	Trip rates by area-type	GB by NTS area-type / Scenario building	E
Increasing recognition amongst planning authorities of the importance of seeking an appropriate location for developments in PPG13 terms, though sequential test	Effectiveness of PPG13 policies in influencing	-	UK selection of local authorities	E

Summary issue	Urban Structure/ Socio-Economic Variable	Travel "Dependent" Variable	Location of analysis / Method of Analysis	Empirical evidence (E) or theoretical argument (T)
criteria more influential. Weak understanding of scope for change in modal shares; highways and parking provision generally still designed for unrestrained access. Implementation difficulties experienced as a result of potential conflicts between policy objectives and limited evidence of impacts on which to base a decision (Ove Arup and Partners, 1999).	development decisions		Study of planning decisions; questionnaire and interviews with practitioners	
Little current evidence in English context that land use principles in national policy guidance have influenced general travel outcomes but research at both local and sub-regional scales has indicate dthat locational attributes can be associated with substantially different travel outcomes (but self-selection may be a factor). Outside London, planning policy and implementation is focused on reducing the need to travel rather than reducing actual travel (Headicar, 2003).	Impact of national policy on travel outcomes	General travel	England Review of empirical research, policy, and implementation	T
Since 2001 retail development has tended to locate in larger towns and cities. New offices are concentrated in a limited number of areas, but not necessarily confined to town centres; little evidence of impact of PPG on office location thus far. Worsening geographical imbalance between jobs and workers is leading to longer commuting, but case study evidence shows planning is impacting on location of new housing with higher proportion in urban centres and planned growth nodes Return to pre1994 plg policy regime would lead to additional 3-4% car passenger km by 2016, but strengthening of plg policies and complementary trp measures would result in little change as some motorists would exploit lower congestion by increasing car use/trip length (WSP and Arup, 2005).	Impact of PPG13, 3 and 6 on current and future development patterns	Relationship to volume and pattern of travel demand	GB by NTS area-type NTS, Census and Valuation Office data; sub-regional case studies and workshops; regional land use/trip modelling	E
The desire of planners to reduce road traffic volumes conflicts with other priorities at the operational (rather than strategic) planning level. So, planning should be done differently by changing how problems are framed. Challenges to this change lie in integration of knowledge (land use and transport), accepting new values and acquiring new knowledge. There is a reliance on traditional transport models that cannot account for the desire to reduce urban road traffic volumes. Reduction in road traffic is often seen as unrealistic by planners and only some have reframed the problem (Tennøy, 2008)	Reframing of land use/transport planning at operational level	Reduction in road traffic volumes	Three largest cities in Norway Case study, survey and practitioner interviews	E

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