INDEPENDENT
TRANSPORT
COMMISSION

WHAT IS THE CONTRIBUTION OF PEAK AND OFF-PEAK TRAVEL TO THE URBAN ECONOMY?

ITC CONSULTATION WORKING DOCUMENT

The Independent Transport Commission
Registered Charity: 1080134
www.theitc.org.uk

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Working Document created by the Independent Transport Commission

The Independent Transport Commission (ITC) is one of Britain's leading research charities with a mission to explore all aspects of transport and land use policy. Through our independent research work and educational events we aim to improve and better inform public policy making. For more information on our current research and activities please see our website: www.theitc.org.uk

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Registered Charity No. 1080134
September 2018

Acknowledgements:

This working document was produced and edited by Research Assistant Saphia Haffejee, alongside ITC Commissioner Sarah Kendall and Dr Matthew Niblett, Director of the ITC. The ITC would like to acknowledge its gratitude to all those who contributed to the ITC Call for Evidence, as this has been the basis of the evidence gathered thus far. A list of contributors is detailed in the introduction of this report.

September 2018

CONTENTS

INTRODUCTION

The peak demand for travel into the UK's cities is a significant policy challenge.

- **For travellers:** who are likely to experience congested roads or public transport, and may be paying higher fares, consuming more fuel and experiencing extended journey times.
- **For transport providers:** who may be providing extra resources, such as vehicles and crews and infrastructure capacity, that are only needed in the peaks and are otherwise surplus, increasing the cost of operation.
- **For funders and city authorities:** as there is continuing pressure to base investment decisions for future capacity and capability of infrastructure to respond to that congested peak. Peak travellers are also voters and there are frequent calls for 'something' to be done.

Despite and probably because of these peak time challenges, there has been limited work to date to understand the relative economic value of peak and off peak travel. This research project of the ITC will explore the value of the transport peak and off-peak by considering behavioural, economic and capacity utilisation issues. A better understanding of these phenomena will enable us to make recommendations to inform future policy decisions.

We are focussing on cities, since these are the focus of the biggest proportion of peak hour journeys made. To keep the parameters of the study manageable we are also looking at personal travel, not freight movements. In considering cities, we recognise that London is a global mega-city, and different to other cities across the UK. We plan to learn from the London experience to identify changes yet to come and inform policy choices for smaller cities across the UK.

This report is the result of a call for evidence held in early 2018. It is the first stage of our project and has sought evidence relating to the current situation: demand factors and their economic impact, and strategies for the future. The call for evidence provided useful information for understanding the current situation, although very limited information on future strategies. This document is therefore a working compilation of evidence to inform the next stages of our work rather than a complete and balanced view. Its incompleteness confirms the ongoing need for our research in this area.

The findings of this document pull together a variety of evidence that was submitted to us. Certain questions in the Call for Evidence resulted in an abundance of information, whereas others were thin on the ground, and indicated which areas would need further investigation in the next stages of the project. In particular, we would very much welcome further evidence or insight on the issues concerning questions 3, 4, 5 and 6 of the Call for Evidence. Whilst we received interesting information regarding the economic impacts of travel, we hope to develop a greater understanding of the specific economic contribution of off-peak travel, and its relationship with economic theories such as that of agglomeration. Regarding questions 4, 5 and 6 – Changing Patterns of Demand, Behavioural change and Economic and Policy Levers respectively - it is clear that much less research has been conducted and therefore we are keen to pursue a greater level understanding of these issues in the subsequent stages of research.

The ITC will be running a series of expert workshops during late 2018 and early 2019 to complement this evidence document. We would also welcome any further contributions on the issues raised in the above paragraph. If you would like to contribute further material, or to discuss the project further, please contact project assistant Saphia Haffejee at saphia@theitc.org.uk or call 0207 253 5510.

PURPOSE OF REPORT: A WORKING DOCUMENT

This document outlines the key evidence provided by the organisations or individuals responding to the themes and questions outlined in our Call for Evidence. It makes note of the useful sources, graphs and data provided, excluding any unrelated material which was submitted. It is important to note this is a working document rather than a final publication, taking stock of the evidence brought to our attention, whilst the research continues into its next phase.

The report is organised according to the different sections as outlined in the Call for Evidence. This document outlines the most common evidence provided for each set of questions and indicates where some questions lacked evidence. It also paints a better picture of recurring themes in terms of where previous studies have focused, or where previous evidence has been found, and equally where further study may be required.

Unless otherwise indicated, the information or facts provided are the opinions expressed in the original Call for Evidence responses. The information is separated according to which response and organisation it came from. Where further sources have been cited by the authors in their responses, this has been indicated in the footnotes. In most cases, where external evidence or reports are cited, links have been provided.

This document has been prepared and reviewed by an editorial team comprised of Matthew Niblett, ITC Director, ITC Commissioner Sarah Kendall and Research Assistant, Saphia Haffejee. The editors of this report are extremely grateful to the following organisations and representatives who provided their insights and evidence to this report:

Professional, Academic and members of Industry:

Transport Planning Society (TPS) *Response provided by Alan Wenban-Smith*

London Travel Watch *Response provided by Tim Bellenger and Arthur Leathley*

Network Rail *Response provided by Jonny Allen*

Professor Martin Mayfield, Sheffield University

Peter Brett Associates (PBA) *Response provided by Sarah Matthews*

Rail Delivery Group (RDG) *Response provided by Mark Havenhand*

The Demand Centre – First Report of the Commission on Travel Demand *Guidance provided by Professor Greg Marsden, Institute for Transport Studies at Leeds University*

Government departments:

Department for Transport *Response provided by Christopher Scott*

Commuting trends in England 1988 to 2015 (Report for the DfT), *Scott Le Vine et al*, November 2017

PART A: The Existing Situation

1. Patterns of Demand

The first section of this report seeks to determine some of the key patterns of Demand which are emerging from recent research. It includes a combination of opinions from respondents of the original autumn call for evidence, as well as relevant graphs and figures which demonstrate patterns of demand. The following questions were asked:

- *What evidence do we have on peak and off peak travel trends in our urban areas?*
- *What are the differences between morning and evening peaks, between seasons and days of the week? What is the breakdown of journey purposes at these times?*
- *How do these patterns differ between various cities and across modes of travel?*
- *Are patterns of demand stable or are they changing, and if changing, do you understand the drivers of the change?*

2. Factors affecting demand

Building on the above section, the second focus was to determine the factors affecting demand, helping to build a better picture of what factors influence the patterns of demand identified before. In particular, it became clear that there is much interest in the impact of new technologies and changing work patterns. The following questions were asked:

- *What are the key social, behavioural and economic factors that affect the time of travel (and by extension peak and off peak patterns of demand)?*
- *Who is travelling at different times of day in our urban areas and why?*
- *What has been the impact of new technologies and working practices on peak and off peak travel?*
- *What has been the impact of new technologies and working practices to increase the capacity of transport systems during the peak?*

3. Economic impacts

This section sought to focus in on the economic impacts of these changes, particularly in regard to how these changes and patterns affect urban economies. The responses for this section were more generalised, and it is clear that more evidence is needed to answer the below questions:

- *What are the economic costs and benefits of peak and off peak travel in our urban areas?*
- *Is there evidence or analysis of the contribution of off peak travel to the urban economy?*
- *Do traditional theories of agglomeration, which justify investment for peak travel, still hold true in 21st century cities?*

PART B: Strategies for the future

4. Changing Patterns of Demand

This section is more forward-looking, intending to gauge perspectives and predictions about the future. Similarly to the above section on economic impact, there was a lack of information available and more evidence is required.

- *How do you foresee patterns of peak and off peak travel changing in our urban areas?*
- *Will changing patterns of demand emerge differently across various cities or between different modes?*
- *How might our transport system change in response to the future patterns of demand?*

5. Behavioural Change

These questions aim to determine what changes may occur regarding travel behaviour in the future.

- *What factors will influence the time people choose to travel in the future?*
- *Are there disruptive factors that we can anticipate that will affect peak and off peak urban travel?*

6. Economic and policy levers

This last set of questions aimed to gain a sense of whether there is potential to influence the changes and trends identified in previous sections, in order to address the broader research questions.

- *What scope exists to influence or encourage peak travellers to move to off-peak journeys?*
- *What are the investment implications of smoothing out peak travel periods, and what will be the economic impacts of doing so?*

PART C: Other issues

Any outlying issues.

LIST OF FIGURES

2) FACTORS AFFECTING DEMAND

3) ECONOMIC IMPACTS

4) CHANGING PATTERNS OF DEMAND

PART A. THE EXISTING SITUATION

- **Patterns of Demand**
- **Factors affected Demand**
- **Economic Impacts**

1. Patterns of Demand

• What evidence do we have on peak and off-peak travel trends in our urban areas?

• What are the differences between morning and evening peaks, between seasons and days of the week? What is the breakdown of journey purposes at these times?

• How do these patterns differ between various cities and across modes of travel?

• Are patterns of demand stable or are they changing, and if changing, do you understand the drivers of the change?

Summary

Overall, the findings from this section proved the strongest in terms of answering the questions. There is a greater amount of peak spreading in the shoulder of the peak and extended peak. There is clearly a growing need for more flexible travel options, as the most important trend has been the growth in off-peak travel. This does not necessarily mean a reduction in peak travel, however, and this needs further attention and investigation. Patterns of demand are changing. The most important detectable reason for this is the technological advancements that have recently transformed working patterns. Conference calling, the internet and other large changes have enabled flexible working and working from home, which overlaps with trends in self-employment and other changing employment patterns which reduce the need for peak travel. In particular, the Commuting Trends Report provides the most detailed and wide-ranging evidence base for trends. Most importantly, it indicates the morning peak is still the busiest, and it also starts earlier than in the past. Whilst generally the AM peak sees the most arrivals into UK cities and is generally the busiest, this isn't universal for all UK cities with some such as Liverpool and Leeds having a busier evening peak.

There is mostly a broad range of data available on commuting patterns, with helpful breakdown by employment, time of day and location. Again, however, there is further evidence needed. In terms of cities, there was, as expected, a much greater amount of data was available for London than other UK cities. For mode too there is more available for rail and car, and less for alternative modes such as bus. Overall, despite changes, peak and off peak rail trends have not shifted dramatically beyond the established paradigms, with peak travel still placing the greatest pressure on roads and rail networks.

MULTI MODAL EVIDENCE

The following evidence provides insight into multi-modal patterns of demand, outlining more generalised trends and observations.

Transport Planning Society (TPS)

Changes in patterns of working have resulted in some significant trends which spread demand around the clock. The Transport Planning Society response provided some general observations regarding patterns of demand:

- **Peak spreading**, so there is more of a **mix of journeys to work and journeys at work in the extended peak**.
- Off peak travel has become increasingly important for **flexible and part-time workers**.
- There is growing demand for **weekend travel** which supports the **retail and leisure economies**, and the increase in availability of 24-hour services that support the **night-time economy** (e.g. London's night tube).
- These trends have the potential to make better use of infrastructure and to make public transport services more viable. These considerations strengthen the case for a broader approach, giving particular attention to land-use effects and interventions.

London Travel Watch

- Demand on the transport network in London has continued to grow in recent years. The most important trend has been an **increase in off-peak travel**, so that services have become **busier throughout the day and the evening.** It is worth noting that London Underground experiences a **third peak hour between the hours of 2230 and 2330,** with crowding levels on Fridays and Saturdays comparable to the other peak hour times in the morning and evening. Dealing with this peak, which is followed by the close of service, was a **main reason for introducing a night tube service** in order to spread out of a longer period this peak demand.

- In London morning peak hours tend to be dominated by **work and education related trips,** whereas the **evening peak has a much wider trip type** as people will also be travelling as a result of earlier off-peak leisure time activity. The late evening peak is characterised by **employment and leisure** derived travel.

- **Demand is changing as work, home and family relationship patterns evolve** especially around technological advances that allow more home working or co-working spaces. These changes have the potential to allow passengers to adapt their travel patterns around the available transport capacity.

Department for Transport (DfT)

- The Department for Transport (DfT) has commissioned a range of research to determine the **underlying trends in peak and off-peak travel.** Much of the evidence below is presented in more depth in the **'Commuting Trends in England' report** that has recently been published by the Department. This has found that **people tend to start their morning commute earlier than in the past and begin their evening commute later.**

Composition of peak and off-peak travel (multi-modal)

- **Employment trends are important in explaining travel trends, in part due to differences in working patterns between occupation types. The National Transport Survey provides evidence of how the composition of peak and off-peak commutes change according to employment type. The composition of employment is similar during the AM and PM commutes. Slightly more non-manual and professional workers commute during the AM peak relative to the PM peak, while more manual workers commute during the evening than in the morning.**
- **During other times manual workers and non-manual workers continue to make up the majority of those making commuting trips, although a lesser proportion are non-manual workers and a larger proportion work in manual jobs.**
- **Recent years have seen an increase in the shares of employment classified as 'non-manual', while those classed as 'manual' have reduced as a proportion of total workers. The 'Commuting Trends in England' report suggests that changing employment composition is likely to have contributed towards greater pressures during peak travel periods.**

Commuting trend report for England

What evidence do we have on peak and off-peak travel trends in our urban areas? (multi-modal)

- The Commuting Trend Report for England covers the period 1988-2015, and demonstrates the travel trends associated with travel for the purposes of work in this period. The long-term nature of this study is useful as it helps identify the key pressures, changes and trends that may be useful in understanding whether there have been changes in peak and off-peak travel. It also shows related issues, namely whether changing workforce trends and labour patterns are connected.
- Commuting - and travel to work more generally - **places a disproportionate burden on the transport network due to the relative length of these journeys and their concentration at particular times of the day**. Understanding how patterns of commuting have developed over time is of particular interest both to those seeking to understand the past and plan for the future.
- **Between 1995/7 and 2013/14, England's population grew 12% while the total number of annual commuting journeys decreased from 8.5 billion to 7.9 billion.** There has been a decline in commuting trips per person, which has not been outweighed by the growth in population. **Commuting behaviour is undergoing a period of change.** This report draws on a range of available datasets to explain and understand that change, anchored by the National Travel Survey (NTS), to document patterns of commuting today and how it has evolved over the last quarter-century. (See bibliography for references.)

Time of day: key findings from report indicating trends relating to travel at different times of the day (multi-modal)

- Trips from work-to-home concentrating in a shorter period in the afternoon; no similar effect seen in the morning peak period
- Home-to-work journeys account for a decreasing share of morning peak period travel
- Decline in mid-day travel to/from work for shopping purposes
- Over time, 'workbound' commuting journeys (journeys from one's home to their usual workplace) **have tended to start a few minutes earlier.** By contrast, the departure time of 'homebound' commuting journeys has **become several minutes later.** This is consistent with the trend of increasing duration of work activities more generally.

Table 3: Start times for 'outbound' and 'homebound' commuting journeys. Source: National Travel Survey

	Average start time of 'outbound' commuting journeys	Average start time of 'homebound' commuting journeys
1988/92	07:55 AM	16:03 PM
2013/14	07:51 AM	16:23 PM

Figure 1: Start times for 'Outbound' and 'Homebound' commuting Journeys. Source: National Travel Survey

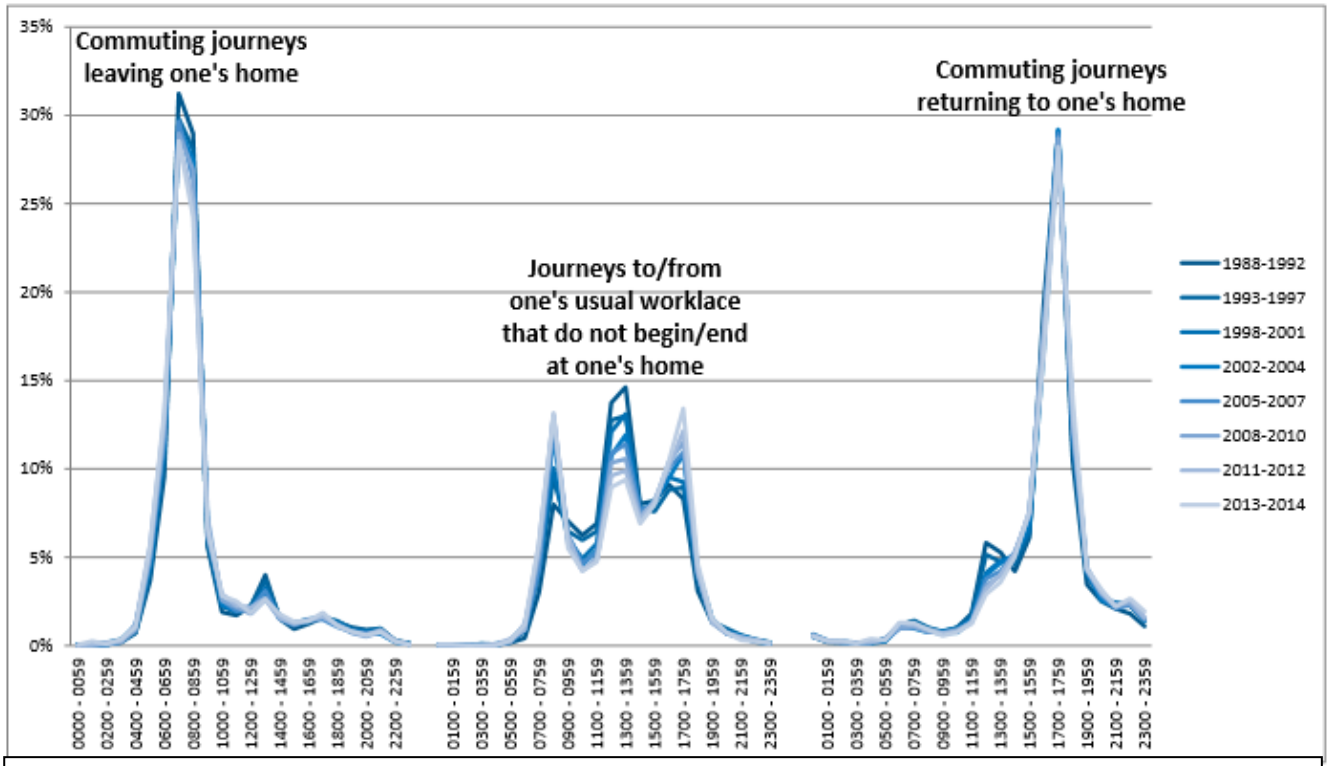


Figure 2: Journeys to/from one's usual workplace by hour-of-day (AM Peak Period). Panels show journeys from one's home (L), to one's home (R), and neither beginning nor ending at one's home (centre). Source: National Travel Survey

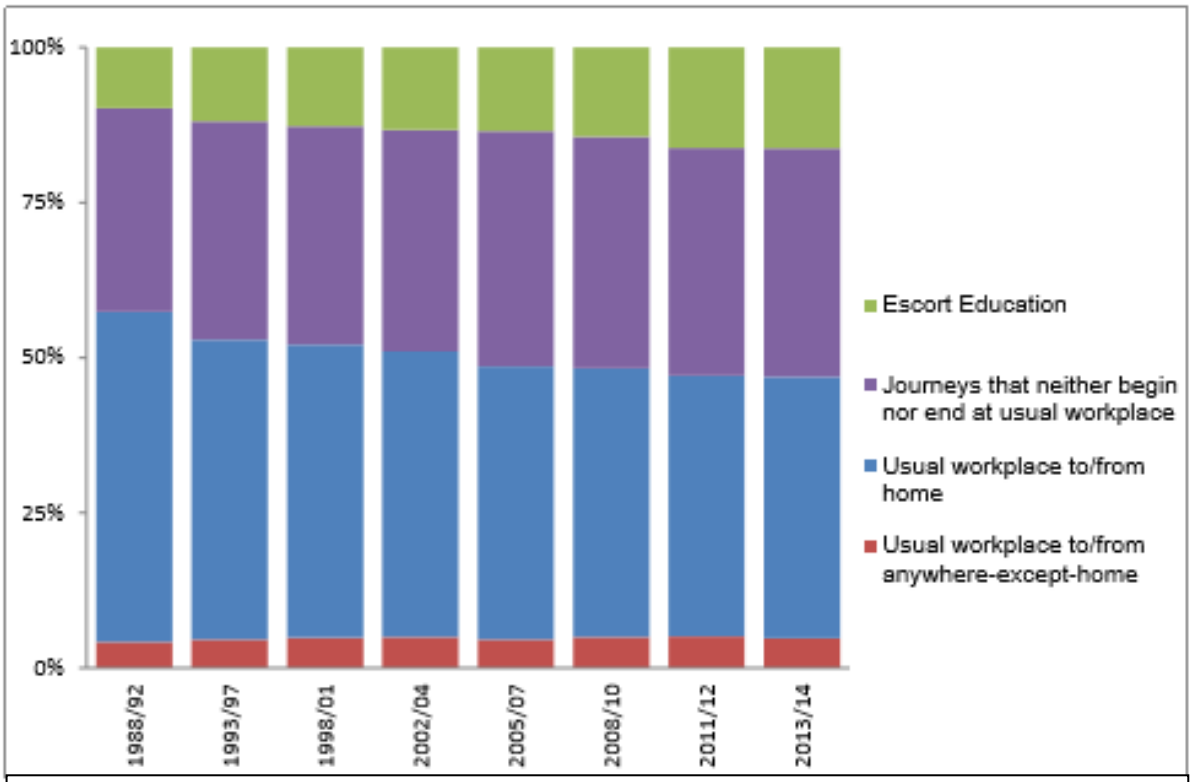


Figure 3: Distribution of journeys by whether or not trip is Escort-to-Education purpose, begins/ends at work, and the purpose of the non-work trip end (All journeys during the AM peak period only: 07:00 – 08:59, as defined in the National Travel Survey). Source: National Travel Survey

Commuting Patterns depend on where people live:

- In addition to demographics, **commuting patterns also depend strongly on where people live.** The table shows commuting by car is higher in more rural areas and lowest in the largest urban areas, particularly London.

	Mainly Rural	Largely Rural	Urban with Significant Rural	Urban with City and Town	Urban with Minor Conurbation	Urban with Major Conurbation	Inner London	Outer London
Walking	13% (+2%)	9% (-1%)	11%	12% (+1%)	8% (-4%)	10%	10%	6%
Bicycle	3% (-1%)	4% (-1%)	3% (-2%)	6% (+1%)	4% (-2%)	3%	8% (+3%)	3% (+1%)
Car/van driver	67% (-1%)	69% (+3%)	67% (+3%)	58% (-4%)	62% (-2%)	56% (-1%)	12% (-5%)	35% (-9%)
Car/van passenger	10% (-1%)	10% (-1%)	10%	13% (-2%)	12% (-1%)	11%	1% (-1%)	5% (-2%)
Local bus	3% (-1%)	2% (-1%)	3% (-1%)	6%	10%	10% (-2%)	21% (-2%)	12% (+1%)
London Underground	--	--	--	--	--	--	26%	16% (+1%)
National Rail	2% (+1%)	3%	4% (-1%)	3%	3% (+2%)	7% (+3%)	18% (+10%)	18% (+3%)

Figure 4: Journeys to/from usual workplace by main mode and area type, 2013/14. Values in brackets show change in percentage points from 2002/4. Source: National Travel Survey, using ONS' standard spatial classification.

