Department for Transport

LATEST EVIDENCE ON FACTORS IMPACTING ROAD TRAFFIC GROWTH

An Evidence Review

70038415
MAY 2018

Department for **Transport**

LATEST EVIDENCE ON FACTORS IMPACTING ROAD TRAFFIC GROWTH

An Evidence Review

PROJECT NO. 1-396
OUR REF. NO. 70038415

DATE: MAY 2018

WSP
The Victoria
150-182 The Quays
Salford, Manchester
M50 3SP
Phone: +44 161 886 2400
Fax: +44 161 886 2401
WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Initial Draft for DfT Comment	Revised Draft for Further DfT Comment	Final Report incorporating DfT Comments	
Date	February 2018	March 2018	May 2018	
Prepared by	Charlene Rohr James Fox Julian Glenesk	Charlene Rohr Bryan Whittaker John Collins	Charlene Rohr Bryan Whittaker	
Signature				
Checked by	John Collins	John Collins	Bryan Whittaker	
Signature				
Authorised by	Bryan Whittaker	Bryan Whittaker	Bryan Whittaker	
Signature				
Project number	1-396	1-396	1-396	
Report number	70038415	70038415	70038415	
File reference				

CONTENTS

TABLES

FIGURES

APPENDICES

PREFACE

This report has been produced for the UK Department for Transport. It presents findings of a rapid evidence assessment review of peer-reviewed papers, reports and other 'grey' literature to provide a better understanding of traffic growth trends – and factors driving these trends – for the strategic road network in Britain. It follows a similar review conducted in 2014 and therefore focusses on evidence published since that review. While the focus of the study is on understanding factors influencing traffic growth trends in Britain, the evidence review incorporates European and wider international evidence, where relevant. No additional empirical analysis has been undertaken for this work.

SUMMARY

AIMS OF THE REVIEW

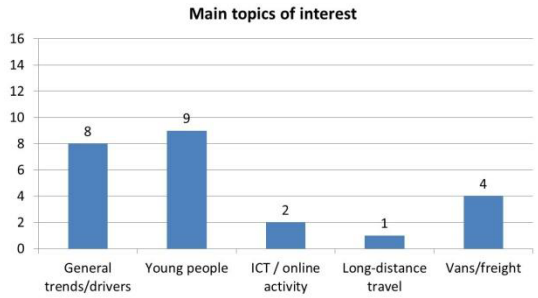
The aim of this rapid evidence assessment review was to update evidence collected in 2014 (referred throughout as the '2014 Review') on traffic growth trends and factors driving these trends to inform the development of the second Road Investment Strategy (RIS2), covering investment in the English strategic road network between 2020 and 2025. Its specific aim was to identify and present findings covering the extent to which technological, social, economic, demographic, political, geographical and environmental changes have affected car usage and ownership. By car usage we specifically mean the impacts on car ownership and use. A secondary aim was, where evidence exists, to explore why a particular factor is important; for example, if an identified factor is that young adults are delaying licence acquisition and car ownership relative to young adults a decade ago, what the reasons are behind this.

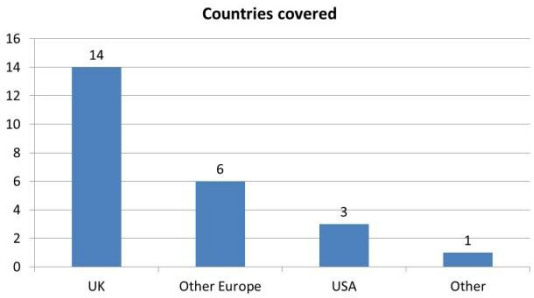
A RAPID EVIDENCE ASSESSMENT WAS EMPLOYED

As in the 2014 Review, a rapid evidence assessment (REA) methodology was employed. A REA review aims to be a comprehensive, systematic and critical assessment of the scope and quality of available evidence from the literature. The REA focussed on new evidence published after the 2014 Review (specifically, studies published from 2012 were included). While the focus of the study is on understanding factors influencing road traffic growth trends in Britain, the evidence review incorporated European and wider international evidence, where relevant. The review is therefore focussed on British, European and evidence from OECD countries with similar economies to Britain. As with the 2014 Review, the review is restricted to papers and reports published in English.

While the 2014 Review focussed on car demand, the current study also incorporated literature on freight travel trends and drivers of these (also focussing on evidence from 2012).

A systematic review process was employed. A two-pronged approach was used to identify potential papers for review: a systematic search was undertaken in the TRID database of literature, and experts who had published in the relevant areas were approached directly by email to identify recent relevant work. Both peer-reviewed journals and conference papers and 'grey' literature – i.e. reports produced by agencies that may not have been subject to peer review – were included in the review. A large number of citations (1,298) were identified from the literature search. The abstracts of these papers were reviewed by a senior transport researcher leading to a longlist of 114 potentially relevant papers. The abstracts of these 114 papers were reviewed in detail and ranked by three independent researchers in terms of relevance in providing evidence on traffic trends for Britain and the strategic road network. Papers that focussed on evidence on road travel trends in urban areas were judged as being less relevant, given the required focus on the strategic road network. On the basis of this assessment, 25 papers were recommended for review to the Department for Transport (DfT) and after discussion with the DfT 24 papers were reviewed. The topics of interest and countries covered in the papers that were reviewed are summarised in the following charts.