Commuting journeys throughout the week (multi-modal)

- As the peak is generally regarded as occurring during the week, in the morning and afternoon, it is interesting to note that there has been a **sharp decrease in travelling to work on six or seven days per week**
- **Home working is increasing, but a more rapidly growing group is self-declared workers who perform no work-related travel during an average week**, but do travel for other purposes. The causes of this increase are not clear.
- The decrease in the proportion of workers travelling to their usual workplace is not primarily due to people switching to 'usually' working from home, but rather to other factors such as people **'occasionally' working from home and an increase in workers who do not have a single 'usual' workplace.**
- **There has been an increase in the proportion of National Rail commuters who commute by National Rail on each day that they work, but who work fewer than five days per week**

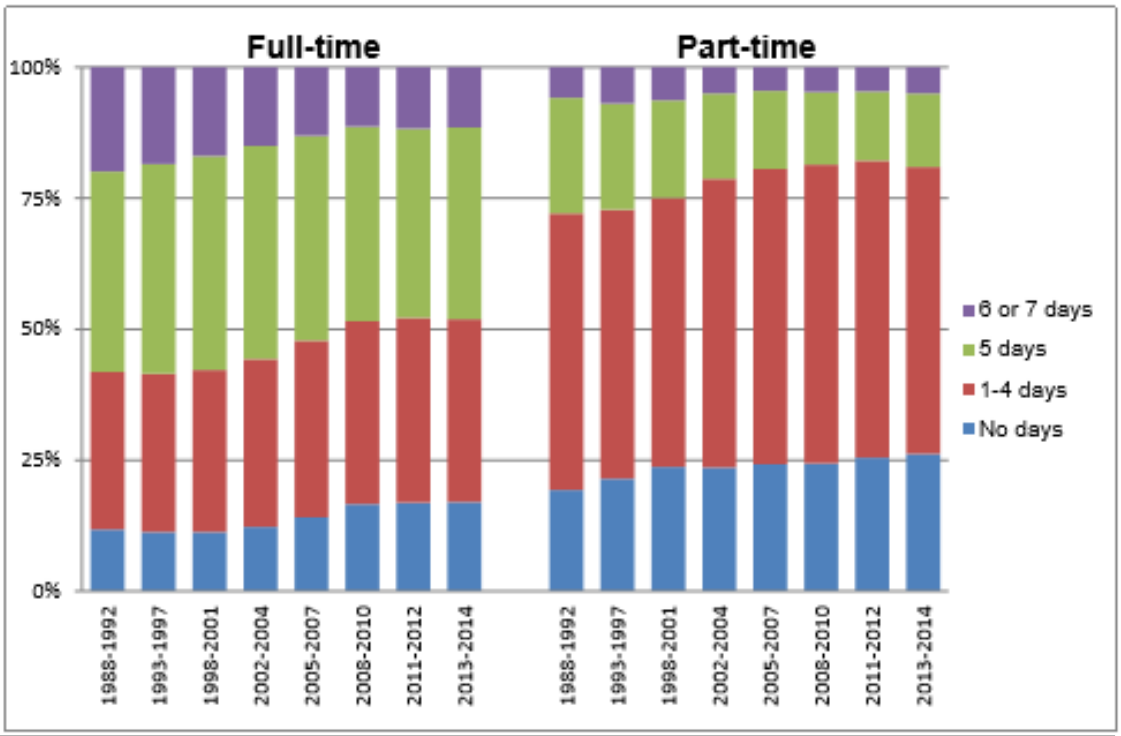


Figure 4: Number of days per week with work related travel for full-time and part-time workers. Source: National Travel Survey

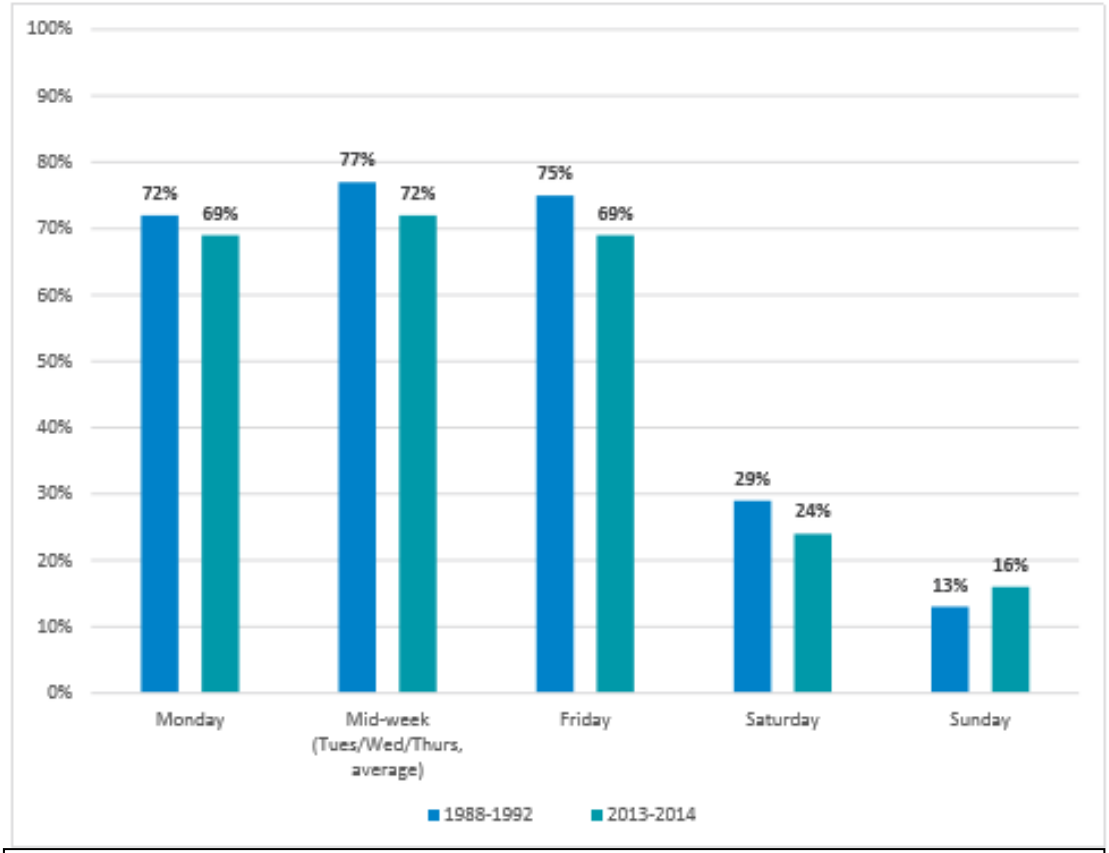


Figure 5: Proportion of workers travelling to their usual workplace on each day of the week (Among workers who do so at least once a week). Source: National Travel Survey

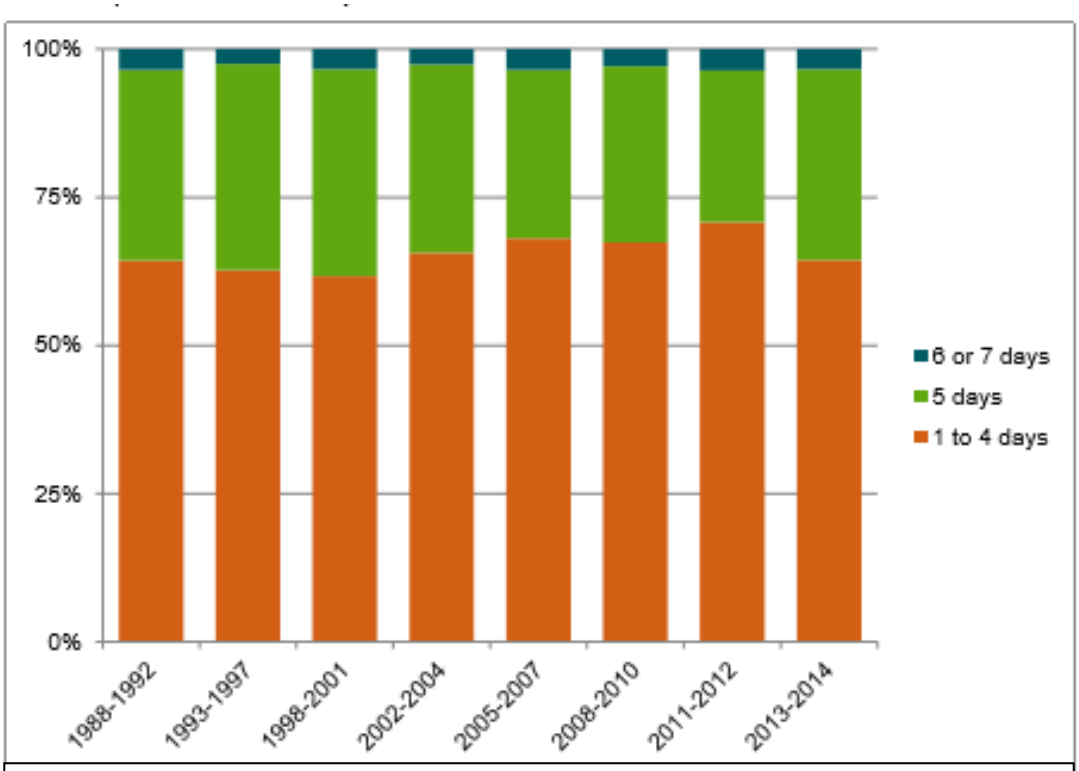


Figure 6: Of people that travelled to/from their usual workplace by National Rail at least once during their diary week, the number-of-days that NR was used for these journeys. Source: National Travel Survey

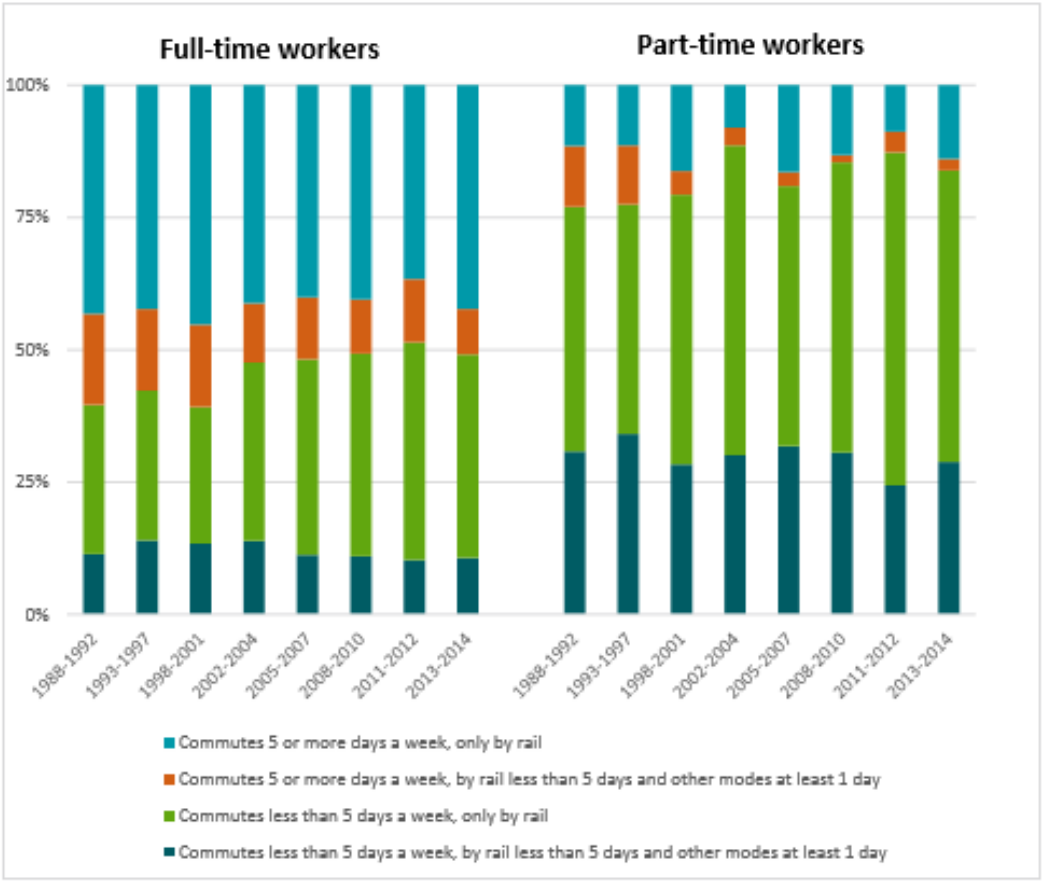


Figure 7: Days with a commute throughout the week, and whether rail sole mode or other mode used on at least one day, and whether full or part-time. Base: National Rail Commuters. Source: National Travel Survey

Decreas

- **n 7.1** eport for further details).
- This is **sharper than the decline in overall trip-making per person during this period**, which highlights the **importance of understanding how commuting is changing.** This decline in commuting journeys is seen whether one measures the number of commuting journeys on a per-person basis, per-worker, or even in absolute terms.

Reasons contributing to the decrease in commuting journeys (multi-modal)

- **Workers are commuting to work fewer days per week** (See section 2 in report 'Headline trends in commuting, Commuting through the week')
- **There has been growth in trip-chaining (where people combine two or more trips for differing purposes, such as dropping-off children at school on the way to work)** between home and work, and a corresponding decline in traditional 'Commuting', which is defined as journeys directly between a worker's home and usual workplace with no intermediate destinations (See section 2 'Headline Trends in Commuting, Time-of-day, Trip-chaining')
- **There has also been growth in the number of workers who do not have a fixed usual workplace and hence are not 'commuting' when they travel to a work site.** This raises an issue of **whether the traditional National Travel Survey definition of 'commuting' remains fit for purpose** (See section 2 'Commuting through the week')
- **Working from home is growing, both occasionally and on a usual basis**
- **There has been an increase in the number of people who report that they are employed, but do not work at home and are not observed to travel to work during their NTS diary week** (See section 2 'Headline trends in commuting, Commuting through the week')

- **Part-time employment and self-employment have also expanded somewhat over time; both of these statuses are associated with reduced numbers of commuting journeys** (See section 2 'Labour force structure, Commuting through the week')

Changes in modes used for commuting

- **Commuting as a Car Passenger has declined, with corresponding growth in use of National Rail and London Underground**. However, Car Driving remains dominant, accounting for more than half of commuting journeys (See section 2 in report 'Commuting mode, Commuting in context').

Increases in commute distance and duration (multi-modal)

- Commuters are travelling further: average distances have increased. At the same time, the duration of commuting journeys has also been growing. These trends are primarily due to rapid changes in commuting behaviour by part-time workers (See section 2 'Commuting journey length and duration').

Changes in time-of-day of commuting

- **Work-bound commuting journeys have shifted on average several minutes earlier in the morning, with homebound journeys shifting to slightly later in the afternoon.** There has therefore been a lengthening in the duration of people's days at work, which has taken place alongside a consolidation of commuting into a smaller number of journeys (i.e. fewer but longer-distance commuting journeys) (Section 2 'Time-of day').
- **As the composition of the workforce shifts, this may have consequences on how concentrated commuting trips are during peak periods**. For instance, there has been a decrease over time in the share of workers classified as 'Manual' workers, and they are less likely than others to commute during peak periods.

The Demand Centre – First Report of the Commission on Travel Demand

- The Demand Centre Commission on Travel Demand recently published their first report, which brought together evidence gathered seeking to explore how travel demand is changing and may change in the future, and the problems with existing forecasting practice. The relationships between how much, how often, when and how we travel and the activities we take part in have changed and continue to do so.
- **The Final Report, 'All Change? The future of travel demand and the implications for policy and planning'** summarises the deliberations of the Commission. **It found that people travel substantially less often today, per head of population, than they did one or two decades ago. The commission argues that there needs to be a change in our approach to understanding and planning for this in response.**
- Ten recommendations for change are set out which challenge decision-makers, practitioners and researchers to make a step change in how they think about travel demand, how the future is planned for and what kinds of evidence are ten serious when taxpayers' money is invested in the transport system. (See appendix for report infographics).

Why does the demand for travel matter?

Whilst current policy plans to accommodate substantial growth in travel, environmental imperatives suggest a need to plan for less. There is a case to be made that some people do not travel enough and others who argue

that there are some who travel too much. It is not just how much we travel that matters but also how we travel and here it seems clear that the reduction in active travel is having negative health consequences as is the dominance of fossil fuel vehicles in our towns and cities.

The demand for travel has changed:

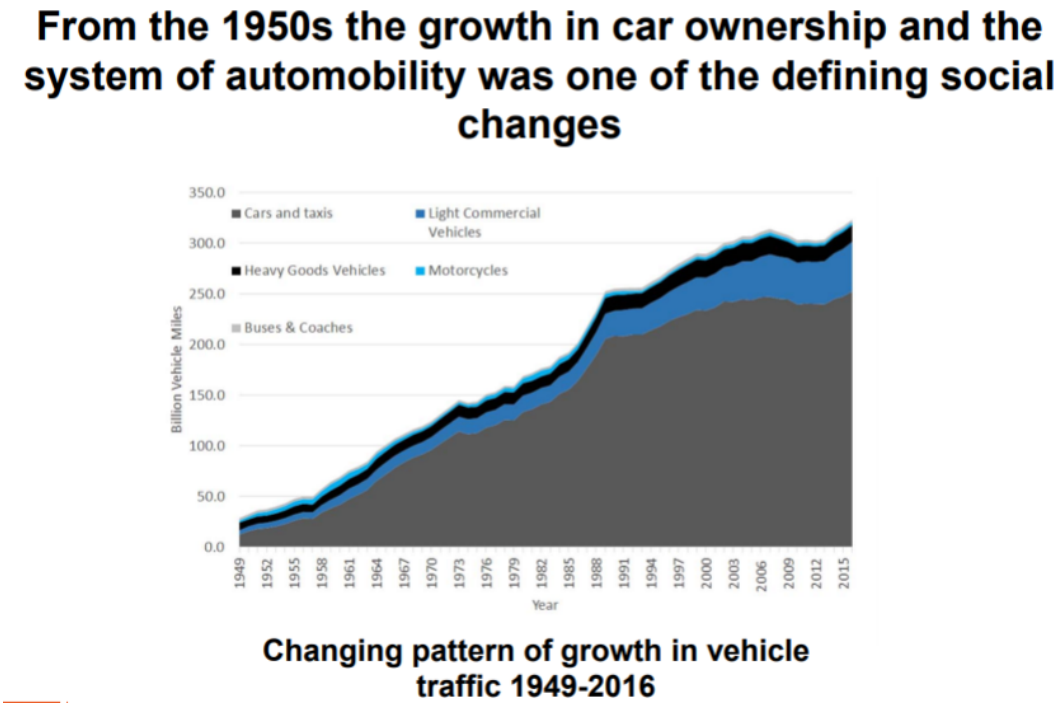
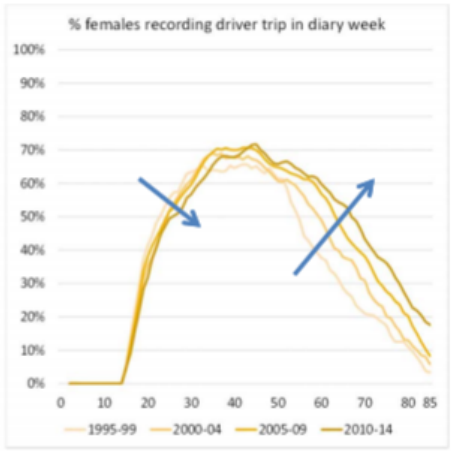


Figure 8: Changing Pattern of Growth in Vehicle Traffic 1949-2016. Source: Demand Centre

There has been a major shift in the behaviour of different cohorts



Evidence from Gordon Stokes

Change is not confined to cities but spatial variation remains important

Chart 17: Percentage change in car driver miles per head per year by age group and area type and BUA size: England 2002-5 to 2011-14

Figure 10: Percentage change in car driver miles per head per year by age group and area type and BUA (Built-up Areas) Size: England 2002-5 to 2011-14. Source: Demand Centre, Peter Headicar (2018) Analysis of National Travel Survey 2016

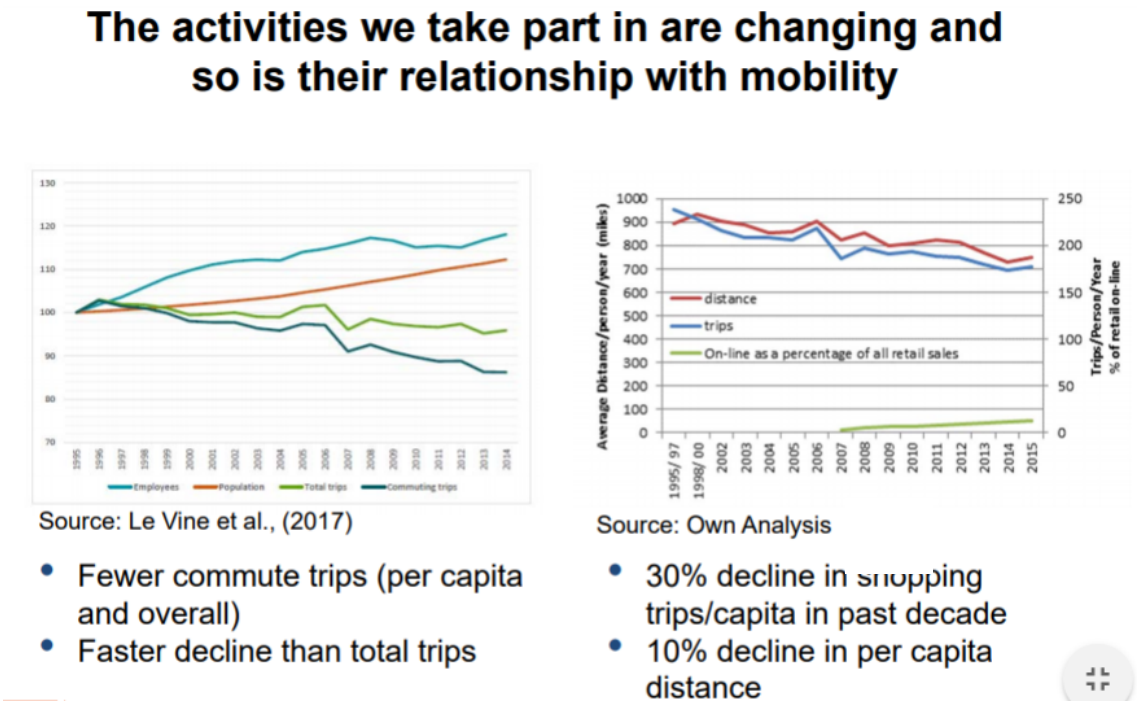


Figure 11 and 12: Changing levels of participation in certain activities. Source: Demand Centre

What about future travel demand?

The commission found that there is very little evidence about the impacts of new technologies. What we do know is that:

- Where integrated transport is good, public transport, cycling and walking dominate mode share
- Despite an increase in car sharing and car club membership, overall vehicles have become less, not more, shared
- Uber/Lyft services have reached 20% of VMT (Vehicle Miles Travelled) in San Francisco. The benefits are to late night users with negative impacts on some public transport, walking and cycling. UK cities know little about use patterns.
- The range of VMT impacts from Autonomous Vehicles in the US was estimated to be -5% to +60%

The activities we take part in are changing and so is their relationship with mobility. So, how these change and how these relate to new mobility options is at least as important as the new technology itself.

MODE SPECIFIC

The below evidence indicates more mode-specific observations and facts regarding patterns of demand. Overall, it is clear there is a good range of data available for rail and car, but less for other modes.

Department for Transport

- The road network is affected by congestion at peak times, with slower average travel speeds relative to the off-peak period. This is despite relative stability in the number of vehicle miles travelled in major cities.

- Rail networks have experienced **growth in passengers** in recent years. **The majority of arrivals into major cities occur during the AM peak, where overall one third of all daily arrivals occur.** Passengers in excess of capacity is also a greater issue during the AM peak relative to the PM peak. **However there is heterogeneity across UK cities.** London, where passenger numbers are highest, experiences the highest proportions of passengers in excess of capacity, which occurs during the morning commute. **By contrast Newcastle and Liverpool experienced greater rates of passenger crowding during the PM peak**. Survey data suggests user satisfaction with rail service punctuality has remained around the 75% for respondents in recent years.

Car and Van Congestion

- **The majority of trips taken in the UK continue to be made by car, including those in peak and off-peak times within urban areas.**
- Recent statistics published by DfT show average speeds on local 'A' roads during the weekday morning peak (7am to 10am) and the weekday evening peak (4pm to 7pm) were 24.0 mph and 22.2 mph respectively in the year ending June 2017.
- Evidence produced in the Department's Annual Road Traffic Estimates shows daily car traffic by hour for all road types in 2016, and shows consistent patterns across road types (including in urban areas). **The majority of car miles are driven between 4-6pm, which exhibits higher levels than the morning peak period. The peak occurs around 5pm on Monday and midweek, whereas on Friday the peak occurs slightly earlier around 4pm. During the AM peak car miles are highest on mid-weekdays, and lowest on Friday.**
- There is also variability in road use across months of the year. The National Road Traffic Estimates 2016 assessed the vehicle miles travelled on an average day between 2012 and 2016 for urban roads. They show that road usage is highest in November, and that from September to October it trends upwards. It is lowest in January, and there are also substantial dips during August and December.

Peak and off-peak travel by rail

- **Rail travel has increased in urban areas.** Since 1994/5 rail passenger numbers in the UK have more than doubled, although there is variability between cities. Average growth in passenger journeys in Great Britain has been 4% per year over the past 20 years.
- **The morning peak is the most popular time for journeys.** Half of daily journeys into London occur during the morning peak, whereas for other cities this is close to a third and one quarter.
- Despite the strong growth in rail there has been **variability in passenger numbers between cities**. London has the largest share of passengers, with 583,000 arriving during peak times and 1,063,000 arriving throughout the day in 2016. This corresponds to growth of 9.42% and 9.41% respectively compared to 2011. Birmingham has the second largest number, with 42,000 arriving during the AM peak and 121,000 arriving throughout the day. This corresponds to growth of 18.3% and 11.9% respectively compared to 2011.

PiXC (Rail)

- The PiXC measure is used to measure the number of passengers on a service in excess of the sitting / standing space provided. **Recent data indicates patterns vary considerable between cities**. In cities including London and Bristol overcrowding has worsened during both the AM and the PM commutes. Overall the morning peaks were most crowded during 2016, with 4.9% overcapacity. This compares to

passengers in excess of capacity of 3.4% in 2012. During the PM peak overcapacity is 2.7%, and is a percentage point higher than in 2012 when it was measured at 1.6%.

- Measures of PIXC are higher in London, which also experiences the greatest inflows of commuters during rush hour. The number of excess passengers during the 2016 AM peak was 5.7%, compared to 4.1% in 2012. Over the PM peak this was 3.0%, representing growth of 1.2percentage point compared to 2012 when it was 1.8%.
- Capacity constraints appear to be less severe elsewhere, with lower rates of growth in passenger numbers in excess of capacity. **Outside of London PIXC during the AM peak was 1.9%, representing growth of 0.8percentage points compared to 2012. In the PM peak this was 1.5%, with growth of 0.6percentage points compared to 2012. However there was variability across cities, with Liverpool and Newcastle experiencing no passengers in excess of capacity. By contrast Manchester experiences a higher proportion of passengers in excess of capacity. During the AM peak it is 3.5%, whereas in the PM peak it is 2.5%. Similarly for Bristol the AM peak has passengers in excess of capacity of 2.7% and 2.6% for the evening peak.**
- Despite increasing passenger numbers, evidence suggests that satisfaction with service punctuality has remained broadly consistent since 2011. Survey data taken in the National Rail Passengers Survey shows that between 2000 –2015 satisfaction with service punctuality / reliability has remained constant at around 75% for both AM peak, PM peak and off-peak travel. However while satisfaction generally increased prior to the 2008 recession there has been a slight decline in subsequent years.

Network Rail

- Rail markets into and within large urban areas have been on a growing trend for the last two decades. **Growth has been particularly strong within large regional cities such as Manchester and Leeds where the demand for rail has grown not only as a result of re-urbanisation (bringing more people and jobs), but also through increasing its share of the market.** The rail market in London is also on a long-term growth trend, although the rate of growth has typically been lower as rail has less scope to grow through market share gains. In general, off-peak markets in urban areas have been growing at a greater rate than peak markets. **Other than the picture of growth, peak and off-peak rail travel patterns have remained relatively stable over a long period of time despite an increasingly flexible labour market and significant advances in information and communications technology. As a result most commuting still occurs within two daily peaks, whilst the off-peak is dominated by leisure travel.**

Existing and historic patterns of rail demand

- Off-peak rail markets have tended to grow at a greater rate than peak markets**. For example, between 2002 and 2015 peak rail travel into central London grew by 2% per year on average, whilst during off-peak hours growth averaged 5% to 6%.** Although it is difficult to evidence the drivers of growth during off-peak hours, it is thought that increasing disposable incomes, growth in leisure and tourism industries, an increasing number of students in higher education (including students from overseas), and decreasing car ownership amongst younger generations are all important factors. Off-peak growth has also been enabled (or at least, not discouraged) by the spare rail capacity to grow during these hours.
- Other than the picture of growth, rail travel patterns in peak and off-peak hours have been relatively stable despite an increasingly flexible labour market and significant changes in information and communications technology. As a result most commuting by rail into large urban areas still occurs during the morning peak, leisure trips still dominate the off-peak, with business travel straddling both peak periods. The shape of arrivals and departures by rail for Manchester and London is shown in Figure 1, which clearly illustrates the peaked nature of rail travel to and from urban areas[1].

[1] Network Rail response Call for Evidence, pg.2

City	Years 2001	2011	Total Growth	CAGR	Source
	Pax	Pax			
Birmingham	18,078	28,419	57%	4.6%	*Census data commuting by rail data 2001/2011*
Leeds	11,411	19,647	72%	5.6%	*Census data commuting by rail data 2001/2011*
Manchester	16,170	22,353	38%	3.3%	*Census data commuting by rail data 2001/2011*
	2002	2015			
London	451,000	581,000	29%	2.0%	*DfT TSGN Table 0106: People entering central London during the morning peak by national rail (2002 to 2015).*

Figure 13: Rail commuting growth into large urban areas. Source: Network Rail Response

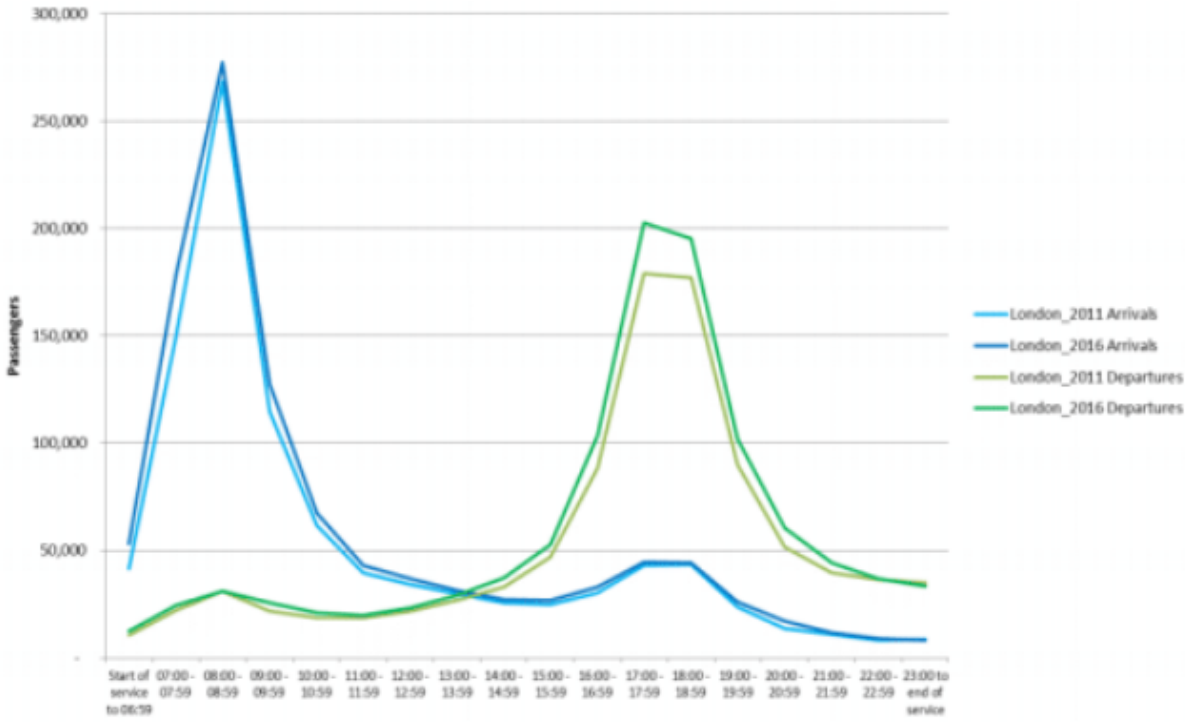
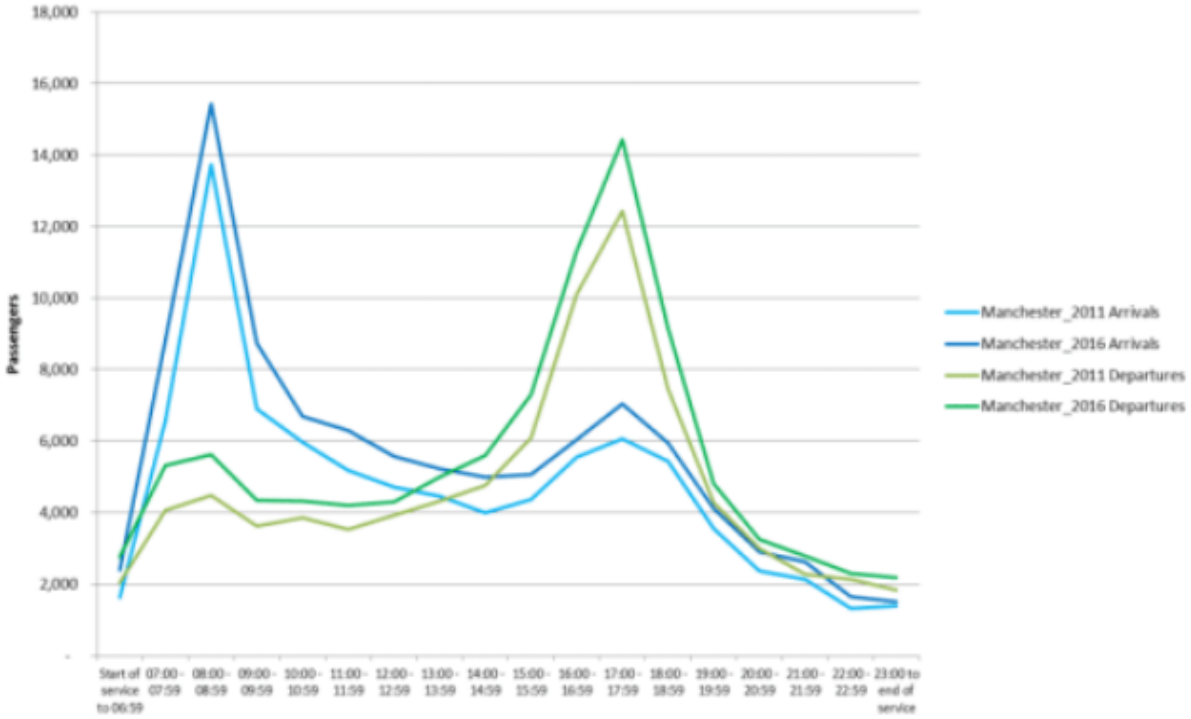


Figure 14: London City Centre Passenger Counts (Arrivals and Departures) by rail on a typical autumn weekday and timeband 2011 and 2016. Source: Network Rail Response



Martin Mayfield, University of Sheffield

- A fractured picture of patterns of demand can be inferred from the data currently available for the UK motorway and major road network. Assembly of a full picture would require the fusion of transport, freight, and commuting data currently available at disparate resolutions and scales from various sources and authorities.

Rail Delivery Group

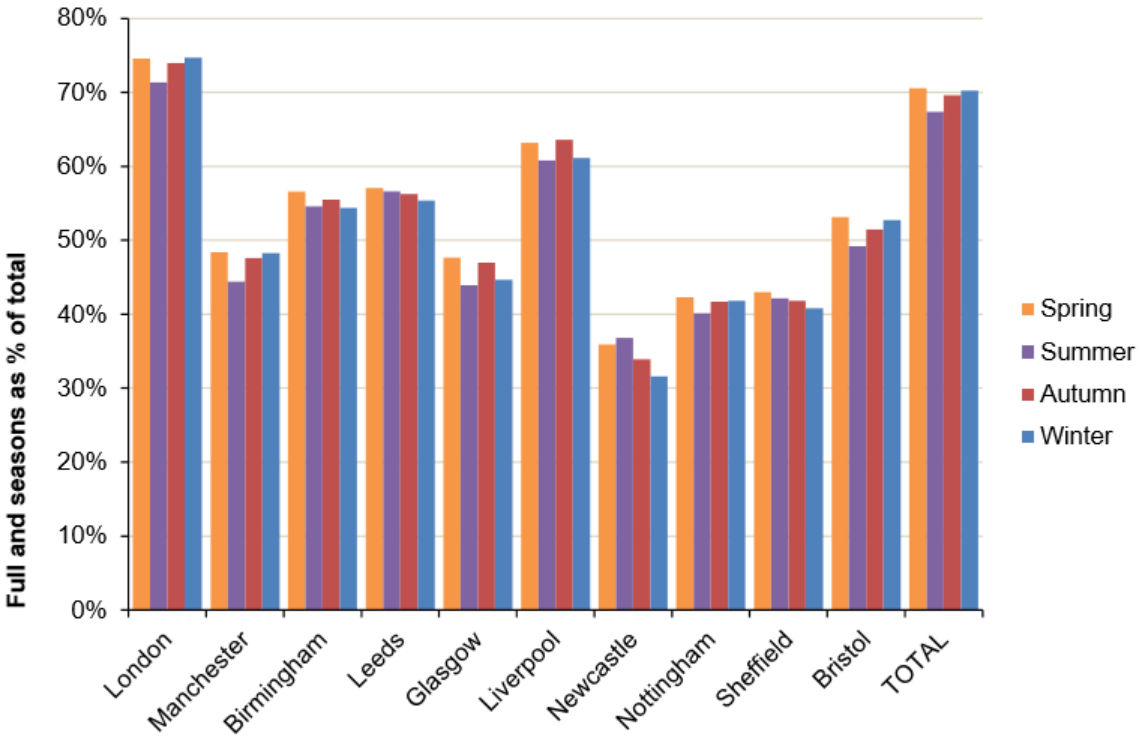
- The rail delivery group contribution to the CFE considers rail travel exclusively.

What evidence do we have on peak and off-peak travel rail trends in our urban areas?

- Data from ticket sales provides a wealth of evidence on travel trends across the rail network. Figure

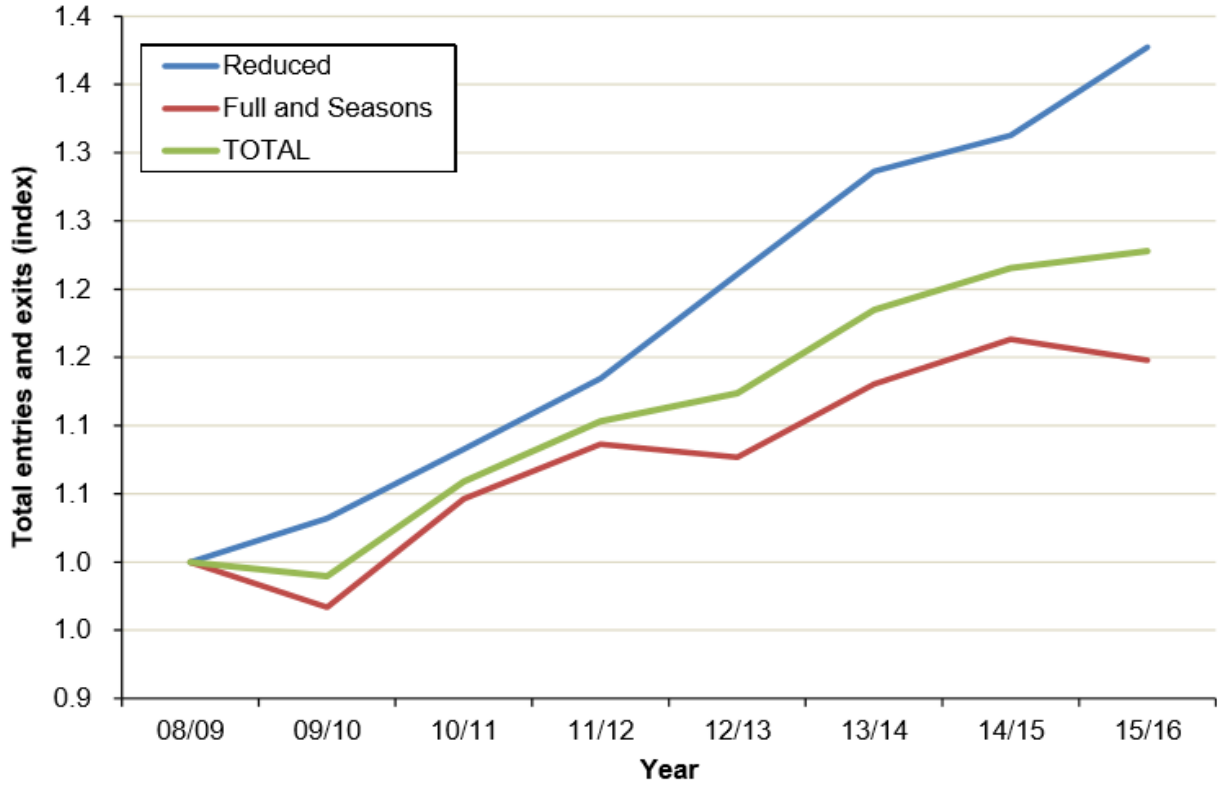
Figure 15: Manchester City Centre Passenger Counts (Arrivals and Departures) by rail on a typical autumn weekday and timeband 2011 and 2016. Source: Network Rail Response

- Within a context of increasing overall rail travel into the UK's largest cities, the data suggests that **off-peak travel has been increasing at a faster rate than peak travel**. This could reflect factors both **exogenous and endogenous to the rail industry**. **Changes in the employment market in the cities will have been a key driver of rail demand**, in terms of both aggregate levels of demand but the spread of this demand across the day. For example, **increased part-time or flexible working may be encouraging a shift from traditional season tickets to the purchase of reduced fare tickets for travel outside the peak** on selected days of the week. Train operator pricing strategies will also have an impact, particularly the use of advance purchase tickets offering higher discounts for travel off-peak. It is possible that concerns regarding the economy and a desire to reduce spending have accelerated the take-up of these cheaper tickets.



What are the differences between morning and evening peaks, between seasons and days of the week? What is the breakdown of journey purposes at these times? (Rail)

Figure 16: Proportion of travel during peak, by city and season. Source: Rail Delivery Group Response



- The LENNON data (See Rail Delivery Group response for further detail of LENNON data) is not available at a sufficient level of disaggregation to draw any conclusions regarding the times of day or days of week at which different types of traveller will be travelling.
- It is however possible to observe trends between seasons. Figure 16 shows the share of rail travel occurring during the peak by season. **Although the variances between seasons are relatively small, it is not surprising that in most cities peak travel is less dominant over the summer, when many workers will go on holiday.** Similarly, in many cities, the **Christmas period reduces the dominance of peak travel over the winter**. However, particularly for London, the purchasing of annual season tickets in January skews the results.
- Although data is available at a weekly level and by period, periodic sales and settlement patterns have significant influence the results, for example, renewals of monthly season tickets and settlement of revenue from London Freedom Passes.

How do these patterns differ between various cities and across modes of travel?

- Figure 18 shows aggregate levels of peak and off-peak rail travel into each of the 10 cities in 2015/16. Interestingly, **to some extent, the significance of the peak period has some correlation with the size of the city region** – the chart ranks the cities in descending order of total population (based on the 2011 census).

Figure 17: Index of entries and exits, peak vs. off-peak, all cities. Source: Rail Delivery Group Response

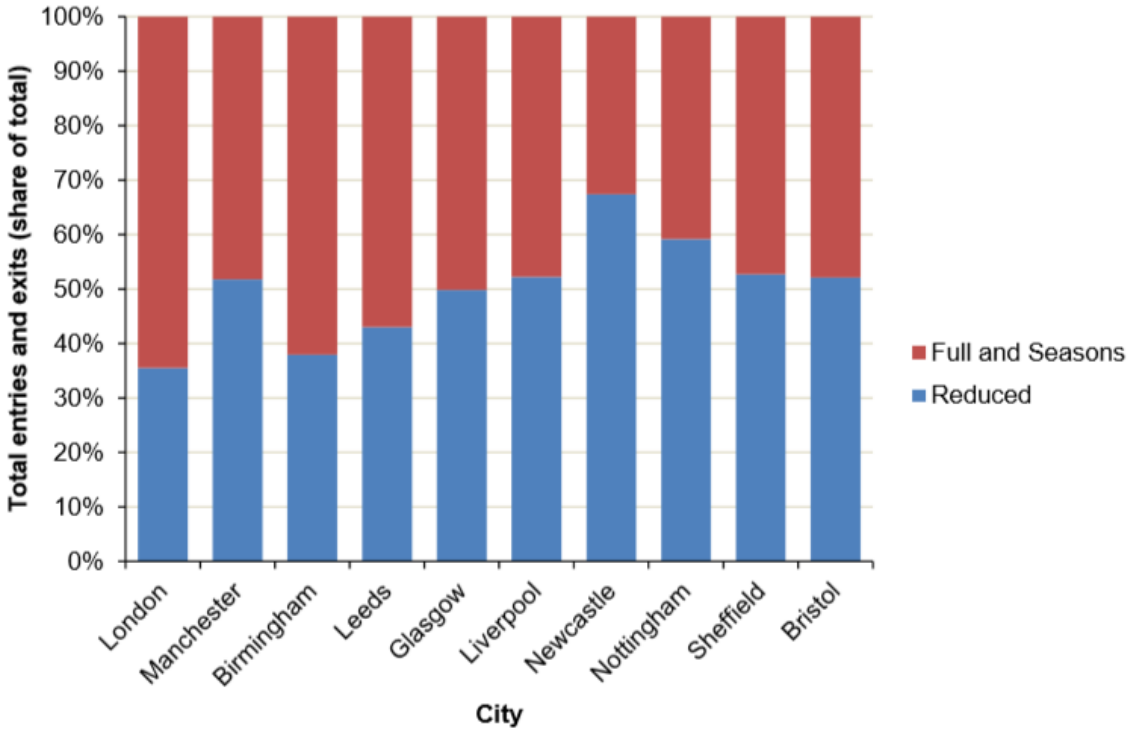


Figure 18: Share of peak and off-peak travel by city, 2015/16. Source: Rail Delivery Group Response

Are patterns of demand stable or are they changing, and if changing, do you understand the drivers of the change?

- Figure 19 shows the **decreasing dominance of peak rail travel at an aggregate level and across each of the ten urban areas.**
- **Although the proportion of rail demand that occurs during the peak period is reducing in most cities, this is not the case everywhere. Liverpool, Birmingham and Manchester are perhaps the most notable exceptions**, which could reflect the reported shift of some office-based activities to Northern cities from London and the South East.
- There are **many potential explanations for the reduced dominance of peak travel, which the response to the next question explores more fully.** These could include **exogenous factors** such as the **availability of city centre employment or the adoption of more flexible working patterns, or endogenous drivers such as crowding or the unreliability of peak services.**

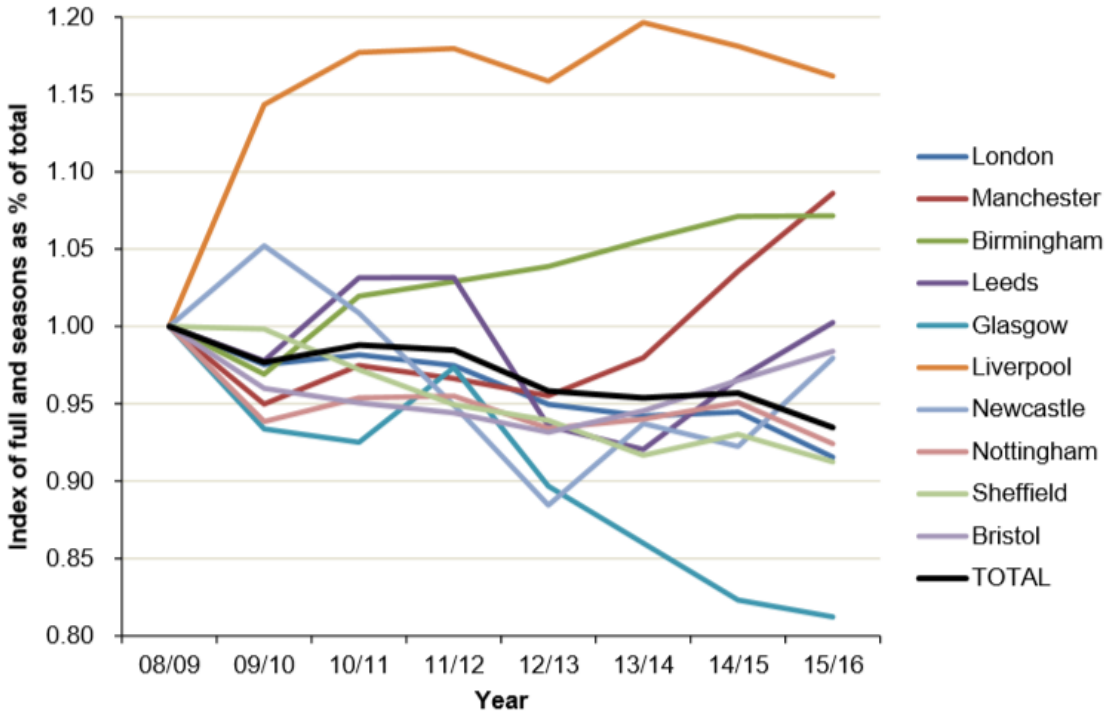


Figure 19: Index of Peak Travel and proportion of total, by city. Source: Rail Delivery Group Response

Car commuters experience the most-variable commute times, though road traffic reliability has improved:

- **Drivers experience the greatest day-to-day perceived variability in the duration of their commuting journeys**, with walkers and cyclists experiencing **the highest reliability**, followed by rail commuters. Reliability in commuting journey times has improved over time for most modes of transport, most notably for driving (Section 3. Comparison of reliability of commuting journey time by mode).