KEY FINDINGS

The literature reviewed for this study provides further evidence on key trends influencing car mileage, and factors driving these trends, to that reported in the review undertaken in 2014. It also provides evidence on factors

influencing vans, LGVs and HGVs, which were not covered in the 2014 Review. Below we summarise the key findings from the current review:

- While many researchers have acknowledged that the 2008 recession and changes in fuel prices have impacted road traffic trends, there has been a question of whether these are able to explain the decline in car traffic observed in the 2000s. This is an area where there has been substantial work since the 2014 Review. Work by Bastian et al. (2016), Stapleton et al. (2017), and Grimal et al. (2013) provide valuable evidence, across a number of countries, of the importance of these factors in explaining much of the levelling-off of car traffic observed in the 2000s. The implications of this work are that these economic factors remain of vital importance in explaining changes in traffic trends and that increases in income and reductions in the cost of fuel would have the opposite effect and lead to increases in road travel. There is also evidence that car travel demand may be influenced by other factors (as discussed below), particularly the locations where people live. But, it is premature to say that these are more important than these traditional economic factors. Moreover, many of these factors may themselves be linked to economic factors, e.g. reductions in driving levels for young people and changes in employment patterns.
- The overall trend of reduced driving levels for young people remains a factor in the overall decrease in car use (Berrington & Mikolai 2014). Many drivers of this travel behaviour trend change in young people have been identified, including economic conditions and car costs (Le Vine & Polak 2014; Klein & Smart 2017), changes in demographics and socio-economics (Wu et al. 2017; Le Vine & Polak 2014; Le Vine et al. 2014b; Berrington & Mikolai 2014), geographic shifts (Le Vine & Jones 2012), and attitudes (Wu et al. 2017; Kroesen & Handy 2015; Levine & Jones 2014). Current evidence suggests that increased use of technology is a complement to travel for young people, rather than a factor for the decrease in car use (Le Vine et al. 2014b; Delbosc & Currie 2015; Kroesen & Handy 2015). The largest gap in evidence related to young people's car use is in quantifying the relative impacts of all these influences.
- There is strong agreement with the 2014 Review that since the 1990s there have been substantial population increases in cities; that car ownership and car use are lower in urban areas relative to rural areas; and that young people are more likely to live in urban areas. Contrary to the previous review, recent research indicates that urbanisation has a significant effect in explaining car traffic levels (based on work undertaken by Stapleton et al. 2017 in Britain).
- There is a high level of agreement on a number of demographic changes. First, like the 2014 Review, the current study finds evidence that the population is ageing, leading to lower levels of car travel, although older people are travelling more than their predecessors did. Second, car mileage levels are still declining for men under 60 years of age, but they have stabilised for women under 60 years of age. But there is still a substantial gap in car mileage levels between men and women. Third, differences in travel behaviour by international migrants and ethnic minorities persist – whereby these groups travel much less by car – and may continue to have a substantial impact on expected car mileage levels.
- A substantial piece of work by DfT (2016) has been undertaken on commuting patterns, which shows that the number of commute journeys has been declining. However, this conclusion is influenced substantially by the treatment of trip-chained trips in the analysis – that is, more complex commute journeys with stops, such as dropping a child off at school on the work journey or stopping at a shop on the way home, that have not been counted as commute journeys. However, it is also observed that workers are commuting fewer days to work and increasing numbers of people are working from home, as well as more structural employment changes like growth in the number of workers who do not have a fixed usual workplace (and hence who are not categorised as commuters), an increase in the number of people who are not observed to travel to work in the NTS work diary week, as well as increase in numbers of part-time and self-employment workers. Employment patterns are likely to continue to be important in explaining car traffic levels.
- The evidence on telecommuting suggests that the amount of telecommuting is increasing, but that this is limited to certain occupations. The impact of telecommuting on trip lengths is not clear.
- Recent evidence suggests that ICT is a complement, rather than a substitute, to travel, but the evidence base is small.
- Key changes to the taxation structure for company cars have probably played out and therefore significant changes in company car ownership are unlikely. As noted by Headicar and Stokes (2016) 'company car ownership has been and remains a male dominated activity' and 'no more than 2 per cent of women of working age had access to a company car'.
- It appears that there have been some mode substitution effects over the last 15-20 years, but it is not clear to what extent these are driven by changes in population and employment location and structure and

changes in the use of company cars. Little evidence has been identified on the impacts of new modes, e.g. car sharing, on car travel.

- There is very little evidence in the papers reviewed for this study on how network supply effects, for example through congestion, have influenced road travel trends.
- We found little evidence of the impact of attitudinal changes towards car travel and car mileage patterns.
- We also find little evidence of car usage saturation effects, except perhaps for those with the highest incomes (Bastian et al. 2016; Grimmal et al. 2013).
- Van mileage is growing more strongly than car mileage. While there is recent evidence on the overall van ownership levels (from vehicle licensing statistics) and qualitative insight into the drivers of recent growth, there is little recent quantitative evidence on the details of the van market.
- While historically there has been a close relationship between GDP and HGV travel, recently that relationship appears to have weakened.

While substantial evidence is emerging on travel behaviour differences across different segments of the travelling population, very little of this evidence has considered the impacts of all influences – for example age, gender, location, car ownership and immigration – simultaneously. The risk here is that many factors may be highly correlated, for example that young people may live in urban centres, have less wealth and better access to public transport. Without such analysis, there is a risk of overstating the influence of individual factors. We recommend such systematic analysis be undertaken, explicitly including correlation across a range of explanatory factors.