Congestion on local 'A' roads and the Strategic Road Network

Morning peak period travel speeds on the Strategic Road Network (SRN) appear to relate closely to traffic volumes, but this is much less true for local 'A' roads, where speeds are generally slower but appear to be less affected by traffic volume.

What Road Traffic Data is available for UK Cities?

The road traffic data available for UK Cities and urban areas can be found in the evidence prepared for the creation of local plans. This is a requirement from government, and therefore the data gathered is available on most local authority websites. The transport evidence base should identify the opportunities for encouraging a shift to more sustainable transport usage, where reasonable to do so.

For the purposes of this report, the availability of data for Greater London and Greater Manchester were reviewed.

Greater Manchester: For Greater Manchester, transport policy is overseen by Transport for Greater Manchester (TFGM). The relevant datasets are available via the gov.uk data portal, in the Transport Statistics

for Greater Manchester Road Traffic Section. The most recent report details the presents results of HFAS's (Transport for Greater Manchester Highways Forecasting and Analytical Services formerly known as GMTU) road traffic monitoring. It includes trends in countywide and nationwide traffic flows.[2] (Source below – November 2017)

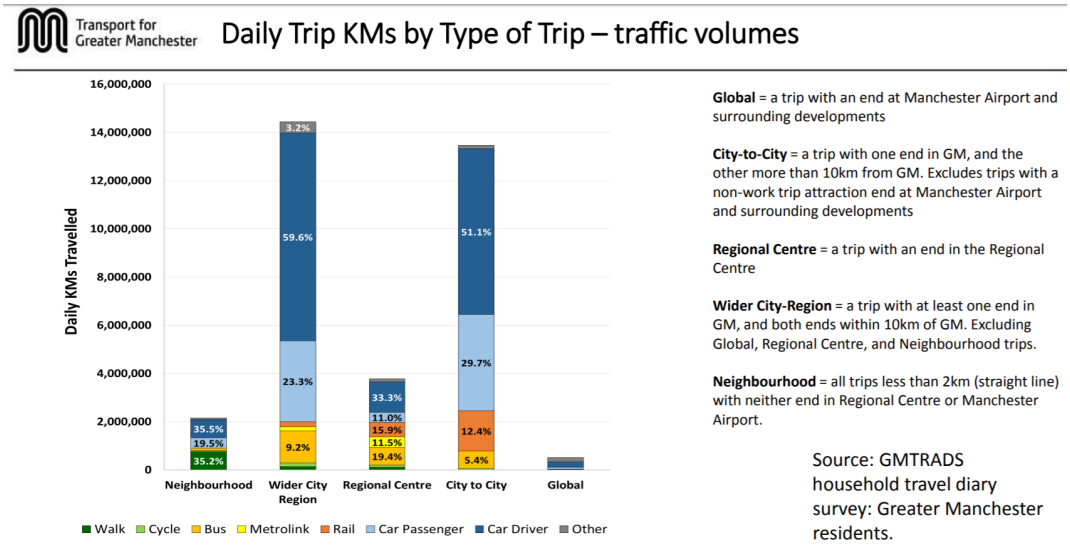


Figure 20: Daily Trips (Km) by type of Trip – Traffic Volumes. Source: GMTRADS Household Travel

Greater London: Similarly for London, the transport network is overseen by Transport for London (TFL) and data sets for road traffic can be found on the London Datastore.[3]

Existing ITC Research Findings

The ITC has been running a major research work stream exploring road and rail travel trends in Great Britain. This has identified the main national travel trends since 1995 and helped to illuminate the stagnation in car travel on a per capita basis since the late 1990s and how the growth in rail travel has come from a greater proportion of the population travelling rather than existing rail travellers going further. Although this research does not explore times of travel throughout the day, it provides a good primer on the main trends.

The ITC is currently running further research studies exploring the drivers of rail demand since 2000 as well as what has been causing the decline in bus travel in Britain. In its discussion evening series, the ITC has explored trends in private hire and taxi use, finding that this is becoming an increasingly important part of city travel.

For more information, please consult the following links:

Recent Trends in Road and Rail Travel: what do they tell us? (P Jones & M Niblett, ITC 2016)

http://www.theitc.org.uk/wp-content/uploads/2016/12/ITC-Road-and-Rail-Travel-Trends-England-December-2016.pdf

[2] https://data.gov.uk/dataset/4c944e4a-9e2b-4363-815c-bf9a7b7873d4/transport-statistics-greater-manchester-road-traffic-section Last Accessed 29/06/18

[3] https://data.london.gov.uk/ and https://data.london.gov.uk/dataset?q=Peak%20traff Accessed 29/06/18

On the Move: Making sense of car and rail travel trends in Britain (P Jones & S Le Vine, ITC and RAC Foundation, 2012)

http://www.theitc.org.uk/docs/47.pdf

ITC Discussion Evening exploring the future for private hire and taxi use, 20th February 2018

http://www.theitc.org.uk/our-events/discussion-evenings/itc-explores-the-future-for-private-hire-and-taxis/

2. Factors affecting demand

What are the key social, behavioural and economic factors that affect the time of travel (and by extension peak and off peak patterns of demand)

Who is travelling at different times of day in our urban areas and why?

What has been the impact of new technologies and working practices on peak and off peak travel?

What has been the impact of new technologies and working practices to increase the capacity of transport systems during the peak?

Summary

The evidence from this section, along with section 1 'patterns of demand' were the most information-rich in terms of responses to the Call for Evidence. It is broadly understood that a range of contextual factors influence travel demand and travel choices. Policy and pricing are the key tools that can be used to determine/influence travel behaviour, but ultimately these tools do not outweigh the fact that many travellers have no choice but to travel in the peak, primarily for work or employment reasons. A number of factors have changed in the last couple of decades, which have altered travel patterns. These include a greater number of people choosing healthier, more sustainable forms of transport in UK cities, such as cycling and car sharing schemes, as well as a broader interest in health and wellbeing that has encouraged more sustainable choices too. Equally, changing demographic factors have resulted in increased pressure on urban transport networks, with an increase in urban living and more jobs centred in city centres being important factors. Other factors include more generally the decline in car ownership in younger generations, despite an increase in the overall number of people who hold a full drivers licence.

Overwhelmingly, work and leisure travel dominates in terms of factors driving demand. When it comes to decisions about when to travel, there is a good amount of data available for rail and road, with road users more likely to have greater flexibility than rail users. Commuting trends remain very important, with the Commuting Trends Report again containing a good breakdown of these issues. Working patterns seem to be a more important factor than technology, although the two are inevitably interlinked. Technology has enabled travellers to make better informed decisions about their routes and journeys (for example, mobile technology and travel apps). The effect of autonomous vehicles, whilst a major technological advancement, is yet to be fully determined. Overall, whilst this factors have been observed, more substantiated evidence, with more tangible links, is still required to determine the effects these factors will have on peak and off peak travel in and out of UK cities.

EVIDENCE:

What are the key social, behavioural and economic factors that affect the time of travel (and by extension peak and off peak patterns of demand)

Transport Planning Society (TPS)

- In **the context of DfT desire to reduce transport emissions, the importance of changing travel patterns is emphasised.** In particular, the TPS response observes the issues around the connection between land-use and transport as identified by the planning policy guidance on transport (PPG13) published in 1994:

  'When looked at in the context of the [intended] absolute reductions in transport emissions of 50% by 2030 and 80% by 2050 called for under the Climate Change Act 2008 (2008) (CCC, 2008)…Visioning and backcasting (Vibat) studies commissioned by the UK Department for Transport demonstrated that these ambitious targets would require ***radical changes in travel behaviour*** *(Hickman and Bannister, 2006), mostly in the form of changes in* ***individual travel choices****. The sigFnificance of* ***'liveable cities'*** *was recognised in this regard, being described by Hickman and Bannister (2006: p. 11) as* ***using urban form to support sustainable transport, with higher density development clustered around an upgraded public transport'***[4]

  Thus demonstrating the link between travel behaviour/travel choices and land use planning.

- Further, evidence provided demonstrated the influence of contextual factors on travel demand and travel choices. In particular, the link between housing/land-use, population increase and increased use of public transport is noted. This has in the last 15 years increased pressure on existing networks which have not been upgraded to match increased demand:

  The period since 2006 has seen ***major changes across many of the factors relevant to the land-use/transport relationship****. The economy has undergone deep recession, the results of which are still unfolding; there has been significant concomitant social change, and radical changes in spatial policies… Two significant changes affecting the land-use/transport relationship are apparent in the later part of the period.* ***From around 2003, the previous trend of strongly increasing average trip lengths appears to level out at about 11 km. From about the mid-1990s, the trend of increasing modal split of motorised surface travel in favour of private transport seems to plateau and start to decline.*** *These changes would reduce the impact of land-use change on transport emissions and may, to some extent, reflect land-use and transport policies that had this purpose, including PPG13. PPG13 was part of a wider national policy shift towards concern with 'sustainable development', which included an emphasis on integrated transport planning (DETR, 1998), urban regeneration (DETR, 1999) and increasing the use of brownfield land for housing (DETR, 2000).* ***Together, these policies may well have played a part in the levelling off of trip lengths and the plateauing of private mode share (Le Vine and Jones, 2012).***[5]

- This indicates factors which may have resulted in increased demand/pressure on peak services. He also refers to congestion and the importance of recognising the relationship with land-use planning, and planning for housing with a reduction in congestion in mind.

[4] 'Land-use drivers of transport emissions–revisited', Alan Wenban-Smith/TPS Call for Evidence response, pg.1
[5] Ibid.pg.2

Department for Transport

- **DfT has also undertaken work to understand how policy can affect travel behaviour.** This includes the use of **pricing incentives** to ease capacity concerns and facilitate commuting during the 'shoulder peak' times.

Peter Brett Associates

- The response from Peter Brett Associates (PBA) suggested that a number of trends which have emerged since the 1950's, **are influencing current travel behaviours.** Their response to the Call for Evidence focused predominantly on cars and highways, but does at points give reference to other modes.

Key Trends regarding travel behaviour, suggested by PBA response:

- Rapid increase in car ownership
- Increases in distance travelled
- Fixed working hours, with the majority of people working from 9am until 5pm
- People tended to make one big weekly food shop, travelling longer distances to large superstores by car
- Huge highways investment
- Cheap fuel
- Poor quality public transport networks
- High public transport costs

Travel Planning, Health and Wellbeing - Bike and Car Share Schemes

- Bike share schemes are becoming more common in the UK, for example the Santander Cycles scheme in London. There are now over 1000 docking stations across the UK, with nearly 140,000 users. Over 10 million trips were made using a cycle share scheme in 2015.[6]
- Such schemes are particularly important in solving 'first/last mile' connectivity issues. **11% of users of a bike share scheme in Oxford stated that they would have done the same trip by car if the bike share scheme had not been available.**[7]
- **For every car club vehicle, four cars had been removed from the roads through car club members selling a car. Additionally, an average of 9.2 vehicle purchases have been avoided per car club car.** Car ownership levels amongst long-term car club users are only 29%. Furthermore, for car club members, annual average mileage decrease by 22% after joining a car club.[8]
- Car sharing and car pool companies and services, such as Zipcar, Uber and EasyCar club, are **allowing people to maintain their ability to travel but choose not to own a car. As a result, less people are reliant on private vehicles for transport, choosing to rent cars occasionally for specific purposes.**

Health and Wellbeing

- Health and wellbeing is becoming increasingly important to people. The number of people using gyms and running has increased significantly over the past decade, with spending on gym

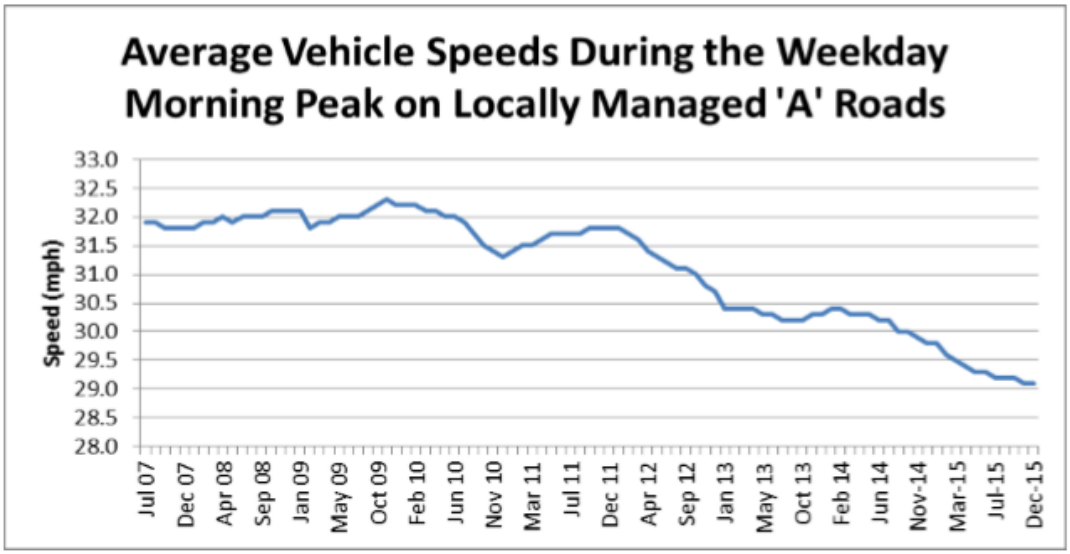
[6] Carplus, "UK Bike share stats," Available: http://www.carplus.org.uk/uk-bike-sharestats/
[7] Carplus, "Societal Benefits of Bike Share," Available: http://www.carplus.org.uk/project_page/bike-share-benefits/
[8] Steer Davies Gleave, "Carplus annual survey of car clubs 2014/15 England and Wales (excluding London)," Carplus, 2015.

membership increasing by 44% in the last year alone[9]**Many people using the facilities before or after work, resulting in travel outside the peak hours.**

Economy/Economic factors influencing travel behaviours

Demographic and Population

- The huge increase in population seen within urban areas has led to increased pressure on transport services. This has been caused peak hour congestion to steadily rise, with traffic speeds reducing over the years, as shown in Figure 21 below.[10]



Some 99.7% of Cambridgeshire's residents live in urban areas, in comparison to 82% of the UK as a whole [26]. This means that people are generally living closer to employment opportunities – as supported by the National Travel Survey, which indicates that the distance travelled per person per year for commuting has generally been decreasing since 2000

Figure 21: Average Vehicle Speeds During the Weekday Morning Peak on Locally Managed 'A' Roads, Cambridgeshire. Source: Peter Brett Associates Response

[9] The Guardian, "UK gym membership spending up by 44%," 18 August 2015. http://www.theguardian.com/lifeandstyle/2015/aug/18/uk-gym-membership-spending-up-by44-per-cent. Accessed 2016

[10] Department for Transport, "Average vehicle speeds during the weekday morning peak on locally managed 'A' roads," 2016.

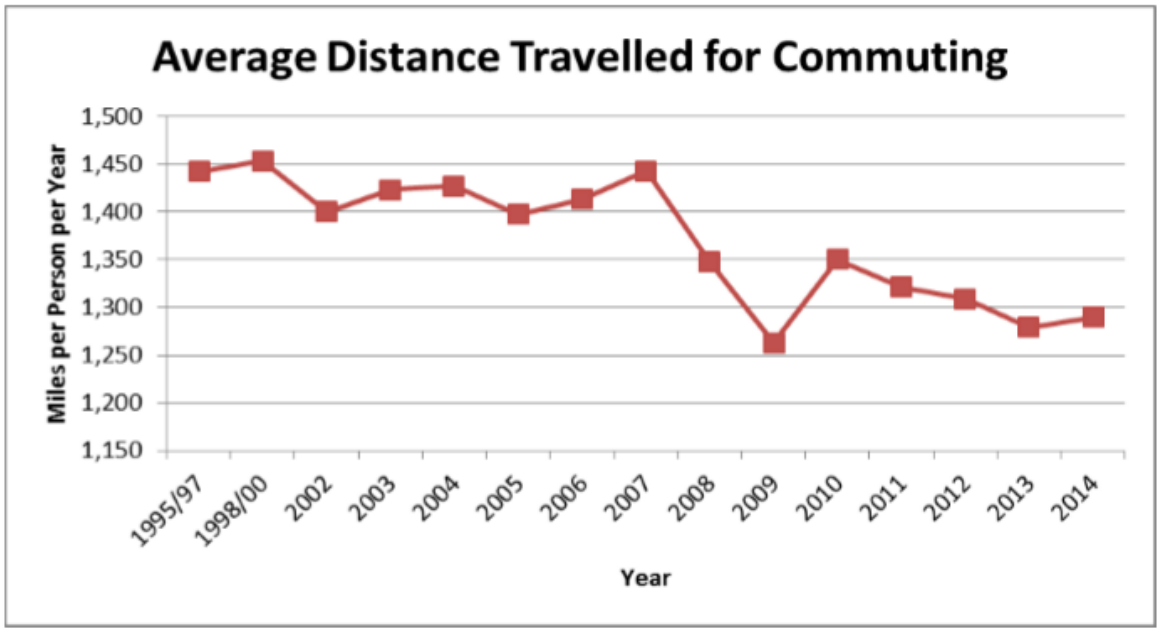


Figure 22: Average Distance Travelled for Commuting. Source: Peter Brett Associates Response

Car Ownership

- Although there has been a rise in the proportion of all people with a licence, this is due to the increase in older people driving (for example, the proportion of over-70s with a licence rose from 40% in 2000, to 62% in 2014).[11]
- **In terms of the younger generation, the proportion of under-30s holding a licence has reduced, by 12 percentage points over this time period, and a reduction of 6 percentage points has been seen in people in their 30s**.[12]
- **37% of 21 to 29 year olds do not have a full driving license. This compares to only 25% in 2000.** NTS data indicates that cost is the primary reason for this, with 40% citing costs as their main reason for not learning to drive.[13]The average spend on the purchase of a car is around £16,800 (new and used)[14] which equates to more than 60% of the average UK salary for a full-time employee.
- **Although car ownership is increasing in lower income households, since 2002, car ownership in high-income households has decreased. The top quintile income households have seen a 50% increase in the proportion of households with no vehicles, suggesting that car ownership is beginning to level off**.[15]
- The concept of a peer-to-peer car club has now become a reality. Several companies now operate in the UK offering this service, and allowing vehicle owners to make money by renting out their car or van when it would otherwise not be in use. This enables people without a car to access one at competitive prices when necessary.

[11] Department for Transport, National Travel Survey 2014, 2015.
[12] Department for Transport, National Travel Survey 2014, 2015.
[13] Department for Transport, National Travel Survey 2014, 2015.
[14] Future Thinking, "Automotive Trends 2015 Changing Lanes," Future Thinking, 2015.
[15] Future Thinking, "Automotive Trends 2015 Changing Lanes," Future Thinking, 2015.

Rail Delivery Group

What are the key social, behavioural and economic factors that affect the time of travel (and by extension peak and off-peak patterns of demand)?

- Transport is a **derived demand**, and therefore **exogenous factors are the primary drivers of patterns of demand.**
- **Travel during the traditional peak periods will be dominated by office workers, with leisure travel typically starting later in the day.**
- **Workers in industries such as retail or healthcare might be required to travel across a much broader range of times**, potentially including overnight.

Factors influencing passenger choices

- However, within the context of these broader drivers, a number of factors could influence the times passengers choose to make their journeys. The AECOM studies appended to the RDG submission demonstrated that a **significant proportion of travellers are already optimising their travel times to avoid the most crowded periods.** It found that around **half of rail commuters have some flexibility in their arrival time and would typically be willing to shift this by up to 30 minutes.** This is highly specific to local characteristics, although several common factors could influence a change in arrival time to avoid the high peak period:

- Length of journey / fares – although potential fare savings for longer distance commuters could be larger and therefore encourage off-peak or shoulder-peak travel, this group of travellers is **more time constrained given their already longer days and reduced service frequencies.** Conversely, although shorter distance commuters are likely to be more flexible, **a large percentage change in fares would be required to encourage them to shift.**
- Relative crowding – inevitably, **excessive crowding in the high peak period will encourage a shift to other times of the day**, or (at least outside of London), potentially other modes of transport.
- **Travellers will only be willing to change their plans if sufficient capacity exists to accommodate them on alternative modes or at different times of day.**
- Income – **lower paid workers are more likely to have specific working hours.** Consequently, this group of office workers would be least likely to travel to and from work outside of the typical high peak periods.

Differing flexibility amongst Road and Rail travellers:

- The research also highlights the **differences between road and rail travellers in terms of their ability to change their travel plans.** Unlike rail, road capacity is relatively constant across the day, and the ability to travel at different times is not limited in the same way as the availability of train services. **The benefits of avoiding congested periods might also be more tangible in delivering real time savings, as opposed to simply avoiding crowding, which would be the benefit typically experienced by rail travellers.**

What factors affect journeys?

- The below graph indicates the most important difficulties affecting passengers using different modes of transport to get to work:

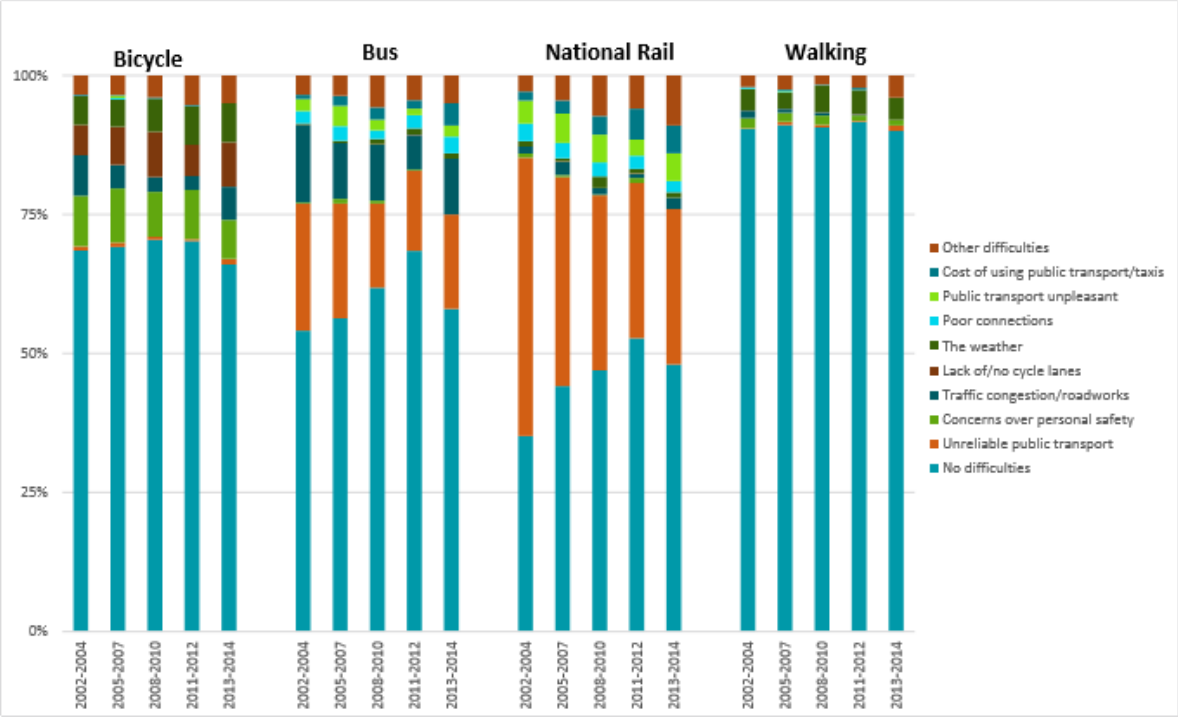


Figure 23: Bicycle, Bus, National Rail, and Walking Commuters' self-reported greatest difficulty with their commute. Source: National Travel Survey

Commuting trend report for England

What is the connection between working practice and commuting trends?

Key trends:

- **Commuting in decline despite population and employment growth**
- **Decline in travel-to-work during the morning peak period**
- Increase in working adults who do no work-related travel during a randomly observed week.

- In 2014, approximately 8 billion commuting journeys were performed. However, **despite the increasing number of workers, the number of commuting journeys has decreased since 1995. This is within the context of overall trip-making having decreased in recent years, also in spite of population growth.**
- **Both of these trends are due to the downward trend in trip-making being greater than the upward trend in the number of workers and population.**

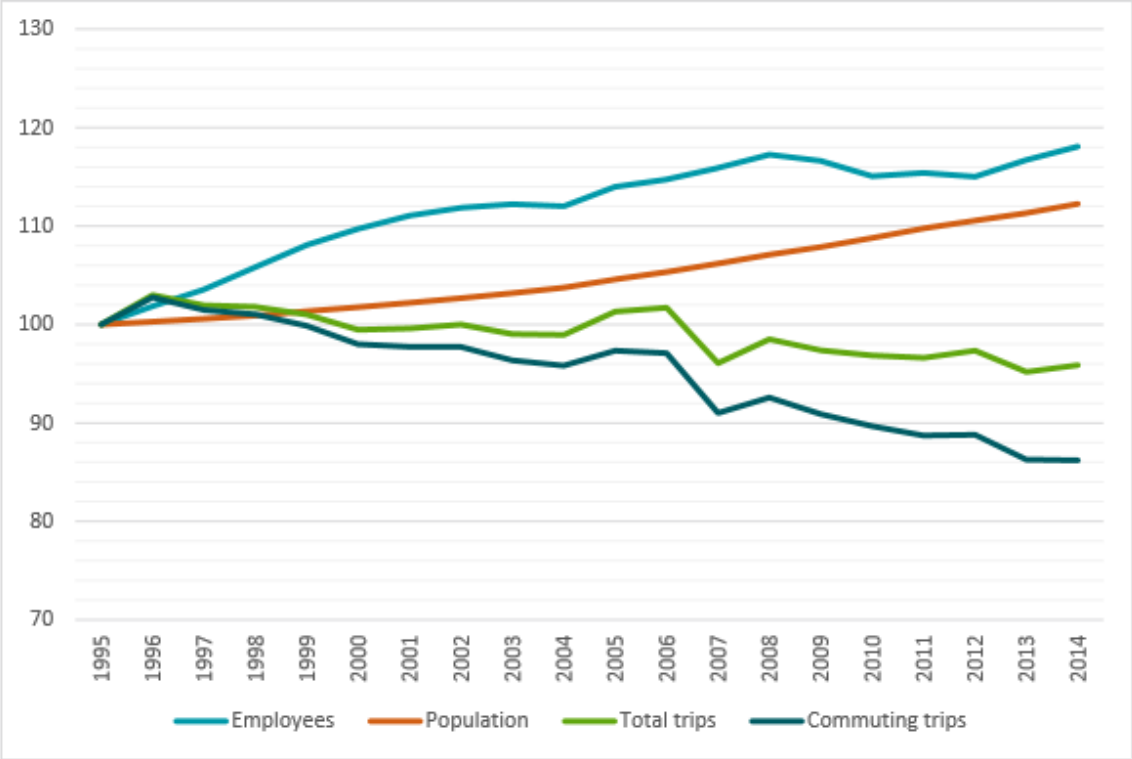


Figure 24: Employees, total population, total journeys and commuting journeys in England (100 = indexed to 1995 levels). Sources: Labour Force Survey, ONS Population Estimates, National Travel Survey

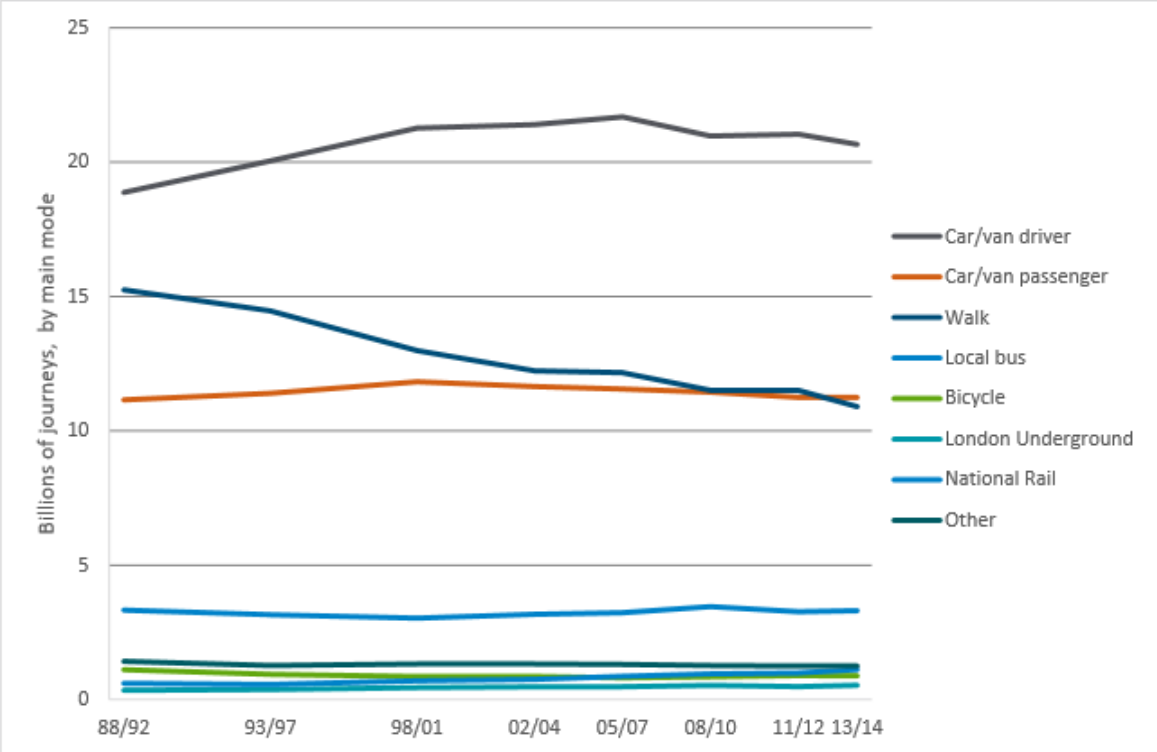


Figure 25: Annual number of journeys, by main mode. Source: Authors' analysis derived from National Travel Survey and ONS Population Estimates

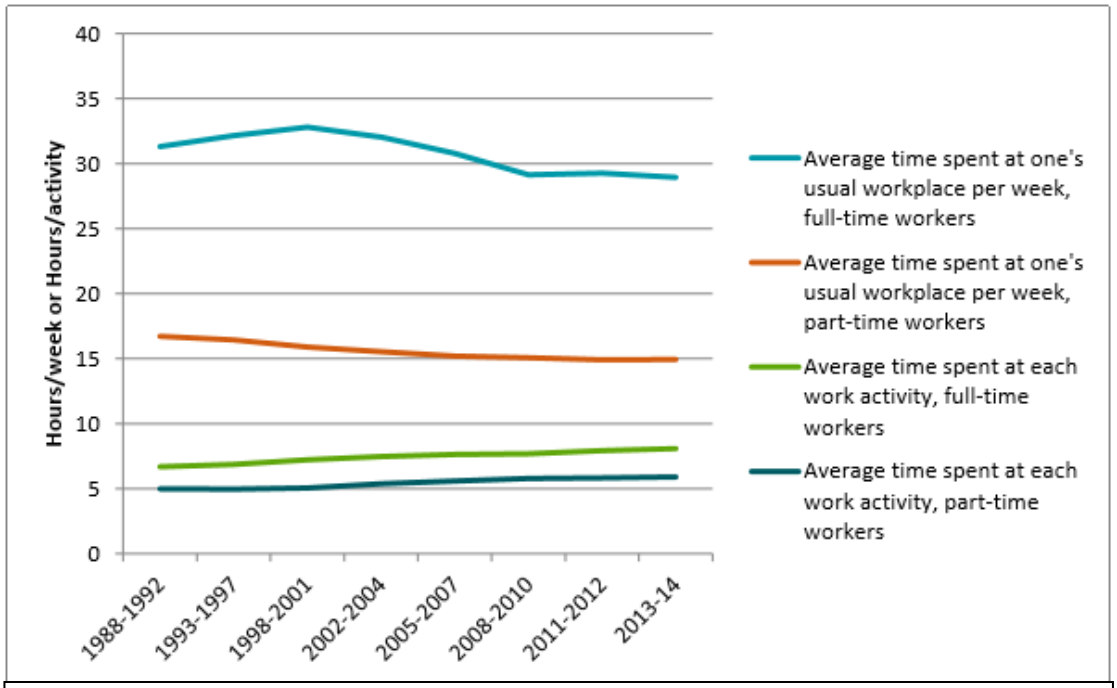


Figure 26: Hours spent at workplace and average duration of work activities. Source: National Travel Survey

- Different types of workers commute to or from work at different times of the day.
- It can be seen that **the 'Non-manual', 'Professional' and 'Employer/Manager' types of workers follow a traditional daily commuting pattern (morning and afternoon/evening peak period) most closely**.
- **At other times of the day, 'Manual' and 'Personal service' workers are over-represented.**
- As the composition of the workforce shifts, this may have consequences for **the degree of concentration of commuting trips during peak periods.**
- For instance, there has been a decrease over time in the share of workers that are in the 'Manual' type category, and it could be that this has tended to counteract the trend of peak-spreading in the morning peak period.

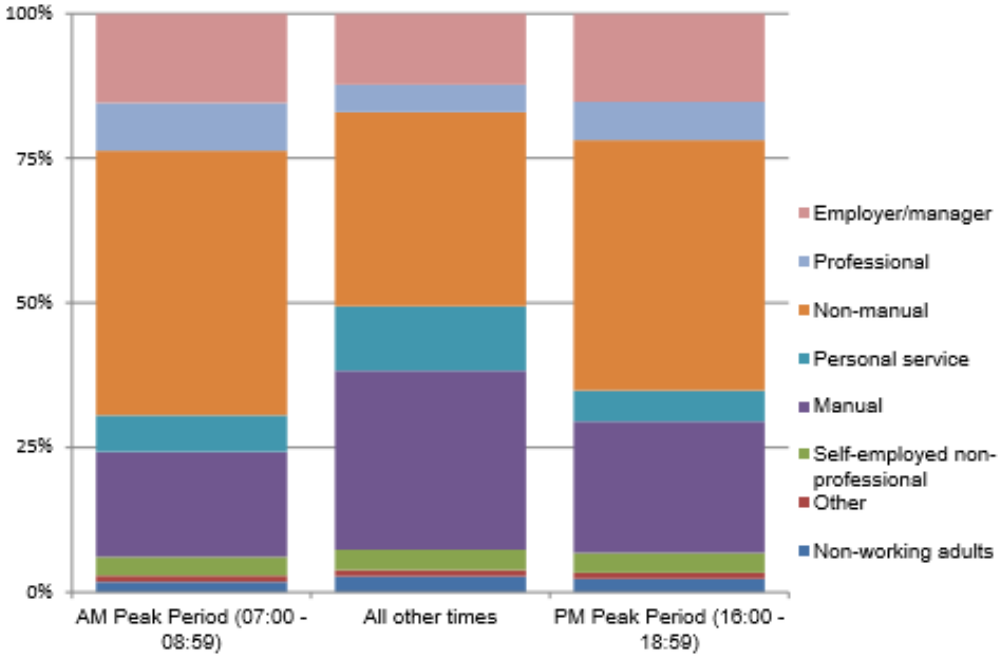


Figure 27: Distribution of workers' occupation type (SEG – Socio-Economic Group) by time of day of commuting journeys. Source: National Travel Survey

School holidays versus Term Time

- During school term time, **part-time workers are much more likely to escort children to/from school than full-time workers.**

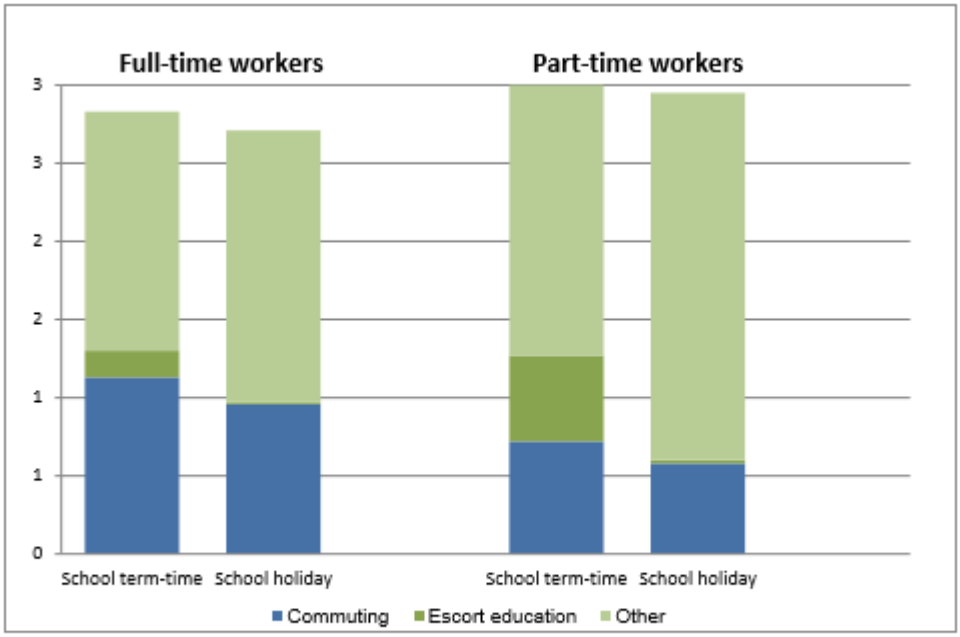


Figure 28: Number of Journeys per worker per day, by school term-time versus school holiday periods (2013/14). Source: National Travel Survey.

What has been the impact of new technologies and working practices on peak and off peak travel?

London Travel Watch

- The key factors affecting the time of travel are the expectations of employers of **work start and finish times, and of educational establishments of when they expect students to start and finish their day. The concentration of these start and finish times will influence the cost and ability of the transport network to cope with the demands put up on it.** An example would be an area with a concentration of schools with similar start and finish times. To cater for all demand at one time might require 12 buses, but if the schools were able to stagger their start and finish times the same amount of demand could be accommodated on say 8 buses.
- **New technologies and working practices have enabled public transport commuters to make better use of their travel time, if there is sufficient capacity to do this in comfort.** They have also enabled some passengers to **travel outside of the peak and still be productive for their employers**. The **growth of part-time employment** by its very nature means that **off-peak public transport services need to be as comprehensive and frequent as those provided at peak times.**
- Within transport new technologies and working practices have allowed services to be expanded e.g. re-signalling of the Victoria line has enabled a 36 trains per hour service. However, **it is noticeable**

that even with these significant increases in capacity, often these become as busy as the previous services as suppressed demand is released. This also applies where additional road capacity is introduced.

Department for Transport

- Behavioural changes, such as **flexible working arrangements, have been important in influencing travel behaviour.** There has been an increasing trend towards working from home some of the time (from 3.0 days per year in 2002 to 4.8 in 2008)[16]. However evidence assessed in a rapid evidence assessment by DfT indicates working from home only has a relatively small impact on total commuting distance travelled.
- Looking ahead **technological advances are likely to have implications for peak and off-peak journeys in cities.** These include the potential for increasing usage of Mobility as a Service (MaaS) and the uptake of Connected and Autonomous Vehicles.

Changes in Travel Time

- **Peak travel times in part reflect working patterns, which have evolved as technology and flexible working arrangements have changed, as well as increases in self-employment and part-time work.** Evidence from the National Travel Survey suggests the working day has grown longer since the early 1990s[17]. **Commuters now leave their homes earlier than in the past**. Whereas the average start time of an **outbound morning commute was 07:55 in 1988/92, it had become 07:51 by 2013/4. The average start-time of an evening commute had shifted from 16:03 in 1988/92 to 16:23 in 2013/14[18].**
- A recent report published by the Department also demonstrates that there has been an increase in people escorting their children to school when travelling to work. A larger proportion of shopping activities are also taking place late in the afternoon. **However these trends are not specific to urban areas and also include journeys undertaken in rural areas**.

- Trip chaining behaviour has reduced in the middle of the day, but increased during the morning and evening peaks. A key underlying factor behind this is the increase in escort to education trips. **People no longer travel during these times solely to commute, and now have multiple purposes for trips[19].**

The impact of technology/working practices on peak and off-peak travel

- Technological advances have facilitated new travel and working patterns. **The ascent of the internet has facilitated growth in online shopping.** Existing work[20] commissioned by DfT has shown people who use internet for shopping make more trips for discretionary purposes that those that do not use it at all. **However, the number of trips then reduces with the increase in frequency of internet shopping. Flexible working arrangements, such as working from home and flexible working hours have also had implications for the number and time of trips taken.**
- **There has been a decline in the number of people commuting on 5 days per week**. A recent report[21] published by DfT shows that between 1988/92 and 2013/4 there has been an increase in the number of people who travel to work fewer than 5 days per week from 30% to 35%, despite being listed as

[16] The 2016 National Travel Survey (Department for Transport, 2017)
[17] Ibid.
[18] Ibid.
[19] Christopher Scott, DFT Call for Evidence Response, pg.1 – NTS (2017)
[20] Atkins, AECOM and Imperial College London(forthcoming), 'Provision of Travel Trends Analysis and Forecasting Model Research'
[21] Levine, S., Pollak, J., Humphrey, A. (2017). Commuting Trends in England. Report prepared for the Department for Transport.

being employed full-time. This has largely resulted from an increasing proportion of workers 'occasionally' working from home.

- **Similarly of those who are recorded as being employed full time, the proportion of people who do not travel to work at all during their diary week increased from 12% to 17%.** While the underlying trends behind this remain unclear, the increase in workers who do not have a single workplace may have contributed to this.
- DfT commissioned a study[22] to produce a rapid evidence assessment to assess the evidence base with respect to car traffic levels in the UK. **This found there is little existing evidence assessing how telecommuting has affected travel patterns.**
- One study[23] in the rapid evidence assessment analysed how the commuting distance travelled varied according to the number of times people work at home each week**. Using data taken from 2002-4, they find that there is only a substantial fall for individuals who work from home more than 3 times per week.** Whereas people who work from home once or twice a month commute 4,112 miles per year, those who work from home 3 times per week travel 1,472 miles per year. This compares to 3,702 miles for people who only work from home once or twice per week. They also find that people who work at home more frequently undertake fewer commuting trips per year, although they also take more business-related trips. **However these measures do not differentiate between the times of day of a commute.**

Network Rail response Call for Evidence

- **Network Rail do not expect "disruptive" technologies such as autonomous vehicles to have a significant impact upon peak rail demand within urban areas, principally because road based modes of travel cannot replicate rail's ability to move high volumes of people and goods into and between city centres efficiently at speed. Urbanisation drives demand for high volume modes of travel.**
- Indeed, autonomous vehicles could complement rail travel by transforming the manner in which passengers access and egress rail stations.
- Significant (and potentially "disruptive") technological changes, such as the introduction of autonomous vehicles seems ever more likely. **However, they do not anticipate autonomous vehicles having a significant impact upon peak rail demand within urban areas, principally because road based modes of travel cannot replicate rail's ability to move high volumes of people and goods into and between city centres efficiently at speed.** Indeed, rather than competing against rail services, it seems likely that autonomous vehicles could complement rail by providing a feeder service giving passengers a seamless door to door travel experience.

Peter Brett Associates

Social, economic, technological and other influencing factors affecting demand

- **Significant changes in technology, health and travel initiatives, population and economic growth** have all been seen in recent years. These, combined with legislation changes and Government funding, have dramatically changed the way we travel.[24]
- **Travellers are now significantly more informed.** Smart phones, travel websites, real-time information, and connected satellite navigation **continuously updates a traveller allowing journeys to be planned, costed and dynamic in terms of routes, modes and time of travel.** (This is discussed in the following sections).

[22] RAND (2014). Evidence levels of car traffic levels in Britain. Available at: https://www.rand.org/content/dam/rand/pubs/research_reports/RR800/RR887/RAND_RR887.pdf
[23] White et al (2007), 'The Role of Teleworking in Britain: Its Implications for the Transport System and Economic Evaluation.'
[24] Peter brett Associates response Pg. 2, 3.1

Technology

- **Internet usage and Big Data are key factors** when considering how travellers make travel decisions.
- **Technology has transformed business over the last 15 to 20 years.** A huge volume of data (estimates put this at 2.5 quintillion bytes of data) is produced every day, for example through mobile phone GPS signals, social media, transaction records, digital images and videos, and sensors used to gather climate information[25].
- **This data is increasingly being publicly presented, in a user-friendly way, allowing people to plan travel more effectively.** Information is now available advising on live congestion, alerts for when public transport services are disrupted, and there is even information available advising when places are likely to be busy. For example:

- On a Sunday, a Waitrose store in Huntingdon is typically busiest at 1pm, whilst Domino's Pizza in St Ives is busy at 7pm on Fridays. **This allows people to plan their travel for less busy times of the day, make dynamic travel decisions, responding to the constantly changing environment, or even decide to not travel at all[26].**

[25] Ibid.
[26] Peter bret Associates response, pg.3

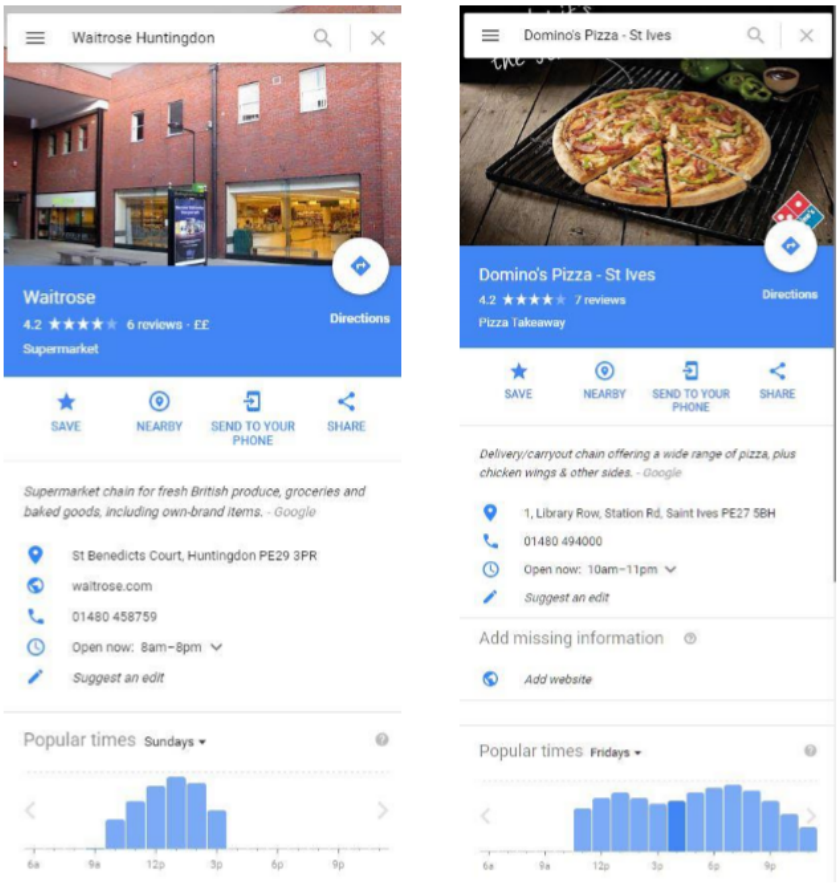


Figure 30: Screenshot demonstrating Huntingdon Waitrose and St Ives Domino's Pizza Busy Periods. Source: Peter Brett Associates Response

Mobile Technology

- Mobile technology took off in the early 2000s, and now is prevalent amongst the population; **with 72% of travellers own a smart phone, 54% of which consider it an essential part of their travel experience**.
- 61% of all UK adults now use their mobile phones to access the internet, with internet speeds available far surpassing those a decade ago (now 15.1 Mbit/s for 4G [4], compared to 400kbit/s 3G in 2004.
- **This smartphone technology is enabling people to do things remotely on their mobile, where previously travel would have been required.** 45% of smartphone owners make purchases online, while 44% use it for online banking, with these proportions approximately 10 percentage points higher for 4G users[27].
- The rapid and vast improvements in internet speeds and accessibility have had wide-ranging impacts on modern lifestyles. The progress of IT development is not slowing, by 2020 new 5G services are planned which will further revolutionise people's expectations and the nature of provision.

[27] Peter Brett Associates Response, pg. 3

Mobile Applications

Big data is now available to users in a wide range of mobile applications for travel, for example:

- Google Maps
- Waze
- Citymapper
- Parkopedia Parking
- Moovit
- National Rail Enquiries
- **Many public transport operators have mobile applications, with live travel information and service updates, timetables, journey planning facilities, fare information, and even mobile ticketing.** Stagecoach launched its own app in September 2016.