Finally, we emphasise that these results are generated by review of 24 papers. While the search process was broad and systematic, it is possible that we will have missed papers on specific topics of interest, which aren't picked up because they focus specifically on one factor that influences road travel, for example papers discussing the influence of information and communication technologies that do not specifically mention the influence on car travel in the title, key words or abstract would not be picked up, or they cover a much broader topic area. However, given the two-pronged approach used to identify literature, we are confident that we have picked up the most important research in Britain on these topics.

ABBREVIATIONS

DfT	Department for Transport
GB	Great Britain
GDP	Gross domestic product
HGV	Heavy goods vehicle
ICT	Information and communication technology
LGV	Light goods vehicle
MOT	Ministry of Transport
NTS	National Travel Survey
REA	Rapid Evidence Assessment
RIS2	Road Investment Strategy 2
SRN	Strategic Road Network
TRID	Transportation Research International Documentation (TRID) database
UK	United Kingdom
VFRPH	Visiting Friends and Relatives at a Private Home
VKT	Vehicle kilometres travelled
VMT	Vehicle miles travelled

ACKNOWLEDGEMENTS

We would like to acknowledge the input of the many people who have contributed to this study. First, we would like to thank all the researchers who took the time to respond to our request for work they had published around factors influencing traffic trends. We had terrific response to our request for papers and reports, which have improved the evidence base for this work. We would like to thank Andrew Daly and Ian Williams for their very insightful inputs and guidance on the study. We would also like to thank the RAND librarian – Sachi Yagyu – for her advice on the search strategy and for undertaking the systematic search of published evidence. Finally, we are grateful to John Collins from WSP and Peter Burge from RAND Europe for their comments on an earlier draft of this report during the quality assurance process. However, we emphasise that any errors or omissions herein remain the responsibility of the project team.

1 INTRODUCTION AND BACKGROUND

1.1 AIM OF THE EVIDENCE REVIEW

1.1.1. The UK Department for Transport (DfT) commissioned literature reviews on two analytical questions to inform the development of the second Road Investment Strategy (RIS2), covering investment in the English strategic road network between 2020 and 2025[1]:

- Traffic growth trends and factors driving these trends
- Induced travel demand.

1.1.2. In order to meet the DfT's objectives, it was essential that each review should:

- Discuss and summarise what recent literature says on these issues for the Strategic Road Network (SRN), specifically with regard to demand for investment in new roads.
- Focus on how evidence has evolved since the last time DfT gathered evidence on the topic. For example, for the review on traffic growth trends, the DfT published the 'Understanding of Drivers of Road Demand' report, which gathered evidence on peak car (DfT 2015). RAND Europe contributed to the literature review that supported the findings of this report, collecting evidence published from 1995 (Rohr and Fox 2014).
- Quantify how robust the evidence is in each area, including the data used, assumptions made, analysis methods and date of evidence.
- Identify gaps in the evidence base, including whether further work, and what work, is required to be able to robustly address the key research questions.

1.1.3. It was emphasised that the aim of this study is to review 'new' research/evidence and not to make recommendations about changes to modelling/appraisal methods.

1.1.4. Further, it was emphasised that the literature review should identify high quality literature and cover European and wider international evidence, as is relevant to the DfT.

1.1.5. This particular review is focussed on the first analytical question: that is "Traffic growth trends and factors driving these trends".

1.2 EVIDENCE TO 2014

1.2.1. This review follows on from a rapid evidence review undertaken in 2014 "Evidence review of car traffic levels in Britain: A rapid evidence assessment" (Rohr and Fox 2014). For brevity we will refer to this as the '2014 Review' throughout the rest of this report. The aim of the 2014 Review was to gain a better understanding of the recent levelling off in total miles driven in Britain – referred to by some as the 'peak car' phenomenon – by reviewing evidence on the factors that may be contributing to this levelling off. The primary aim was to identify and present findings covering the extent to which technical, social, economic, demographic, political, geographical and environmental changes had affected car usage and ownership. A secondary aim was to explore why a particular factor was important, i.e. what were the drivers behind some of the observed changes.

1.3 FRAMEWORK FOR ANALYSIS

1.3.1. To structure the 2014 Review, a range of **areas of interest** were defined, setting out key areas that could explain changes in miles travelled on the road network. For each of these areas specific **trends** and **drivers** or **influencers** of these trends were defined.[2] For example, 'employment levels and patterns' were considered a general area of interest. Within this area of interest, changes in teleworking levels were considered an observed trend, with improved internet technology, a growing service economy, etc. being potential drivers or influencers of this trend. The areas of interest and trends/drivers are summarised in Table 1.1. This list was based on one provided by the DfT, which we added to where we felt there were gaps. It is emphasised that areas of interest or trends were not presented in any order of importance. The list also explicitly allowed for 'other' trends and drivers, which were not enumerated prior to the review.

[1] The first Road Investment Strategy (RIS1) covered investment in England's motorways and principal 'A' roads (the 'strategic road network' during the 2015 to 2020 period. This was the initial step in a long-term programme to improve England's motorways and major roads. This process is repeatable and work is now underway to develop the second RIS, known as RIS2, covering the second road period post 2020.

[2] In general we prefer to use the term 'drivers' of trends. However, in some cases we refer to 'influencers' of specific trends to reduce confusion with car drivers, given the topic of interest here.