Satellite Navigation

- More than 50% of privately owned cars/vans have either an integrated or hand-held/plug-and go satellite navigation system.[28]
- Google maps was launched in 2005, and was released for mobile in 2008, and now 74% of smartphone users in the UK use their phone at least weekly to find a location.[29]

Retail

- Online shopping has seen huge levels of growth, and now **makes up approximately 12.5% of all retail sales.** (**This may have had an effect on the number of people travelling to retail outlets, but need to be aware in the subsequent increase in delivery vehicles too.)** This has been reflected in the increasing demand by retailers for smaller stores, rather than the large 'superstores' that were common pre-recession. In fact, many more recent planning permissions granted for these larger stores have not been implemented, or completed stores are not yet open – for example the Tesco store at Chatteris, which has been empty since its completion, and Tesco has confirmed will no longer open.

Public Transport

- **Real time passenger information now allows travellers to plan journeys more effectively, minimising waiting times, and also increases passenger satisfaction**. Additionally, the data is available to the public transport operators, allowing dynamic responses to incidents, and manage non-fixed route operations more effectively.[30]
- The five largest UK bus operators (Arriva, First Group, Go-Ahead, National Express and Stagecoach) have made a commitment to bring smart-ticketing to all bus services by 2022. This follows on from the delivery of smart integrated-ticketing in nine Smart Cities and City Regions outside London.

Autonomous Vehicles

- Research on the impacts of connected and autonomous vehicles has demonstrated that there is **great potential for substantial improvements in network performance, particularly in highspeed, high-flow situations.** On major roads where traditional vehicles outnumbered automated vehicles benefits are relatively small, but increase as the percentage of driverless cars on the roads increases - **when measuring peak traffic periods with a maximum of up to 100% of driverless vehicles PBA saw**

[28] Department for Transport, National Travel Survey 2014, 2015.
[29] PwC, "ConsumerIntelligence Series Mobile advertising: What do consumers want? Crosscountry comparison," PwC, 2014.
[30] Next Bus, "5 Biggest Benefits of Real-time Passenger Information Systems," 6 August 2008. [Online]. Available: http://nextbus.cubic.com/News/ID/1451/5-Biggest-Benefits-of-Real-timePassenger-Information-Systems

journey times reduced by more than 11% and delays cut by more than 40%. On urban roads benefits are seen in peak traffic periods even with low levels of automated vehicles on roads - benefits include a 12% improvement in delays and a 21% improvement in journey time reliability[31].

Adaptation of the Workplace

- T**hese fast-paced improvements in technology have changed the way we work.** There is no longer the huge demand for travel, as **employees are able to work in places other than the workplace, due to the improvements in connectivity.** People are able to work from home, on the move and in coffee shops, with unrestricted access to email and servers. **This in turn increases the attractiveness of flexible working.[32]**
- There is a growing demand to work on the move – **in 2008, only 4.8% of people worked while commuting, but by 2013 this had risen to 7.5%**.[33]
- Workplaces are adapting to these changes, for example through the introduction of hotdesking. This, combined with technological advances such as the increasing use of laptops and flat screen monitors, rather than desktop computers, is **leading to increases in employment densities and more effective utilisation of space.[34]**
- **Audio, and in particular, video conferencing has taken off in recent years, and now 70% of UK SMEs would rather have a video conference than travel to meetings**.[35]**This has business benefits in terms of productivity with reduced time spent travelling, as well as financial benefits in that the costs of conferencing are decreasing, whilst the costs of travel rise.**

Changing industry/work patterns

- **Over recent years there has been an increasing shift away from traditional UK manufacturing industries towards the service industry.** Since 1981, there has been a 34% increase in the proportion of people working in the service industry.
- This shift in the balance of employment has led to a **greater proportion of the population working in jobs where flexible working is more common, for example working part time or compressed hours, working flexi-time without fixed start or finish times, or working from home**.[36]

Flexible Working

- The Flexible Working Regulations 2014 give the majority of employees the legal right to request flexible working. Employers can only reject requests for a limited number of business reasons.
- **13% of people in work have flexible working hours[37]** and **91% of businesses now have remote working arrangements[38] Only 49% of full time workers now commute every day, with 17% not travelling to work at all**.[39]

[31] Peter brett Associates response, pg.5
[32] Atkins, "Research on Impacts of Connected and Autonomous Vehicles (CAVs) on Traffic Flow," DfT, 2016.
[33] Randstad, "Britain's workers are using their commutes to become more productive," 2014 07 25. Available: https://www.randstad.co.uk/job-seeker/career-hub/archives/britainsworkers-are-using-their-commutes-to-become-more-productive_587/.
[34] Homes & Communities Agency, "Employment Density Guide 3rd Edition," Homes & Communities Agency, 2015.
[35] Powwownow, "The rise of video conferencing," [Online]. Available: https://www.powwownow.co.uk/smarter-working/rise-video-conferencing.
[36] Office of National Statistics, "Annual Population Survey 2014," Office of National Statistics.
[37] Office of National Statistics, "People in employment with a flexible working pattern, by gender April to June 2015," Office of National Statistics, 2016.
[38] Office of National Statistics, "People in employment with a flexible working pattern, by gender April to June 2015," Office of National Statistics, 2016.
[39] The Independent Transport Commission, "ITC debates the impacts of work on travel," 21 October 2015. Available: http://www.theitc.org.uk/our-events/discussionevenings/itc-debates-the-impacts-of-work-on-travel/.

- In 2011, the Government phased out the default retirement age, meaning that most people can now work for as long as they want to. **This is likely to lead to increased levels of phased retirement, with employees gradually reducing their hours and working more flexibly**.
- Traditionally, women have tended to stay at home once they have families, and give up their career. However, this trend has changed significantly over recent years. **Increasingly, this is likely to lead to requests for flexible working in order to share childcare responsibilities, with almost a third of working parents currently working part-time rather than full time**.[40]
- **Over three quarters of workers believe they should be able to work at home, but this rises to 84% of workers born between 1981 and 2000 (Generation Y), compared to only 58% for over55s**. **This highlights the changing attitudes to working, with the younger generation understanding that a physical presence in the workplace is not always necessary.**
- **This is supported by evidence from the National Travel Survey, which indicates that there has been a 4.0% reduction in trips made per person in the peak hours between 2006 and 2014.** This increases to a 5.8% reduction when looking at trips made as a car driver only.[41]

Rail Delivery Group

What has been the impact of new technologies and working practices on peak and off-peak travel?

- The general downward trend in the dominance of peak travel suggests that new technologies and working practices have had some impact, although it is not straightforward to estimate how significant this might have been.

Commuting trend report for England

Average Worker is making fewer commuting journeys:

- Commuting journeys per worker have consistently trended downwards in recent years, from 7.1 journeys per week in 1998/92 to 5.7 in 2013/14.
- In Wales commuting journeys per worker fell from 6.8 in 1988/92 to 5.9 in 2011/12, and in Scotland the trend was from 7.6 to 6.1 over this same time period.
- Similar trends have also occurred in other advanced industrialised nations: the USA's National Household Travel Survey, for instance, shows that the number of trips to/from work per worker decreased by 4% between 1990 and 2009.
- **The fact that the typical worker now travels to work at their usual workplace less frequently is due in part to the growth of people working either from home or at multiple places but without a single 'usual' workplace. However, this is not a complete explanation: even if we only consider people that travel to their usual workplace at least once per week, Figure 31 demonstrates that the number of times they do so has gone down.**

[40] ONS, "Family status by number of parents working by dependent children in family by economic activity," Nomis, 2016.
[41] Department for Transport, National Travel Survey 2006, Department for Transport, 2007.

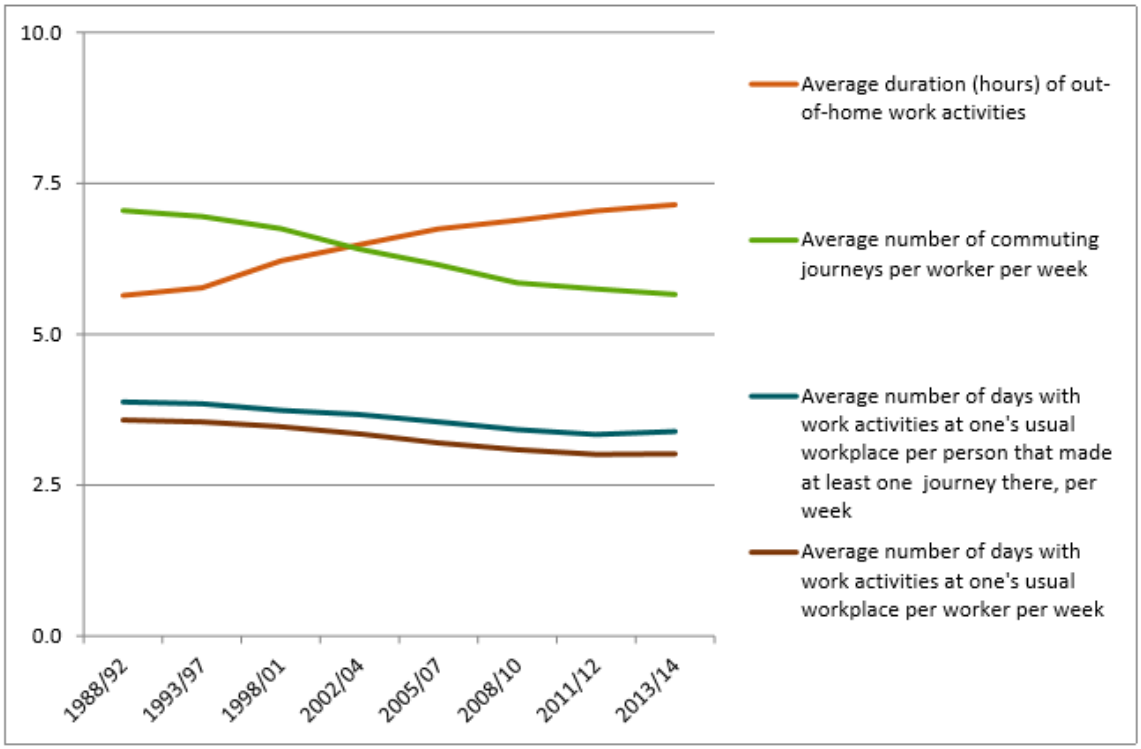


Figure 31: Trends in Commuting and Work activity, 1988/92 to 2013/14. Source: National Travel Survey

- **Interestingly, this graph showing Work related travel during an average week, indicates that there has been a sharper and more sustained downward trend of eight percentage points in the proportion of adults traveling to work on any given weekday during the traditional morning peak period for commuting.**

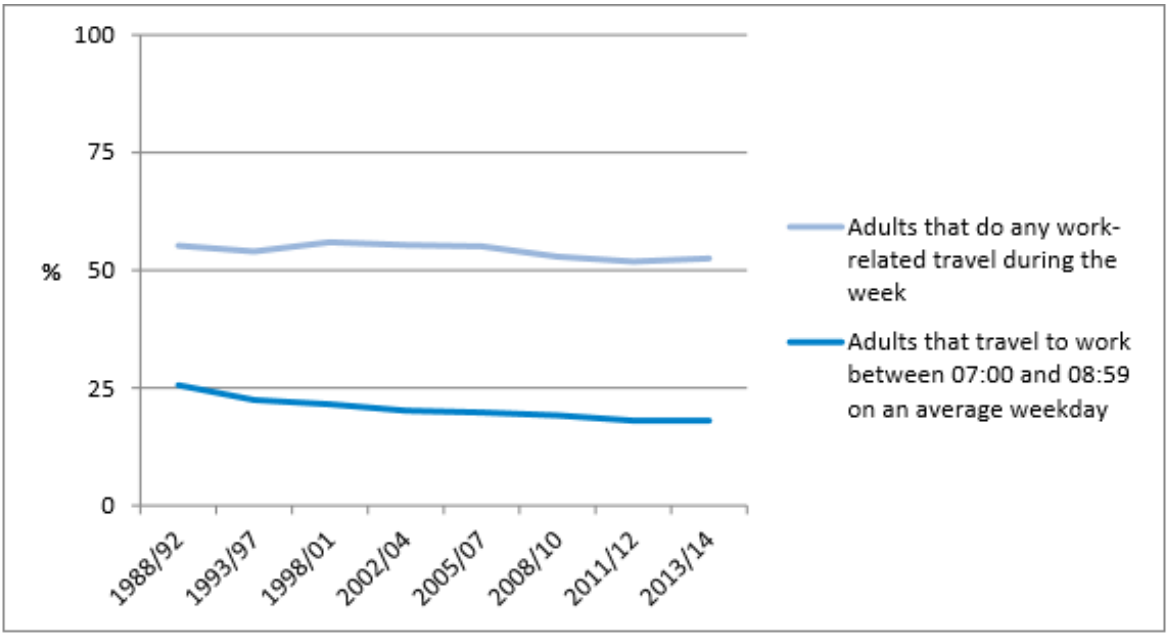


Figure 32: Work related travel during an average week. Source: National Travel Survey

- While England has seen a longer average working day, **the number of hours per week worked declined throughout the 2000s, with a small rebound since 2011.** Figure 10 shows this pattern exists for both full- and part-time workers. **Both have tended to spend fewer hours per week at their workplace, though they are spending more time there during each day that they work.**

What has been the impact of new technologies and working practices to increase the capacity of transport systems during the peak?

No evidence directly answered this question.

Existing ITC Research Findings

The ITC conducted an attitudinal research study in 2015 exploring changing behaviours amongst four groups where travel behaviour had changes significantly over the past 20 years. These groups included business travellers, young people, pensioners and migrants. The research demonstrated that young people were much more likely to value flexible travel options and preferred to rent or share vehicles rather than own these. There was no evidence at the time that flexible working patterns had been having a strong effect on reducing business travel. The findings can be accessed by downloading the report using the following link:

On the Move: Exploring attitudes to road and rail travel in Britain (Social Research Associates, ITC 2015)

http://www.theitc.org.uk/wp-content/uploads/2015/07/ITC-ORR-Road-Rail-Attitudinal-Report-Final.pdf

The ITC has also run some Discussion Events exploring related phenomenon. In October 2015 we explored how the changing nature of work and workplaces were affecting travel. A number of key trends were identified including the preference of people to work while travelling. Evidence presented showed that since 2003 flexible working had been increasing and at the same time part-time work had grown relative to full-time employment. As a result, only 49% of full time workers now commuted 5 days a week or more, and 17% were not travelling to work at all. This was reflected in a 20% fall in commuting trip rates over the two decades prior to 2010, although the absolute number of commuting trips had only marginally declined since the absolute number of people in work had increased significantly over the same period. A report on the evening's discussion can be viewed at the following link:

http://www.theitc.org.uk/our-events/discussion-evenings/itc-debates-the-impacts-of-work-on-travel/

In July 2017 the ITC ran a discussion evening exploring how to address overcrowding on public transport systems in our cities. Rising demand for public transport, particularly rail and light rail, in British cities had placed strains on the network. Several delegates noted that behavioural nudging could have an important role in improving capacity and reducing overcrowding. Technology now allowed flexible working patterns, and employers, particularly in the public sector, could do more to embrace these developments. However, such flexibility in working hours and location would need to be staggered in order to spread the capacity benefits across the working week. It was noted that Transport for London was already using real-time communications technology to help people re-plan journeys outside the busiest hours, and evidence showed that this was moving 3-5% of journeys to the shoulders of the peak. For a report on the discussion please visit the following link:

http://www.theitc.org.uk/our-events/discussion-evenings/itc-discusses-crowding-on-public-transport/

3. Economic impacts

- **What are the economic costs and benefits of peak and off-peak travel in our urban areas?**
- **Is there evidence or analysis of the contribution of off peak travel to the urban economy?**
- **Do traditional theories of agglomeration, which justify investment for peak travel, still hold true in 21st century cities?**

Summary

In terms of economic costs, the peak is the most expensive to account for. Off peak travel is generally cheaper to provide, which is why fares are less expensive. There is a good amount of data available for how rail travel contributes to the UK economy, but generally existing research and analysis hasn't focused on this conception of, or way of assessing what off peak travel actually contributes to the UK urban economy. Regarding theories of agglomeration, they appear to both hold true and provide the primary rationale behind investment in peak travel, and justifying transport infrastructure: this is because peak demand has not decreased, and economic/employment clusters are key to urban economies. Theories of agglomeration are closely linked with planning strategies which focus on densification and regeneration of urban areas, to lessen the pressure on longer-distance commuting services which often reach near full capacity. This is hoped to also encourage more sustainable, shorter-distance journeys which can be taken by bus, bike or walking. Agglomeration is important in ensuring transport systems can operate successfully and sustainably, as they justify investment in certain routes and services. There is still much to be determined on how or whether investment in off peak travel could be justified economically, as little research has been done in this area. Additionally, there is little in terms of explaining the economic contribution of off peak travel in urban contexts more generally, and as such this area definitely requires further attention.

What are the economic costs and benefits of peak and off-peak travel in our urban areas?

London Travel Watch

- **The principle economic cost of peak travel is that of providing sufficient capacity at the right time.** Transport operators generally aim to cover all the direct costs of peak time operation from the fares charged. **Off-peak travel can generally provided at marginal cost and therefore lower fares can be charged as an incentive to travel at these times – this means that most of operators profit is generated from off-peak travel.**

- **Off peak services are an essential component of flexible working environment and the ability of consumers to take up part time employment and participate in the social and economic life of the city.**
- In addition, **in an increasingly connected world, some workers need to be able to travel at different times of day and night, if their businesses operate in multiple time zones or where there are different norms of weekend working e.g. the Middle East.** An example of adaption that has been needed is the addition of late night and weekend services to the Moorgate branch of Great Northern, which have benefitted workers in high-tech businesses around Old Street that have a focus on the Middle and Far East.

Keith Mitchell/Sarah Matthews, Peter Brett Associates

The economic consequences of changing urban travel patterns and trends:

Commercial Traffic

- Commercial traffic: total increases in traffic have been higher at 7%. This is primarily due to commercial van traffic increases, particularly for internet shopping deliveries.[42] **It is considered that a large proportion of this traffic will travel off-peak, due to the financial and time-saving benefits.** Furthermore, a large proportion of this traffic replaces single-occupancy car trips to retail, which are more likely to occur at peak times.
- Peter Brett CFE response provided a comprehensive overview of the changes they observed in travel behaviour and the effect this has on travel patterns (see table to the right detailing travel patterns and travel behaviours). Whilst not necessarily answering directly to the focus on peak and off-peak, there are important indications of where the research has been so far and what areas may need further investigation.

Table 4.1: Current Travel Trends SummaryTrend / Initiative	Effect	Effect on Travel Patterns
Technology		
Internet	78% of households have a fixed broadband connection, with average speeds at 22.8 Mbit/s	More informed travellers and reduction in trips
Big Data	Big data is increasingly being publically presented in a user-friendly way, allowing people to plan travel more effectively	More informed travellers
Mobile Technology	72% of travellers own a smartphone	More informed travellers
Mobile Applications	There is a wide range of travel-specific applications, including relating to mapping and public transport, which contain live travel information.	More informed travellers
Retail	12.5% of all retail sales are now online	Reduction in trips
Satellite Navigation	74% of smartphone users use their phone to find location at least weekly, and over 50% of private vehicles have a satnav system	More informed travellers
Public Transport	Real time passenger information is now available, and operators are introducing smart and integrated ticketing	More informed travellers and cheaper public transport
Autonomous Vehicle Technology	Advancements in technology contribute to reducing accident rates. 94% of accidents are due to human error and so as this technology advances, accident rates, which contribute to congestion, are likely to decrease	Improved accident rates
Workplace Adaptation	Hot-desking, audio and video conferencing and working on the move are all increasing. 70% of UK SMEs would rather have a video conference than travel to a meeting	Reduction in trips
Travel Planning, Health and Wellbeing		
Bike Sharing	Bike share schemes are solving 'last mile' connectivity issues – 11% of users of one scheme would have made the journey by car if they did not have access to the bike share scheme	Reduction in car trips and improved connectivity to public transport
Car Sharing	Average annual mileage decreases by 22% after joining a car club, and an average of 4 vehicles are removed from the road for every car club vehicle, with a further 9.2 purchases avoided	Reduction in car ownership and vehicle mileage
Travel Planning	PTP has been shown to reduce vehicle mileage by 15%, including 31% for journeys to work	Reduction in vehicle mileage
Health and Wellbeing	Beat the Street resulted in 42% of people taking the car less, and 78% of people aiming to continue their changes. Gym memberships have increased, with many people using facilities before or after work, reducing peak hour travel	Reduction in car trips and peak hour travel
Government Funding		
Data	Funding to increase the volume of publically available data	Better informed travellers
Intelligent Mobility	£100 million fund to establish UK as global centre for excellence in connected and autonomous vehicles	Reduction in accident rates and intelligent routing

[42] Department for Transport, "Road Use Statistics Great Britain 2016," 7 April 2016. [Online]. Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/514912/roa d-use-statistics.pdf.

Rail Delivery Group

What are the economic costs and benefits of peak and off-peak travel in our urban areas?

Earlier this year the RDG commissioned research from Oxera (see bibliography for details) into the **contribution of rail to the UK economy**. The key conclusions of the research were as follows:

- The rail industry and its supply chain **employ up to 240,000 people, contributing up to £10.4 billion in Gross Value Added to the UK economy.**
- User benefits for passengers and freight from travelling on rail are up to **£16.7 billion per year.**

T-TRIG	Grants to fully fund projects that help facilitate a more efficient transport system	Improvements to overall transport system
LSTF	Bike It project funded by LSTF achieved a 20% shift away from car usage for school transport	20% reduction in car trips to and from education
Better Buses Area Fund	Achieved a 3.3% increase in bus passengers	Switch to alternative modes
Population Growth		
Urbanisation	99.7% of Cambridgeshire residents live in urban areas. People live closer to employment opportunities and the average distance travelled for commuting has decreased	Reduction in distance travelled
Economy		
Car Ownership	Lower proportions of young people now have driving licences, and 40% cite the cost of driving as the main reason for not learning to drive. Car ownership in high-income households is also reducing	Reduction in car trips
Financial Incentives	Off-peak ticketing is significant cheaper, discouraging peak hour travel.	Reduction in peak hour trips
Changes in Industry	There has been a 34% increase in people working in the service industry, which has led to a greater proportion of the population working in jobs where flexible working is more common	Reduction in peak hour trips to work
Flexible Working	Only 49% of commuters now commute every day, and 17% do not travel to work at all. There are more families with two working parents, so flexible working is increasing to accommodate childcare responsibilities.	Reduction in peak hour trips to work
Changing Times of Travel	There has been a 5.8% reduction in car driver trips made in the peak hours	Reduction of 5.8% of car driver trips

Figure 33: Table detailing current Travel Trends, summary of travel trends and Effects on Travel Patterns. Source: Peter Brett Associates Response

Is there evidence or analysis of the contribution of off peak travel to the urban economy?

Rail Delivery Group, Mark Havenhand:

Figure 34: Infographics detailing the Contribution of Rail to the UK Economy. Source: Rail Delivery Group Response

Commuting trend report for England

Connection between income and travel in the peak/off peak:

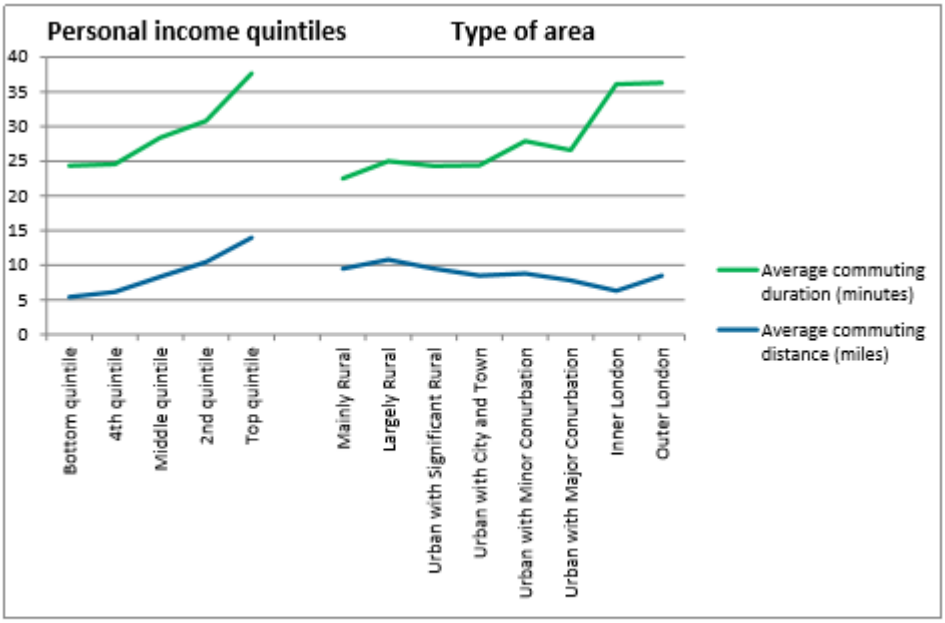


Figure 35: Average commuting distance (miles) and duration (minutes) by personal income bands and ONS' Standard urban/rural spatial classes (2013/14). Source: National Travel Survey.

Do traditional theories of agglomeration, which justify investment for peak travel, still hold true in 21st century cities?

Transport Planning Society (TPS)

- In their response, Alan Wenban-Smith on behalf of the TPS argues that the emphasis on meeting peak demand has resulted in more spread out patterns of occupation for businesses and residential choices which has harmed the economic benefits of agglomeration and densification:

Historically, the priority given to meeting peak hour demands has enabled (and to a major extent, driven) ***dispersion of activity and settlement,*** *and* ***this has had detrimental effects on urban agglomeration and environment off-peak as well as on. We would therefore be concerned if there was a return to transport planning and evaluation methodologies that placed undue emphasis on meeting peak hour demands.*** *The immediate economic benefits of a wider labour market at traditional commuting times needs to be set against the longer-run negative consequence of more* ***dispersed locational choices*** *generating additional travel demands and congestion costs throughout the day.*

- He further suggests that regeneration of urban centres, investment in quality housing and land-use planning in urban areas is important, as the house-building trend has resulted in more diffuse patterns of development further out of city centres, putting additional pressure on commuter services. Densification also helps agglomeration economies and encourages more sustainable travel within cities rather than in and out of them. The link between land-use/housing policy and transport

planning needs to be revisited as the consequences for congestion of networks and transport emissions is large. The below figures illustrate social-economic factors in cities in relation to policy, which influence travel behaviour. The effects of current housing and transport policies:

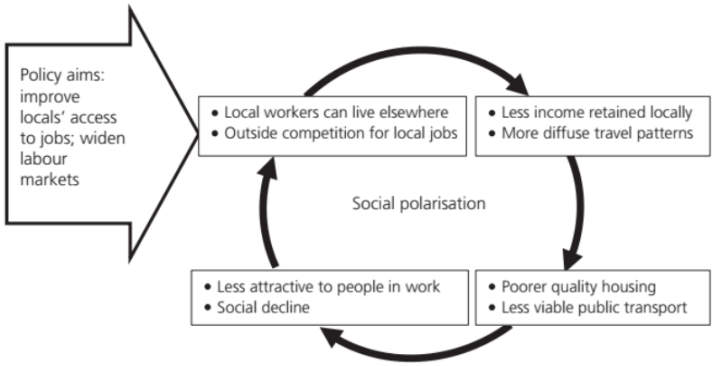


Figure 36: Transport as a driver of land-use change: an example of negative cycle. Source: Transport Planning Society (TPS) Response

Figure 2. Transport as a driver of land-use change: an example of a vicious cycle

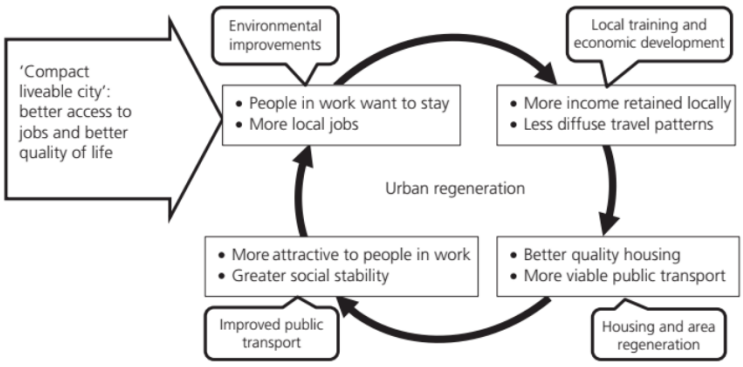


Figure 37: Transport and land-use: complementary action for a virtuous cycle. Source: TPS Response

Figure 3. Transport and land-use: complementary action for a virtuous cycle

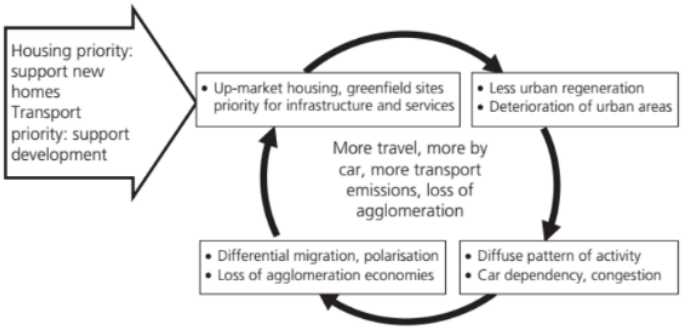


Figure 38: Effects of current housing and transport policies – a vicious cycle. Source: TPS Response

Figure 6. Effects of current housing and transport policies – a vicious circle

London Travel Watch

- **Agglomeration is an important part of ensuring that transport systems can operate successfully and sustainably. This is important not only for peak travel but also increasingly for the off-peak as well.**

Concentration of development around transport hubs also ensures that investment in infrastructure is justified and also can help contribute towards the cost of improvements.

Network Rail response to Call for Evidence

- **Traditional theories of agglomeration still appear to hold true in 21st century cities, not least because the exchange of ideas (as opposed to 'data') and knowledge spill overs still fundamentally rely upon human interaction.**
- **Off-peak transport is also an important enabler of growth in leisure industries, evidenced by the development of the night tube to support London's night time economy.**

- Research commissioned by rail industry funders to support the development of their investment appraisal frameworks continues to show **that economic density, and access to economic mass, drive productivity higher, leading to the clustering of knowledge intensive industries within urban areas.** Network Rail anticipate that this will continue to hold true, not least because the exchange of ideas (as opposed to 'data') and knowledge spill overs still fundamentally rely upon human interactions. Off-peak transport is also an important enabler of growth in leisure and travel industries, for example, the development of the "night tube" to support London's night time economy.

Martin Mayfield, University of Sheffield

- Improving transport links, especially those serving peak-time inter-city mobility demand, **build up the usual bulk of transport planning based on the theories of agglomeration in the UK.**
- Most recently, these include schemes in the **Northern Powerhouse and the Midlands Engine** providing **peak-time inter-city transport infrastructures that reduce journey times encouraging agglomeration economies (National Infrastructure Commission, 2016).** Such schemes have only been argued at macro scales by borrowing from the infrastructure implemented in city regions of Randstad, the Netherlands, and Rhine-Ruhr, German. There remains a conspicuous absence of evidence for transferability and comparability of these continental examples.
- The social reactor model (Bettencourt, 2013) can be used to offer **categorical mesoscale comparisons of cities and urban regions against an idealised realisation of a city within an agglomeration framework.** For the different delineation of cities, we have looked at a mix of administrative, functional, and density-based boundary definitions.
- Their method uses the Bettencourt model, which also enables an **examination of cities current performance, in terms of the balance between economic balance and the transport and mobility costs, with the optimal balance expected from theoretically idealized versions**.
- This enables identifying **whether each city considered is suffering from lack of mobility within its boundary to be addressed through transport upgrades or whether it has grown too large and would require built-up area compaction and densification.**
- **The most prominent pattern observed is the rampant and persistent lack of mobility in the North regardless of the city boundary considered.** While the overall transport and connectivity focus of the existing infrastructural planning appears to agree with our study from an agglomeration framework perspective, **a purely inter-city focus when providing travel and mobility upgrades ignores the current underlying inadequacy of intra-city transport and mobility across smaller scale boundaries.**

Peter Brett Associates

Agglomeration benefits:

- **Rail enhances the productive potential of the UK economy by up to £11.6 billion per year by reducing road congestion and enabling companies to locate near to one another. Benefits of up to £1.9 billion a year arise from the sharing of knowledge and technology due to firms locating in clusters near rail links, and up to £424 million in increased output arising from reduced transport costs.**
- Rail reduces traffic on the roads, resulting in up to £11.8 billion in **travel time savings per year, reducing CO2 by up to 8.4 million tonnes per year, and preventing up to 880 serious casualties and fatalities per year.**

- Unfortunately, **it is not possible to disaggregate this travel between urban and non-urban travel, or between the peak and off-peak**. However, the nature of the markets served primarily by rail suggests that peak travel into urban areas will be the main driver of the overall numbers.

Do traditional theories of agglomeration, which justify investment for peak travel, still hold true in 21st century cities?

- The RDG has not commissioned analysis to consider whether these theories still hold true. **However, even in spite of the potential for technology to improve the efficiency of the utilisation of road space by cars, it remains the case that only rail can support very high densities of employment.** It is not currently feasible to construct the equivalent scale of road infrastructure required to carry these flows, as road travel is less efficient in its usage of space (although new technologies such as platooning and/or autonomous vehicles could enhance the efficient use of road space to some degree**). These high densities typically raise the productivity of the employees through information- and knowledge-sharing.**

Existing ITC Research Findings:

The ITC conducted research into the economic and spatial impacts of High Speed Rail investment during 2013-16, as well as a related report into rail system development in 2017. This work found that there were clear agglomeration benefits arising from shorter journey times provided by better rail connectivity. Currently, peak hour links between major cities in the Midlands and Northern England are extremely poor, suffering from overcrowding and having slow journey times compared to inter-city links of a similar distance in mainland Europe. However, to realise the full benefits of rail investment it was clear that improved transport connectivity around stations would also be essential. High density urban living is likely to be supportive of increased rail demand in the future. For more information on this work, please consult the following reports:

The Spatial Effects of High Speed Rail: Capturing the Opportunity (ITC, 2013)
http://www.theitc.org.uk/docs/108.pdf

Classic Rail and Connected Cities: Capturing the benefits from rail system development (ITC, 2017)
http://www.theitc.org.uk/wp-content/uploads/2017/04/ITC-Rail-and-Cities-Report_FINAL.pdf

PART B. STRATEGIES FOR THE FUTURE

- **Changing Patterns of Demand**
- **Behavioural Change**
- **Economic and Policy Levers**

4. Changing Patterns of Demand

- **How do you foresee patterns of peak and off peak travel changing in our urban areas?**
- **Will changing patterns of demand emerge differently across various cities or between different modes?**
- **How might our transport system change in response to the future patterns of demand?**

Summary

In general, it is expected that the growth in off peak travel will continue. This will require further investigation, as previously indicated. The impact of technology is expected to have a continued impact on travel patterns, as will changing working practices, but again the link between these factors and off peak travel is yet to be fully explored, as the evidence available for cities and urban areas is limited.

London Travel Watch

- **London TravelWatch predicts that change in peak and off-peak demand will continue to change in the current fashion, with more growth in off-peak travel, and also in contra-peak journeys (e.g. commuting out from central or inner London to outside London business areas such as the M4 and M3 corridors).** This will need a change in investment evaluation for transport projects to place a much greater value on improvements to off-peak travel as well as peak times.

- It will also be expected that travel demand will vary by mode, location and demography. The transport network will change to reflect this e.g. by more demand responsive services.

Network Rail

- Looking to the future, **Network Rail anticipate that rail markets into and within large urban areas will continue to grow, in part through a continuation of the longer term trend towards re-urbanisation, and also through growth in knowledge intensive industries.** Growth is expected to be strongest in large non-London urban areas which are in the process of 'transitioning' to cities dominated by public transport.

Peter Brett Associates

- PBA suggested some ideas for what may emerge in the future regarding factors influencing peak and off-peak travel. This is based on the evidence presented regarding the current influencing social, economic and other factors.

Changing future patterns: Technology and work patterns

- **Mobility as a Service** – this is a potentially a 'game changer' for the travel industry. People will buy a travel contract, similar to a mobile phone, telephone, broadband, online delivery, maintenance and service contracts that many of us purchase at the moment. You will book your travel and it will be serviced by the provider.
- **Autonomous Vehicles** – International Transport Forum (ITF) during peak hours claims that just one third (35%) of the current number of cars would be needed to provide the same number of trips as today. Reducing accidents is also key to reducing congestion.
- **Connected vehicle technology** – vehicles will communicate with each other and transport infrastructure, and traffic will be spread out and directed to allow the network to operate more efficiently
- Cars with folding E-bikes for the 'last mile'
- New public transport infrastructure (stations, railway lines and services, mass rapid transit routes, tram lines etc.)
- **Contactless payment technology** – this will become integrated with all transport, so that people will swipe in and out, and be charged on this basis, whether they travel by bus, train, car club vehicle, bike share etc.
- **Virtual Meetings technology** – the next step beyond video conferencing, where participants enter a virtual reality
- **Work/meeting pods in community areas** – rather than travelling to work, people will be able to hold meetings close to where they live

Rail Delivery Group

How do you foresee patterns of peak and off-peak travel changing in our urban areas?

Patterns of peak and off-peak travel may change in response to the trends and disruptors set out below. These changes could include:

- **SOCIAL: Aggregate reductions in the volume of passenger travel, from the automation of employment, potentially offset by increases from an older population with more leisure time, and an increased need to travel for social interaction as households become smaller and more dispersed.**
- Reductions in the volume of freight traffic, as 3D printers allow production of some items in the home, and drones replace deliveries by road.
- **Demand is spread more evenly across the day, as traditional roles which become automated are replaced with new, more flexible jobs; and flexible working (supported by improved IT systems) and the 'gig economy' continue to become more dominant.** An older population may also travel more during off-peak periods for leisure. However, this could be offset by a reduction in shopping trips, typically between the peaks or at weekends.
- **The first order effects described above could generate a diversity of second order effects that are potentially even more difficult to predict**. For example, although the decline of the traditional high street could reduce leisure travel for shopping, this demand could be substituted by leisure travel for other purposes and with a potentially much wider range of destinations. **Similarly, reductions in demand during the high peak hours could encourage passengers currently travelling outside of their preferred times to move back to the high peak.**

Will changing patterns of demand emerge differently across various cities or between different modes?

Some potential modal impacts could comprise:

- **Demand switching more readily between transport modes – continued development of smart ticketing and journey planning software could encourage more flexible travel choices**, either planned around the need to travel, or **in response to real time information on service disruptions.**
- **Higher levels of road traffic across the day, as technological improvements reduce the cost of road travel and increase its attractiveness.**
- **Demand transfers to new transport modes: for example, Hyperloop or high-speed rail.** This could offset to some degree the likely increase in road traffic, although this would depend on the type of journey.
- **The extent to which the patterns outlined in the response to the previous questions emerge differently between cities will depend on the characteristics of transport demand and supply.** This could include the nature of the **local employment market, the range and quality of transport choices available, and the rate of adoption of new technologies. (These will vary according to different urban settings).** The combination of these effects is very difficult to forecast.

How might our transport system change in response to the future patterns of demand?

- **The response to the changes in the future patterns of demand will primarily be a policy decision reflecting the circumstances of the day.** The growth of autonomous vehicles could require dramatic changes to the allocation of road space between users, for example. Although Mobility as a Service could support 'door to door' rail services, it might not be economical to provide the required infrastructure at all stations, which could necessitate a review of the stations estate.

Commuting trend report for England

Changes across modes:

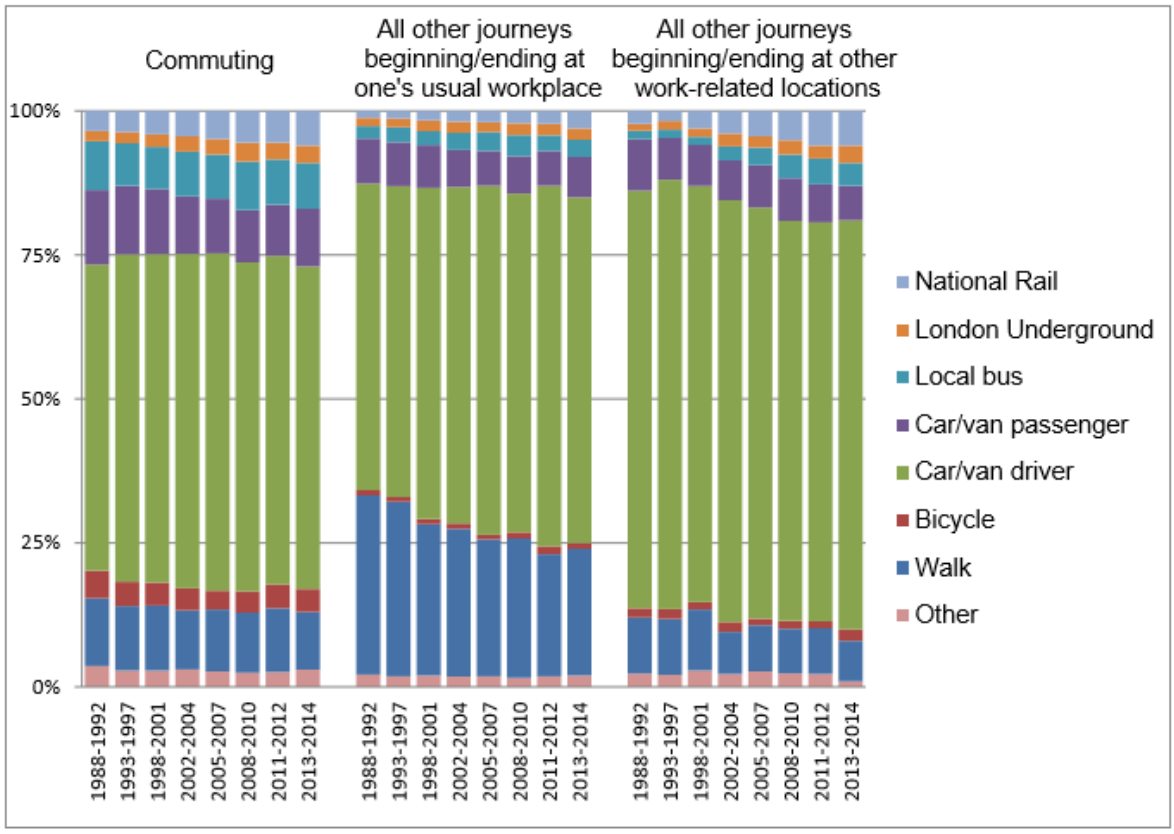


Figure 39: Proportion of Journeys by mode, by types of work-related trips. Source: National Travel Survey

- More than half (56% in 2013/14) of commuting journeys are made by car as a driver. This proportion was stable through to 2008, after which it decreased by several percentage points.
- Approximately 10% of commuting journeys are performed as a car passenger; this proportion has decreased over time
- **National Rail commuting journeys are, on average, further than commuting journeys by other modes of travel**
- Cycling to work has increased in London, but the trends elsewhere have been mixed.
- The long-term trends indicated in this report (25 years) may provide a good indication for where the future of travel demand lies.

Variability in Commuting Journey duration by area type:

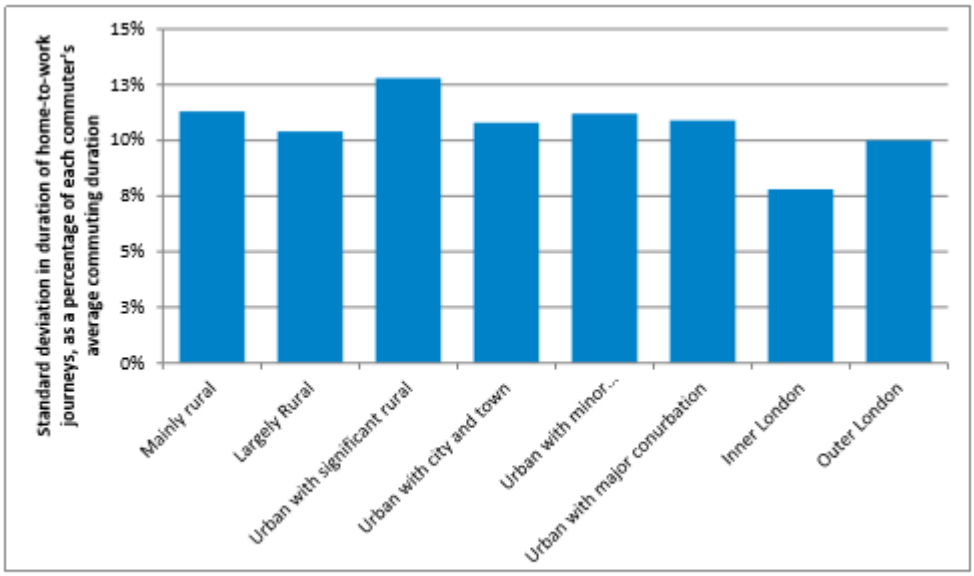


Figure 40: Variability in Commuting Journey duration, by area type (2013/14). Source: National Travel Survey

Reduction in Speed in morning-peak-period relative to free-flow speed:

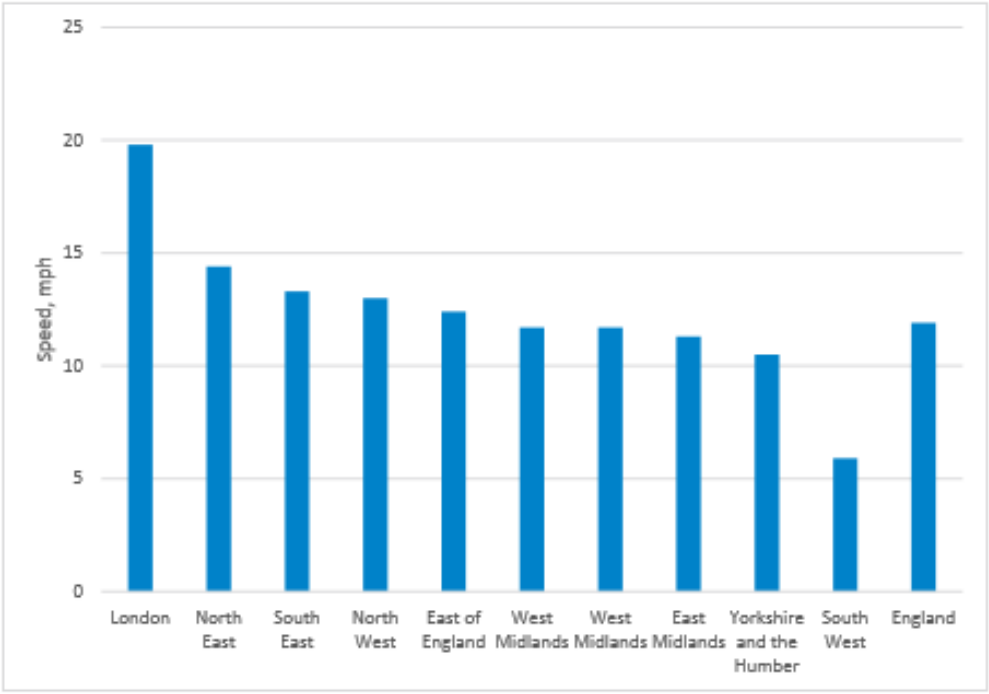


Figure 41: Reduction in speed (miles per hour) on the Strategic Road Network in the morning peak-period, relative to free-flow speed. Source: DfT Road Congestion Statistics.

National Rail – PixC – Congestion:

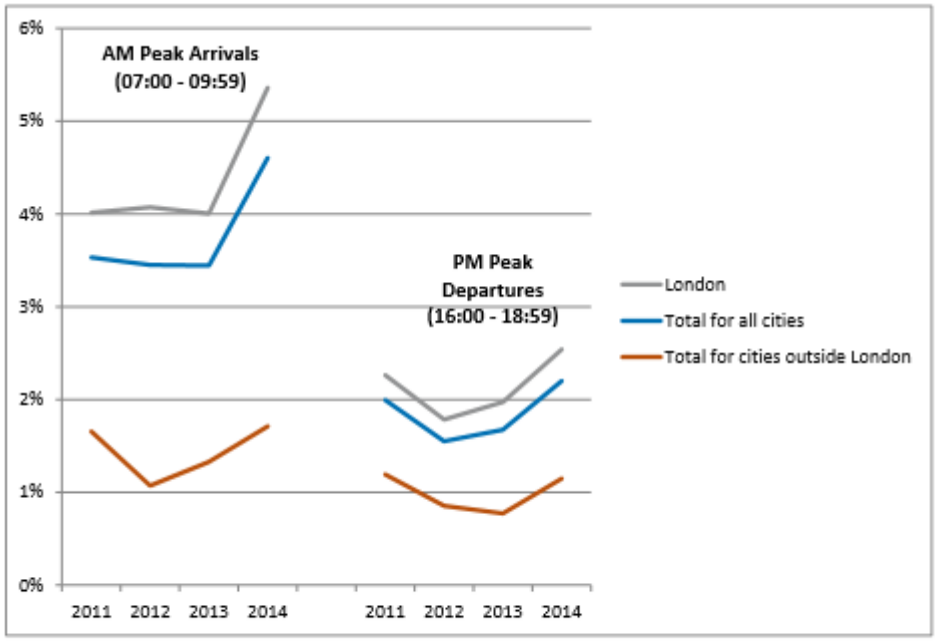


Figure 42: Passengers in excess of capacity (PiXC) as percentage during AM and PM peak periods, 2011-2013. Source: DfT Table RAI0209, based on passenger count

5. Behavioural Change

- **What factors will influence the time people choose to travel in the future?**
- **Are there disruptive factors that we can anticipate that will affect peak and off peak urban travel?**

Summary

Evidence for this section was fairly limited, particularly with regard to off peak travel. More generally, similar influencing factors will apply in the future as do apply now, with technological changes and changes in working practices being most important. Policy and pricing will have an important role to play to, but again there isn't extensive evidence available with regard to off peak travel.