1.3.2. This structure guided the review by focussing the information to be collected from the reviews (on areas of interest, trends and drivers). Specifically, it helped to ensure that the reviewers reviewed each source on a consistent basis.

1.3.3. For this current review, which is an update of the 2014 Review, we have used the same framework for analysis. However we have also incorporated freight as an additional area of interest, as requested by DfT.

Table 1.1 Framework of areas of interest, trends and drivers

Areas of interest		Trends/Drivers	
1	Traditional economic factors	1.1 1.2 1.3 1.4 1.5	Fuel prices Parking Taxation Role of income Other factors
2	Reduction in driving levels for young people	2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8	Changes in car costs Technology Living locations Legal restrictions Impacts of changes in tertiary education Employment levels for young people Changing attitudes to driving Other factors
3	Developments in land-use	3.1 3.2 3.3	Increasing urbanisation Travel trends in urban areas Other factors
4	Population structure and demographics	4.1 4.2 4.3 4.4	Population ageing Immigration Changes in household size/occupancy Other factors
5	Employment levels and patterns	5.1 5.2 5.3 5.4	Teleworking Part-time working Changing employment characteristics Other
6	Technology	6.1 6.2 6.3 6.4 6.5 6.6 6.7	Teleworking Online shopping trends Social media Mobile internet access Video-conference, Skype Provision of information Other factors
7	Use of company cars	7.1 7.2	Taxation policy Other factors
8	Substitutes	8.1 8.2 8.3 8.4 8.5	Mode shift Shift to new alternatives Increasing car occupancy Increase in international travel Other factors
9	Supply effects	9.1 9.2 9.3 9.4 9.5	Impact of congestion Impact of reliability Quality of road supply Effects of policy, e.g. reallocation of road space Other factors

Areas of interest		Trends/Drivers	
10	Changing attitudes	10.1 10.2 10.3 10.4	Attitudes to the environment Attitudes to cars Attitudes to health, e.g. walking, cycling Other factors
11	Market saturation	11.1 11.2 11.3	Saturation in car ownership Saturation in car usage Other factors
12	Freight		
13	Other		

Source: Rohr and Fox, 2014

1.4 KEY FINDINGS FROM THE 2014 REVIEW

1.4.1. Key conclusions from the 2014 Review (shown below) formed the starting point for the current review.

- A number of papers acknowledged changes in traditional economic factors, like fuel price increases, changes in vehicle use costs and income growth, but the size of the impact of these effects on car mileage levels was not quantified or discussed.
- Observed reductions in driving levels for young people were well described, but the size of the impact of these trends on car mileage trends more generally, in the short term, but also over the longer term – when young people may be expected to get licences but may have developed different travel behaviour – were less well described. Moreover, key drivers for these changes were not well quantified.
- There was strong agreement that in the prior decade there had been substantial population increases in cities; that car ownership and car use were lower in urban areas relative to rural areas; and that young people were more likely to live in urban areas. However, it was found that the relative impact of growing population in conurbations and cities on per capita car mileage was relatively small. There was little discussion on reasons or drivers for increasing urbanisation trends.
- There was also high agreement on a number of demographic changes. First, it was observed that car use for women was still increasing, although women were observed to still drive less than men. It was also observed that the elderly drive less than other population groups, although car mileage was also increasing for these groups. Last it was acknowledged that immigration levels increased during the 1990s and that migrants drive less than the native population, even after correcting for the fact that they tend to live in urban areas. Again, however, the size of the impacts on overall car mileage was not well quantified.
- There was little information on how employment levels or types of employment, including by industry type or employment type (such as full-time employment, part-time employment or self-employment), influenced car mileage.
- While internet technology changed substantially in the period between 1995 and 2010, the effect of information technology on car mileage remained unclear, with some evidence starting to emerge around the impacts of telecommuting, but with much less known about the impacts of e-commerce and social media.
- Detailed information was provided on the decline of company car ownership and mileage in the previous decade, and how this impacted total car mileage of men, of those in 'Employer/manager' and 'Professional' employment types, and those living in the South East. These changes are likely to have been associated with changes in UK tax policy, but no causality of this relationship was established.
- There was little evidence on how substitutes, in terms of mode shifts or switching to new destinations – for example for international travel – may have impacted car mileage patterns.
- There was little quantitative evidence on how network supply effects, for example through congestion levels, influenced car mileage patterns.
- There was little evidence on changes in attitudes towards car travel, and how these may have influenced car mileage patterns.
- Some authors had suggested that car ownership and usage could be approaching saturation – that is to say, car ownership levels (per household) and the use of those cars had stabilised at some maximum level. However, the evidence for saturation of car usage relied on analysis of aggregate car trends, which do not adequately account for the significant changes in car travel patterns for different segments of the population.

2 LITERATURE REVIEW METHODOLOGY

2.1 RAPID EVIDENCE ASSESSMENT REVIEW METHODOLOGY

2.1.1. A rapid evidence assessment (REA) review aims to be a comprehensive, systematic and critical assessment of the scope and quality of available evidence from literature. REAs follow a similar structure to systematic literature reviews, in that they aim to be replicable and transparent, yet they have the advantage of being less resource intensive. This is achieved by each paper being reviewed by one person only, and formally constraining the types of research to be reviewed.