London Travel Watch

- Notes that start and finish times of employers and education establishments are the main influencers of peak time travel demand. Changes in these patterns will be the principle drivers of consumers adopting different behaviours.

Department for Transport

Road Traffic Forecasts

- DfT is 2015 Road Traffic Forecasts forecast road travel demand up to 2040, splitting road traffic by area type (urban, conurbation, London and rural) in different scenarios designed to reflect uncertainty about the key drivers of travel demand. **Conurbation areas are projected to exhibit higher traffic growth than urban areas or London, with the forecasts suggesting traffic will be 14-54% higher in 2040 relative to 2010.** In London vehicle miles are forecasted to increase between 13% and 47%. For urban areas in general vehicle miles forecasts range between a 6%-50% increase across different scenarios.
- Forecasts are also produced for increases in peak and off-peak demand by 2040, although these do not distinguish between rural and urban areas. The range in increases across scenarios during the weekday peak is 14-35%, and for the inter-peak period is 7-24%. On minor roads the corresponding figures area 9–14% increase, and for the inter-peak period demand is forecasted to rise by 6–10%. On principal roads during the midweek peak congestion are expected to rise by 17 –35%. During the midweek inter-peak this increase falls to 12-24%.

The impact of technology on peak and off-peak travel

- **DfT is actively considering how technology such as Connected and Autonomous Vehicles (CAVs) and the use of online journey planners, smart phones and the internet could impact on travel demand,** and how this may impact on travel during peak and off-peak travel times. Often this has involved commissioning work to external stakeholders, and such work is used to inform DfT's travel forecasts and policy outlook.
- An increase in the prevalence of Mobility as a Service (MaaS) could affect peak and off-peak travel. A study was commissioned by the Department[43] to investigate how MaaS could affect travel demand in London. **The study indicates potentially large benefits from MaaS could be to reduce journey times when travelling across London and improved dissemination and real-time information.** Medium impact benefits could also be to provide better connectivity, reduce traffic jams and improved service experience for the transport user.
- An increasing uptake of CAVs could also have implications for peak and off-peak travel. DfT commissioned a study[44] by Atkins in 2017 which modelled how average delays, average journey times and journey time variability were affected as the penetration of CAVs in the vehicle fleet increased.
- The results found that increased CAV uptake had significant benefits during peak times on each factor of interest. As CAV penetration reaches 50% of the vehicle fleet the average delay, journey time and journey time variability are reduced by 17.4%, 26.1% and 88.7% respectively. At 100% penetration these benefits increased to 27.1%, 30.7% and 93.2%, suggesting that many of the benefits of CAVs during peak times are accrued at lower penetration levels. During off-peak periods the reductions are smaller, where at 50% penetration average delays, average journey times and journey time variability are reduced by 5.4%, 5.3% and 39.6% respectively.

[43] Kamargianni, M., Matyas, M., Li, W. and Schäfer, A. (2017). Feasibility Study for 'Mobility as a Service' Concept in London. UCL Energy Institute

[44] Atkins (2017). 'Research on the Impacts of Connected and Autonomous Vehicles (CAVs) on Traffic Flow'. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/530091/impacts-of-connected-and-autonomous-vehicles-on-traffic-flow-summary-report.pdf

- There remains uncertainty about the potential impacts because improved network performance may in itself increase demand for road travel, offsetting some of the benefits. Much of their overall impact will depend on the policy environment, and whether regulation changes to facilitate their efficient use on the road network.

Network Rail

Anticipated future trends

- **Collectively our environment and societal needs will shape future travel patterns and whilst there have been many significant technological changes over the last few decades, their impact on the demand for rail travel has been relatively marginal.**
- Looking to the future, Network Rail anticipate **that rail markets into and within large urban areas will continue to grow, in part through a continuation of the longer-term trend towards re-urbanisation, and also through growth in knowledge intensive industries.** Growth is expected to be strongest in large non-London urban areas which are in the process of 'transitioning' to cities dominated by public transport. In terms of travel patterns, working practices will continue to influence behaviour. The strength of demand drivers during the peak -perhaps best illustrated by the peaked nature of rail demand despite higher fares and disutility from crowding - suggest that any change is most likely to be marginal and not transformative[45].

Martin Mayfield, University of Sheffield

- Martin Mayfield provided interesting information on the way in which travel demand for car users on congested roads at peak times might be managed, **by looking at shifting travel behaviour and emphasising different transport options**. The average car spends more than 90% of its life parked (Bates & Leibling, 2012). This means that there is, in theory, a theoretical 10-fold reduction achievable in the number of registered vehicles if we accept a paradigm shift from ownership of a good, i.e. the car, to the enjoyment of a service, i.e. the transportation.
- The deployment of autonomous vehicles is argued to drastically reduce demand for ownership (WSJ, 2017). **With the cost of taxis currently due to human drivers, autonomous vehicles would provide fleets of extremely affordable taxis, with obvious impact on urban public transport networks and parking space needs in city centres.** This could be improved further through additional paradigm shift, e.g. from autonomous private journeys to autonomous shared commuting. The drastic reduction to 50% of cars circulating in city centres is a European Union target, but cities such as Oslo are anticipating this by closing the city centres to vehicle traffic as early as 2019 (EU Environment Action Programme, 2016) forcing most commuters to use their private vehicle up to the city border and then moving by public transport. If the diffusion of connected and autonomous vehicles takes place in time, such closures may turn out to be redundant before the deadline for their implementation[46].
- **The 2016 National Travel Survey (Department for Transport, 2017) reveals that more than 50% of the journeys up to 350 miles are travelled by car in England**. Rail starts to compete with cars just above this threshold. The distance travelled by car, on average, has increased by 45% in the last 45 years during which the road and vehicle technology has seen only incremental changes. This can be mainly summarised into a wider availability of roads and improved comfort of cars. A symptom of the relatively slow progress of travel technology, at least in the last 15 years, is the constancy of the commuting mileage (about 4000 miles per year per household) revealing how the acceptable work-home distance has not changed. The introduction of connected and autonomous vehicles will probably challenge the figures given by the National Travel Survey.

[45] Network Rail response to Call for Evidence, pg.3
[46] Martin Mayfield, University of Sheffield, Call for Evidence response, pg.5

- It can be argued that having a single door-to-door transportation mode will increase the acceptable distance between the usual residence and work place and further decrease the share of rail travels. This is likely to reverse the trend of rail mainly used for long journeys with far reaching consequences on the infrastructural investments. **Even more, foreseeable changes can be argued in the house market and the land occupancy driving the demand for transportation and, finally, in the job market with mainly intellectual occupations starting from the time people board their autonomous vehicles.**

Rail Delivery Group

What factors will influence the time people choose to travel in the future?

- In many respects, the factors that will influence the time people choose to travel in the future are likely to be broadly the same ones that influence the time they choose to travel today.
- However, their relative significance could change for a variety of reasons. **Most obviously, an increasingly affluent population would be less sensitive to price incentives, or a continued increase in home working could diminish the impact of travel to and from employment, at least for the sectors that lend themselves to home working.**

Are there disruptive factors that we can anticipate that will affect peak and off-peak urban travel?

The KPMG study commissioned by RSSB identifies a disruptor '…as an innovation that creates a new market and eventually disrupts or displaces an existing market'. (See bibliography). **Some of the more disruptive anticipated changes which could affect peak and off-peak urban travel are related to new technology, and comprise:**

- **The impact of automation – whereas this could significantly reduce employment, it could also encourage new, more flexible forms of employment.**
- Increasing alternatives to travel – by 2023, 3D printing could be 400 times faster and 50 times cheaper, which could lead to lower levels of freight traffic and further erode the traditional role of the high street.
- The price, quality and availability of transport modes – autonomous vehicles are likely to reduce significantly the cost of car travel through better use of cars and by removing the cost of the driver. Drones could replace deliveries by road and Hyperloop could offer a new transport choice if the technology is proven. Alongside this, the completion of HS2 and widespread adoption of new technologies could also significantly improve the quality of rail travel in the UK.
- A further range of less disruptive factors will have an impact. In contrast to the items listed above, these are primarily contributions of existing trends, and could include:
- More flexible working and growth in the 'gig economy'. Ongoing improvements to IT systems (including more effective telepresencing) are key to supporting more flexible working.
- Continuation of demographic changes such as ageing and living in smaller households.
- Widespread rollout of smart ticketing, accompanied with more sophisticated journey planning software and potential Mobility as a Service (MaaS) businesses.

6. Economic and policy levers

- **What scope exists to influence or encourage peak travellers to move to off-peak journeys?**
- **What are the investment implications of smoothing out peak travel periods, and what will be the economic impacts of doing so?**

Summary

The majority of policy interventions and economic mechanisms available are governed by demand from the peak. There still remains a need to build further the evidence base for this section.

London Travel Watch

TfL tell us that despite the incentive to travel at off-peak times of lower fares there are only very minor changes in demand around the times when this would the most difference e.g. 0630, 0930, 1600 and 1900. This would indicate that for very local journeys, passengers value the ability to travel at a particular time above comfort of the journey. For investment purposes, as noted above a change in evaluation methods is likely to be needed that gives more emphasis to off-peak travel.

Department for Transport

Potential for policy intervention

- DfT have commissioned research to inform consideration of policy options for tackling issues surrounding overcapacity and congestion on travel networks. **Such measures include incentivizing commuters to journey during the 'shoulder peak' periods rather than during peak travels.**
- A study[47] commissioned by DfT and produced by IFF asked employers for their opinions on scenarios for ticketing options to incentivise travel during the shoulder peaks. **Season tickets would be more expensive in the rush hour (8-9am in the mornings and 5:30-6:30 for London in the evenings).**
- **Employers indicated that the ultimate impact would depend on the extent to which workers requested flexible working arrangements, and the likelihood that employers would provide these. Those interviewed indicated that they would only be able to accommodate a few additional requests for flexible working, limiting the policy's effectiveness.**
- Employer responses to the scenario also varied by sector. The public/third and retail sectors was most likely to feel they could easily accommodate requests, while the Business Services sector was least likely to do so. **When interviewed Business Services employers tended to have reservations about the policy.**
- Work has also been undertaken to gauge workers' receptiveness to travelling at off-peak times. A study[48] commissioned by DfT in 2013 measured the proportion of commuters who would be prepared to switch from their peak travel time to travelling at another point in the day. This was achieved through a self-completed questionnaire enquiring about current tickets used and the best alternative currently available. The estimated proportions were then used to generate cross elasticities for use in the Department's Strategic Fares Model.
- The study's findings show that of those on London inner-suburban services, 17% of season ticket holders travelling daily said they would be prepared to switch to a part-time ticket, while 13% of season ticket holders who travel ¾ times a week would do so. Among non-season ticket holders 24% of those travelling 3 or 4 days a week would be prepared to buy it. The off-peak ticket only appealed to 3% of peak season ticket holders while 19% of off-peak season ticket holders would be prepared to use it.
- For London outer-suburban services 14% of season ticket holders who travelled every day would be prepared to switch to a part time ticket, and 37% of those travelling 3 or 4 days a week would do so. 24% of non-season ticket holders would be prepared to purchase a part time ticket.
- **These results indicate there is limited appeal to switching from peak to off-peak products for commuters who travel during the peak period. These same products are more attractive to off-peak users.** This suggests peak travellers are more likely to take into account the constraints placed on them by non-peak tickets which would restrict their travel to particular times of the day.

[47] IFF Research (2013). 'The Scope for flexible working in future.'

[48] Wardman, M. Toner, J. and Shires, J. (2013) Updating Diversion Factors using Primary Research. Report prepared for the Department for Transport.

Network Rail

- **Policy choices, including the pricing of rail fares, can influence the volume and distribution of rail demand. Evidence continues to suggest, however, that the price differential between peak and off-peak travel would need to be much larger to have anything other than a marginal impact upon behaviour.**
- Policy choices, including the pricing of rail fares, can influence the volume and distribution of rail demand. Evidence continues to suggest, however, that the price differential between peak and off-peak travel would need to be much larger to have anything other than a marginal impact upon behaviour
- To a certain extent growth in urban rail demand, during both peak and off-peak hours, will depend upon the type of future we decide to create. This implies that not only will the rail system need to change in response to demand and travel patterns, but demand will change in response to the transport system provided. In this context, policy choices are as important as external trends.

Peter Brett Associates

Government Funding:

- The UK Government has recently committed large sums of money towards improving travel, including:
- Increasing the volume of data that is publicly available through the Release of Data Fund, with a budget of £7 million and the Breakthrough Fund (£2.5 million per year).
- £100 million Intelligent Mobility Fund to establish the UK as a global centre for excellence in connected and autonomous vehicles.
- Transport-Technology Research Innovations Grant (T-TRIG) set up to fully-fund projects that use science, engineering and technology to help facilitate a more efficient transport system in the UK.
- £1.5 million investment in car clubs since 2014

Rail Delivery Group

- What scope exists to influence or encourage peak travellers to move to off-peak journeys?
- **Traditionally, rail companies have changed the fares structure to influence demand, with higher fares applying at busy times and cheaper pricing applying for journeys taken on services with lower demand.**
- This approach was used before privatisation, and formed the basis for fares regulation at privatisation. This regulation capped the price of many season tickets, and prices for walk-up longer distance off-peak return tickets. **However, as demand and travel patterns have changed, this regulation has increasingly acted as a blockage to adjusting fares as a way of smoothing demand.**
- The 'peak' period for travel extends for longer than it used to, with a wider band of travel to and from work reflecting the more flexible working hours that many people now experience. Fares regulation however means that the only option to move people to quieter travel times is to charge them less – there is no option to trade off price increases at the busiest times with price reductions at quieter times.
- Rail Delivery Group have been in discussion with Government about the need to reform fares regulation so that it reflects modern trends, ideally in conjunction with new ticketing technology that removes the complexity of having to choose between an off-peak or peak ticket before travelling, but this remains at an early stage.
- **If implemented, any strategies to manage peak demand through changes in the fares structure would have to recognise the practicality for different types of customer to change their journey time – see the earlier responses.**
- Also appended to the Rail Delivery Group submission is a short report on the Spitsmijden concept introduced in the Netherlands. (See bibliography). This demonstrates success in smoothing peak

demand on both rail and road, provided the correct incentives are in place. For rail travellers, the key attraction was a discount on the fare if travelling off-peak (with the discount being passed on to the passenger, as opposed to being retained by an employer, if they had paid for the season ticket). Road travellers received financial rewards based on GPS tracking, and the scheme offered information on other modes and an off-peak discounted rail card as incentives.

- Reflecting the UK research, higher income travellers were more likely to participate in the concept, the result of their more flexible working hours. Along with introducing flexible working hours, the report also suggested that employers could influence the travel behaviour of their staff by issuing passes for other modes, financial incentives for setting up workplaces at home, or personal mobility budgets to enable employees to make their own choices.
- **What are the investment implications of smoothing out peak travel periods, and what will be the economic impacts of doing so?**
- **The investment implications are potentially quite significant, since railways operate at peak efficiency with a smooth demand profile whilst spikes in demand (such as the ones that occur at peak times) are extremely resource heavy and inefficient to serve cost-effectively.**
- Whilst a consistent demand curve is unrealistic to achieve, modern lifestyles that allow for flexi-working, working from home and staggered hours are more aligned with the desired changes than the traditional Monday to Friday '9 to 5' working hours of the past.
- The economic impact potentially becomes quite significant when one also considers the ability to manage the customer relationship through automated account-based ticketing (which removes the complexity of having to choose in advance a specific travel pattern). For example, heavy infrastructure investment to meet a peak 'spike' could be deferred or reduced in scope if it were possible to ameliorate the demand in other ways.
- There is already significant investment taking place in the ticketing technology to allow for such ticketing processes, but the industry is at a much earlier stage in the process of getting government engagement on the fares reform needed to maximise the impact of this. Inevitably, any pricing strategy to smooth demand would require sufficient peak and shoulder-peak train capacity to accommodate the displaced demand.

Commuting trend report for England

- Car commuters in London report that they would have less difficulty in switching commute mode than car commuters elsewhere
- As city size decreases, the proportion of car commuters who say that they could switch to public transport also decreases.

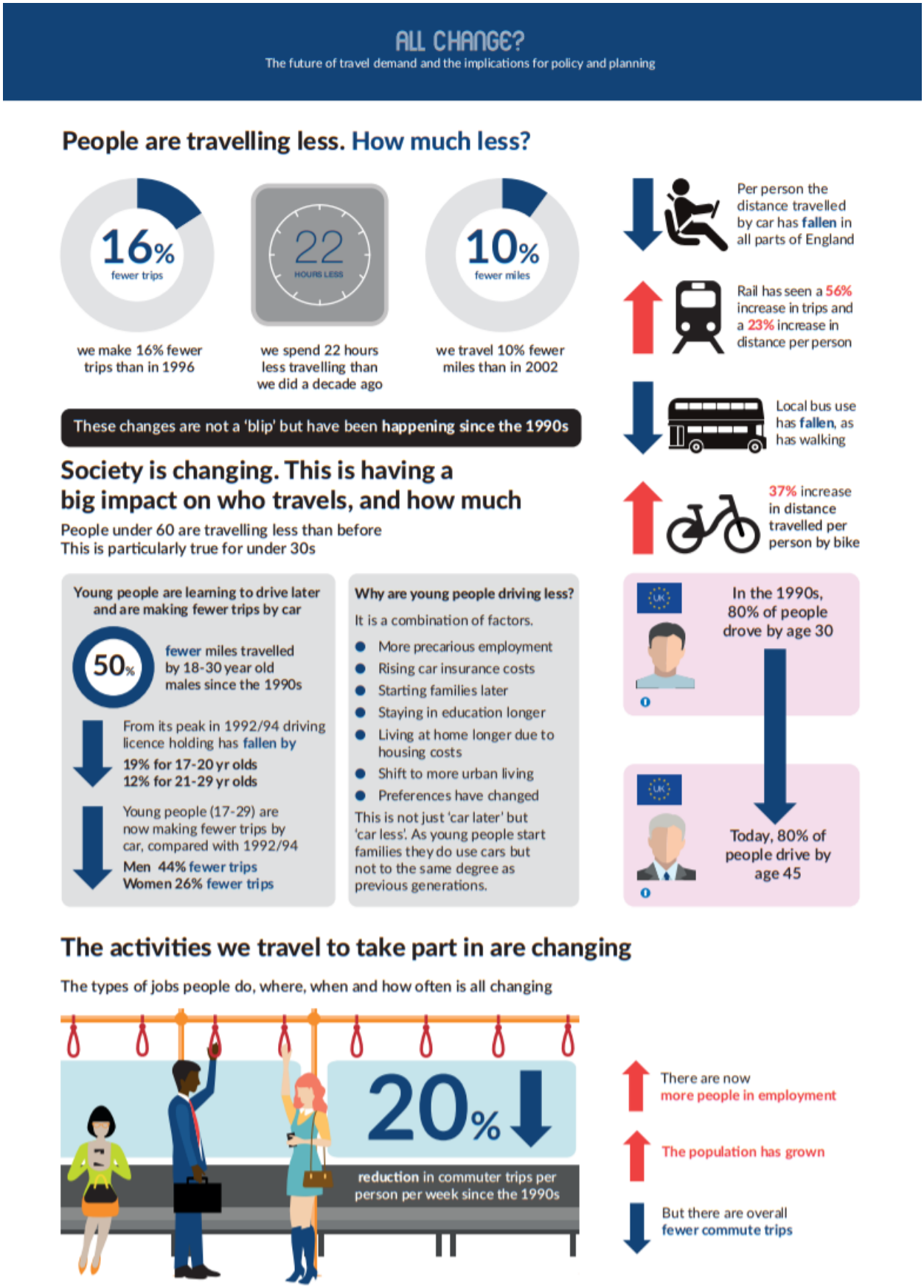
C. Other issues

7. Please alert us to any other relevant information in the context of urban peak and off peak travel that you believe should be brought to our attention.

- **Christopher Scott, DFT: There is a lack research in this area, and so the DfT welcomes the work of the Independent Transport Commission and are pleased to provide this submission summarizing evidence from our recent research in this area.** Our work provides considerable insight into underlying trends behind peak and off-peak travel, both in general and for urban areas in particular. Our work has also highlighted that there are areas relating to peak and off-peak travel where there is currently insufficient evidence, including the costs and benefits of peak and off-peak travel and their contribution to the urban economy. DfT are happy that the ITC is taking action to fill these[49].

[49] Christopher Scott, TFL Call for Evidence response, pg.6

APPENDIX


ALL CHANGE?
The future of travel demand and the implications for policy and planning
People are travelling less. How much less?
16% fewer trips
we make 16% fewer trips than in 1996
22 HOURS LESS
we spend 22 hours less travelling than we did a decade ago
10% fewer miles
we travel 10% fewer miles than in 2002
These changes are not a 'blip' but have been happening since the 1990s
Per person the distance travelled by car has fallen in all parts of England
Rail has seen a 56% increase in trips and a 23% increase in distance per person
Local bus use has fallen, as has walking
37% increase in distance travelled per person by bike
Society is changing. This is having a big impact on who travels, and how much
People under 60 are travelling less than before
This is particularly true for under 30s
Young people are learning to drive later and are making fewer trips by car
50% fewer miles travelled by 18-30 year old males since the 1990s
From its peak in 1992/94 driving licence holding has fallen by
19% for 17-20 yr olds
12% for 21-29 yr olds
Young people (17-29) are now making fewer trips by car, compared with 1992/94
Men 44% fewer trips
Women 26% fewer trips
Why are young people driving less?
It is a combination of factors.
More precarious employment
Rising car insurance costs
Starting families later
Staying in education longer
Living at home longer due to housing costs
Shift to more urban living
Preferences have changed
This is not just 'car later' but 'car less'. As young people start families they do use cars but not to the same degree as previous generations.
In the 1990s, 80% of people drove by age 30
Today, 80% of people drive by age 45
The activities we travel to take part in are changing
The types of jobs people do, where, when and how often is all changing
20%
reduction in commuter trips per person per week since the 1990s
There are now more people in employment
The population has grown
But there are overall fewer commute trips

1. Demand Centre – Commission on Travel Demand Report Infographics

ALL CHANGE?

The future of travel demand and the implications for policy and planning

The way we shop is undergoing major change

On-line shopping is growing at 10-12% per year. It is now almost 17% of total UK retail sales.

The rise in on-line has coincided with a 30% decrease in physical shopping trips over the past decade and a 16% decline in distance travelled

Yet traffic is still growing right?

Motorway traffic is increasing

599m fast food deliveries made in 2016

10% per year

Van traffic is growing at 5% per year

next day deliveries grew by 50% between 2012 and 2015

City centre traffic has decreased

...but it's not that simple

- On the motorway network there is significant traffic growth
- BUT in major cities traffic levels have reduced and more people reach the centre by public transport
- FOR INSTANCE Greater Manchester data shows 38% increase in motorway traffic and a 40% decrease in city centre traffic since 1996
- AND Bristol shows a 15% increase in motorway traffic and an 11% decrease in city centre traffic since 2014

Areas with high GVA growth have achieved this with traffic reductions

To understand how travel might change in the future we need to pay more attention to changes in society

Percentage change in car driver miles per head per year by age group and area type and Built Up Area (BUA) size: England, 2002-5 to 2011-14

Some reasons why traffic has continued growing

- The number of miles driven per capita by 65 year olds and older has increased by around 12% over the decade to 2014
- The population is growing due to net immigration and an aging population
- The 'baby boomers' who are entering retirement now have higher car ownership levels than previous cohorts and drive more

If younger people continue to travel less and drive less as activities change then growth will be much lower

All Change: The Future of Travel Demand and the implications for policy and planning explores these trends.
For further information download the full report at: **www.demand.ac.uk/commission-on-travel-demand/**

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