2.1.2. Specifically, the relevant literature evidence for this study was restricted in several ways:

- First, given that this study is focussed on evidence published after the 2014 Review it focussed on studies published from 2012.[3]
- Second, as with the 2014 Review, the review is constrained to papers and reports published in English.
- Third, while the focus of the study is on understanding factors influencing road traffic growth trends in Britain, the evidence review incorporates European and wider international evidence, where relevant. The review is therefore focussed on British, European and evidence from OECD countries with similar economies to Britain.

2.1.3. While the 2014 Review focussed on passenger car demand, for this study we have extended the search criteria to incorporate studies looking at freight travel trends and drivers of these (also focussing on evidence from 2012).

2.1.4. The current REA covered two main strands of literature: published, peer-reviewed journals and conference proceedings; and 'grey' literature – generally, reports that have not been subject to peer-review.

2.1.5. In order to ensure that all relevant evidence was picked up, a two-pronged approach was used to identify papers for the review:

- A systematic literature search was undertaken to identify papers for review;
- Experts who had published in the relevant area were approached directly by email to identify recent work and grey literature that might not be picked up by the systematic search.

The method employed for each is described in the following sections. Furthermore, we held a workshop with experts on travel demand trends after the papers were reviewed. As part of this workshop we again explored whether any relevant literature was missed in addition to identifying key findings from the review.

2.1.6. This was followed by systematic identification of relevant papers, collation of data from the papers and assessment of key themes. These procedures are also discussed below.

2.2 SYSTEMATIC LITERATURE SEARCH

2.2.1. A search protocol was developed to capture relevant evidence on travel trends for road traffic (see Appendix A for the detailed search protocol). The search protocol consists of search strategies and inclusion criteria. A number of separate, but not mutually exclusive, search strategies were implemented to cover the literature on all aspects specified in the scope of work.

2.2.2. We agreed with DfT that we would use a similar search strategy to that implemented in the 2014 study, which focussed on identifying papers describing road travel trends. This was adjusted slightly for this study.[4] An alternative approach would be to conduct searches on each of the different factors of interest, but this was not feasible within the study timescales and budget.

2.2.3. The primary database for the search of journal papers and conference proceedings was the Transportation Research International Documentation (TRID) database.[5] With over 900,000 records worldwide, the TRID is

[3] We focussed on studies published from 2012 to ensure coverage of papers that may have been published between 2012 and 2014 that could have been missed in the 2014 Review. In fact, no papers in this period were picked up.

[4] Specifically by including an additional search term for traffic growth.

[5] The TRID database integrates the content of two major databases, the Organisation for Economic Co-operation and Development's (OECD's) Joint Transport Research Centre's International Transport Research Documentation (ITRD) Database, and the US Transportation Research Board's (TRB's) Transportation Research Information Services (TRIS) Database.

arguably the most comprehensive database for transport research and contains peer-reviewed journals, reports and conference proceedings.

2.2.4. The TRID database was searched by a trained librarian using strategies based on specific combinations of search terms, and the results (abstracts of papers identified through the search strategy) were then screened by the review team to obtain a longlist of relevant papers. The TRID database contains published articles from peer-reviewed journals, conference proceedings and grey literature, thus it provided much of the literature that was reviewed here. Full details of the search methodology can be found in the search protocol in Appendix B.

2.3 LITERATURE PROVIDED BY EXPERTS WHO HAVE PUBLISHED IN THE AREA

2.3.1. In parallel to the systematic search for literature, we contacted over 30 researchers, practitioners and managers in academia and consultancy, industry bodies and other stakeholder organisations, by email, to request material that they had published or were aware of on the topic of travel trends. These researchers reflect comprehensive coverage of people who have published work in this area. We had a very positive response, with nearly three-quarters of the experts responding to our email and providing a substantial number of additional publications and grey literature. There was little duplication of the literature identified from the systematic search (see Appendix A) because much of the literature provided by the experts was on specific factors influencing travel trends, rather than on the travel trends themselves (which were the subject of the systematic search). Both sets of literature were considered when developing the long-list of potential articles to review.

2.4 SELECTION OF PAPERS TO REVIEW

2.4.1. The systematic search of the TRID database led to a database of 1,298 citations (titles and abstracts). These were reviewed by a senior researcher who identified a longlist of 114 papers, including the papers, articles and reports provided by experts. Inclusion criteria were based on the criteria set out in Table 2.1. We cover evidence published from 2012 to allow for some overlap with the literature considered in the 2014 Review (which was published in December 2014).

Table 2.1 Inclusion criteria

Criterion	Value
Published in or after year	2012
Language	English only
Location of study	UK, Europe, OECD
Type of publication	Journal article, conference abstract/paper, PhD thesis, high quality agency report
Study type	Quantitative empirical analyses, preferably with comparator, modelling studies
Scope	Car travel on the strategic road network, Road freight transport

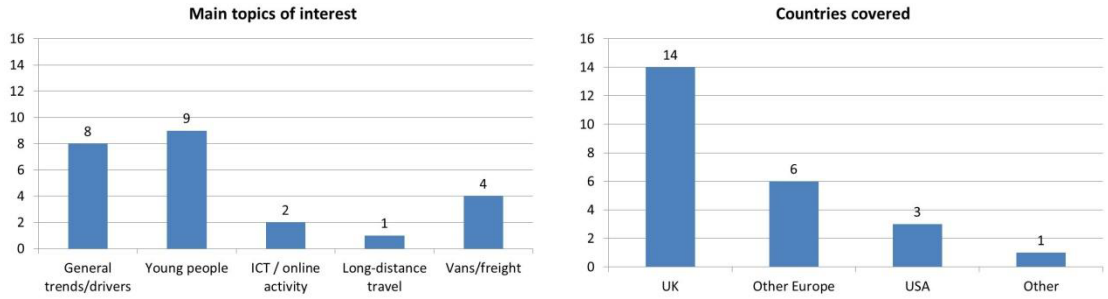
2.4.2. Three senior members of the team ranked the longlist of papers independently scoring them as either highly relevant (green), relevant (amber) or not relevant (red), based on their relevance in terms of providing evidence on traffic trends for Britain and the strategic road network, more specifically. Papers that focussed on evidence on road travel trends in urban areas were judged as being less relevant, given the required focus on the SRN. A further consideration was to ensure that the range of recommended papers covered the range of different factors that could influence road traffic trends, both for car travel and freight.

2.4.3. On the basis of this assessment 25 papers were recommended for review to the DfT. It was noted that a substantial amount of evidence had been generated since the 2014 Review on factors influencing travel of young people (10 of the 25 papers identified focussed on this topic). The DfT requested that we replace one of the papers on young people with a paper on another topic, to provide a somewhat better distribution across the topics of interest. Examination of the papers indicated that all of the papers on travel by young people were

published since 2014 and six of the ten were based on research from the UK. The papers dealt with a range of issues influencing young people's travel, including economic and demographic changes, the use of information and communication technologies (ICT) and attitudinal changes. Further examination of the papers indicated that the Nordbakke et al. (2016) paper was not written in English and therefore this paper was dropped, reducing the number of papers on young people's travel by one. Additionally, we found that the Circella et al. (2016) paper was picked up twice, with two different titles, so one of these was dropped from the shortlist. Further, once we started the review of the Engstrom (2016) paper we found that it did not contain relevant information on freight trends. This left very few papers on freight. At the workshop two further papers on freight were recommended by project experts (Allen et al. 2016 and Piecyk and McKinnon 2013), which were added to the shortlist.

2.4.4. In total, 24 papers were reviewed (see detailed list of papers in Appendix A). The characteristics of the papers are summarised in Figure 1.

Figure 1 Main topics of interest and countries covered in the initial short-listed papers



2.4.5. In addition, the DfT publication "Commuting trends in England: 1988-2014" was reviewed (Le Vine et al. 2017). We also refer to findings from the 2014 Review (Rohr and Fox 2014).

2.5 DATA EXTRACTION

2.5.1. A data extraction template was set up in Excel to collate the data collected from each study. As in the 2014 Review, the following information was collected:

- Paper title
- Authors
- Year published
- Journal
- Abstract, if relevant
- Reviewer
- Area of interest
- Drivers/Trends
- Evidence on impacts for specific segments
- Type of evidence, e.g. analysis of observed data, model outputs, other
- Date of evidence, if reported
- Sample size
- Quality assessment
- Key findings for study.

2.5.2. The quality of the paper was judged by considering:

- Quality of the study methodology, including consideration of sample sizes
- Clarity of argument
- Whether the research was published in a peer-reviewed journal and the quality of the journal.

2.5.3. This structure guided the review by focussing the information to be collected from the reviews (on areas of interest, trends and drivers) and ensuring that reviewers reviewed each source on a consistent basis. Further, at the outset of the review, one of the sources was reviewed by all reviewers. Once this first review was complete all reviewers sat down together to discuss and contrast their reviews and to agree a consistent approach for this evidence review.

2.5.4. After review of all papers a workshop was held with experts on travel demand to identify key themes and findings from the review.

3 EVIDENCE ON ROAD TRAFFIC TRENDS AND FACTORS INFLUENCING THESE

In this chapter we summarise the key trends and drivers influencing these trends, in turn, as identified from the evidence review. We conclude each section with a summary of findings, noting evidence gaps where relevant.

3.1 TRADITIONAL ECONOMIC FACTORS OR PRICES AND INCOMES

3.1.1. This is an area where there has been substantial work since the 2014 Review. At the time of the 2014 Review, a number of studies acknowledged changes in traditional economic factors – such as fuel price increases, changes in vehicle use costs and income stagnation – but the size of the impact of observed changes in these factors on car mileage levels was not quantified. In the current review, three studies quantify the impact of income and fuel cost changes (as well as other variables) on car travel demand over time, finding that changes in these factors are largely able to predict the levelling off of car traffic (Bastian et al. 2016; Stapleton et al. 2017; Grimal et al. 2013).

3.1.2. Bastian et al. (2016) find that simple models predicting per-capita vehicle-kilometres travelled (VKT), or vehicle-miles travelled (VMT), as a function of real GDP/capita and real fuel prices were able to predict car trends in six countries (USA, France, UK, Sweden, Australia and Germany), including the 'peak car'[6] plateau in the 2000s, as well as very recent upturns observed in a number of countries. The one possible exception was in Australia, where VKT/capita decreased more than predicted in recent years. The authors hypothesise that this is a result of growing immigration from non-Anglo-Australian countries and data measurement issues. The resulting elasticities from the models are largely in line with results from studies with more advanced analysis of elasticities, including those conducted before 2000. The models developed in Bastian et al. (2016) would have predicted the decline of VKT/capita, given accurate information on fuel prices and GDP/capita. However, Bastian et al. (2016) also find evidence of declining GDP elasticities over time in all countries. The authors suggest that this would be consistent with a saturation of car use and car ownership in the highest income segments, but that this trend has been going on for decades. They find no evidence of increasing fuel price elasticities over time, as would be expected with fuel price increases.

3.1.3. Stapleton et al. (2017) provides strong evidence that changes in income, the fuel cost of driving and the level of urbanisation (an effect not explicitly considered by Bastian et al. 2016) largely explained the annual distance travelled by personal cars in GB from 1970 to 2012, with peak car being driven by a combination of rising fuel cost of driving, increased urbanisation and economic difficulties as a result of the 2008/2009 recession. They also find some evidence that the proportion of licensed drivers influences aggregate travel trends, but no evidence that growing income equality or the diffusion of ICT has played a role (to be clear: these factors may have had a role, but they have not been identified as such in this study). While not being in complete agreement with the Bastian et al. (2016) contention that GDP and fuel price are able to explain most of the trends in terms of VKT/capita, this study does suggest that economic and demographic variables have explained much of the past aggregate car travel trends. They are also consistent with the view that economic recovery and low fuel prices could encourage renewed traffic growth – particularly because the resulting income elasticities are significantly larger than the fuel price elasticities.

3.1.4. In terms of elasticities, Stapleton et al. (2017) find that a 1 per cent increase in equivalised real income[7] was associated with a 0.55 per cent increase in vehicle kms (an income elasticity of 0.55). They also find that the mean income elasticities from static models are about 20 per cent higher than those from the dynamic models (which may be consistent with the interpretation that static models provide long-run equilibrium estimates while dynamic models provide intermediate-run estimates). This is consistent with findings from the Goodwin et al. (2004) review of international studies, which found a mean income elasticity of 0.5 from static models and 0.3 from dynamic models. Stapleton et al. (2017) also estimate a significant long-run rebound effect as a result of improved vehicle fuel efficiency, whereby a 1 per cent decrease (increase) in fuel cost per km was associated with a 0.26 per cent increase (decrease) in vehicle kms over the period. Furthermore, they found that the dynamic models performed much better than the static models, suggesting lagged effects.

3.1.5. Grimal et al. (2013) come to a similar conclusion through analysis of trends in car use between 1974 and 2010 in France (car use is measured as vehicle kilometres per adult). The car use models use a variable saturation

[6] Some of the literature in this area uses the term 'peak car' to describe the observed phenomena of levelling off in total miles driven by car.

[7] Equivalisation is a technique in economics in which the total household income is allocated to individuals.

rate that varies according to fuel prices and income, with separate models estimated for three area types (core cities, suburbs, low-density areas). Estimates show significant differences in car use between area types and income quartiles. Results suggest that in 2010 diffusion of car use was more advanced in the highest income quartiles, at about 80 per cent for Q1 and 97 per cent for Q4, suggesting that car use is closest to saturation for the highest income groups (a diffusion level of 100 per cent indicates car use has reached saturation, so a level of 97 per cent is very close to saturation). Resulting fuel price elasticities of around -0.15, on average, are identified. Moreover, fuel price elasticities of usage vary with income, e.g. suburbs -0.31 Q1 to -0.08 Q4.

3.1.6. On the other hand, from their review of literature Garceau et al. (2014) conclude that economic factors cannot explain the peak car phenomena on the basis that the peak car phenomena started before the 2008 recession and that changes in fuel costs alone could not explain the observed changes. To back up this point they cite work by Millard-Ball and Schipper (2011), Van Dender and Clever (2013) and Madre et al. (2013). The work by Millard-Ball and Schipper (2011) is largely descriptive – no models are developed to quantify the impact of income or petrol prices on per-capita motorised travel. As part of a general review on the impact of a range of factors on car travel Van Dender and Clever (2013) do develop quantitative models to explore the relationship between GDP, fuel costs and the proportion of working adults and car travel (measured as car passenger kms per year). They find significant, but declining, GDP elasticities and significant fuel price elasticities. However, they do not go on to use the models to quantify the extent to which they explain observed changes in car travel demand. Madre et al. (2013) also develop models of car ownership and total distance travelled for French travellers, but again do not seem to use these to explore the impact that observed changes in income or fuel costs have on the outcomes predicted.

3.1.7. Circella et al. (2016) explore a range of influences on US travel demand, again largely based on literature review. They report that 'travel seems to have decoupled from economic growth', citing work by Garceau et al. (2014), as discussed above. They also report fuel price elasticities, but again no work is undertaken to quantify the impact of these on car travel demand.

3.1.8. **Conclusions:** The balance of recent quantitative evidence (particularly the work undertaken by Bastian et al. 2016, Stapleton et al. 2017 and Grimal et al. 2013), across a number of countries including the UK, indicates that changes in income and fuel costs continue to have a strong influence on car travel demand. However, there is also evidence that car travel demand may be influenced by other factors (as discussed below), particularly the locations where people live. But, it is premature to say that these are more important than traditional economic factors. Moreover, many of these other factors may also be linked to economic factors, e.g. reductions in driving levels for young people, changes in employment patterns, etc. Finally, as pointed out by Bastian et al. (2016), these findings also provide good news for policy design, specifically that changes in economic variables such as fuel prices can impact car travel demand.

3.2 REDUCTIONS IN DRIVING LEVELS FOR YOUNG PEOPLE

3.2.1. As noted earlier, a substantial amount of new research on young people's travel has been undertaken since the 2014 Review.[8]

3.2.2. The overall trend of reduced driving levels and licence holding for young people in Le Vine and Jones (2012) has been reasserted, most notably in Berrington and Mikolai (2014). Since the mid-1990s there has been a drop in both miles driven and licence holding among young people and these reduced levels have remained steady since the mid-2000s. The decline is larger amongst young males than females.

THE INFLUENCE OF DEMOGRAPHIC FACTORS

3.2.3. The 2014 Review identified several hypotheses for influences affecting this change in behaviour including several demographic and socio-economic variables. These changes include a decrease in full-time working,

[8] After the literature review work for this study was finished the report 'Young People's Travel – What's Changed and Why? Review and Analysis' was released by The Centre for Transport & Society, UWE Bristol and Transport Studies Unit, Oxford (Chattergee et al. 2018). This report has therefore not been part of the literature reviewed for this study. In terms of the implications for this work, we note that the study identifies many of the same factors that influence young people's travel. However, it also finds that growth in car use with age is increasing at a slower rate than in the past, suggesting to the authors of that study that the changes in young people's travel behaviour is more than just a postponement of driving. In fact, the authors conclude that 'given that many young people have become accustomed to a lifestyle in which private car use is less central than it has been for previous generations, it is also likely that significant differences in travel behaviour will remain throughout their lives (representing a long-term cohort effect)'. From analysis of NTS data undertaken as part of the study, it finds that time spent at home by men and women aged 17-29 has increased over time (by 80 and 40 minutes per day, respectively). It also notes that ICT effects have been noted in contrary directions, but concludes that this remains a plausible contributor to the total fall in travel by young people.

increase in single young people, increase in those living at home, increased participation in tertiary education and an increasing young population in London. All of these findings have since been reasserted, while several additional demographic and socio-economic variables have been shown to influence driving levels and licence holding (Wu et al. 2017, Le Vine and Polak 2014, Le Vine et al. 2014b, Berrington and Mikolai 2014). Living with one's own children is positively associated with driving levels for males, while evidence is mixed for females (Le Vine and Polak 2014, Berrington and Mikolai 2014). Higher education achievement is positively associated with higher likelihood of holding a driving licence. Higher levels of income are associated with higher driving levels, although for males there is a 'J'-shaped distribution with a spike in the lowest income level (which may be due to low income jobs that require driving). Immigration status has been shown to have a large impact on driving levels, with young people born outside of the UK driving far less than their UK-born counterparts (this is further discussed in Section 3.4.3). Geographic factors including urban density and proximity to transit are associated with fewer car miles driven (as would be expected), however Berrington and Mikolai (2014) note that those who live in urban areas other than London travel more car-miles than those in rural areas.

THE INFLUENCE OF CAR COSTS

3.2.4. Findings regarding car costs remain largely consistent with the findings in the 2014 Review in that they remain important, with the cost of learning being identified as the most important barrier to young people wishing to obtain their driving licence. However, new research by Le Vine and Polak (2014) shows that car costs themselves are the stated primary factor for not obtaining a driving licence for only 7 per cent of young people in Britain. Road safety, availability of alternative travel options and general interest in driving are also found to have a major level of importance for a small minority of young people. Moreover, they find that 94 per cent of those that cite cost as a reason for not obtaining their licence expect to do so within 10 years, supporting the delayed life-cycle hypothesis. There remains limited evidence that there are differing sensitivities towards different types of car costs (such as insurance, buying a car, fuel etc.). In the US, Klein and Smart (2017) investigated car access between financially independent millennials and millennials who are financially dependent on their families. They found that car ownership for financially independent millennials is actually 1 per cent higher than past generations, suggesting an important divide between financially dependent and independent young people.

THE INFLUENCE OF ATTITUDES

3.2.5. There has been more research into travel attitudes of young people since the 2014 Review, however evidence remains mixed on the impact this may have on the decrease in car travel. Using Structural Equation Models and the 2004 British Household Panel survey and the Understanding Society Survey for 2012/2014, Wu et al. (2017) find a positive relationship between pro-environmental attitudes and more environmentally friendly behaviour, including cycling and use of public transport. They find no effect of pro-environmental attitudes on car use or ridesharing. Exploring the direction of this relationship, they find that attitudes affect behaviour more than behaviour affects attitudes. From research in the Netherlands, Kroesen and Handy (2015) find that young people hold 'moderately positive' views on cars, which is consistent with evidence from DfT (2006) as reviewed in the 2014 Review. They also find that, although older people hold more positive views towards public transport than young people, the use of social networks is correlated with positive attitudes towards public transport. While Le Vine and Jones (2014) support the notion of environmental attitudes affecting travel behaviour, they find that pro-environmental attitudes are in fact decreasing amongst young people and only 1.3 per cent of young people in the UK state environmental reasons as a contributing factor for not obtaining their driving licence, casting doubt on changing attitudes being a significant driver for the decrease in car travel amongst young people.

THE INFLUENCE OF INFORMATION AND COMMUNICATION TECHNOLOGY

3.2.6. Arguably one of largest gaps in evidence about young people's travel behaviour lies with technological influence. On this topic, there is increasing evidence that the internet boom in recent decades has in fact been a net complement to trip-making, rather than a net substitution (Le Vine et. al 2014b; Delbosc & Currie 2015; Kroesen & Handy 2015). Using microdata from the Scottish household survey that provides a unique, large-scale, nationally representative data set – including both a travel diary instrument and a pseudo diary of participation in online activity – Le Vine et al. (2014b) find an inverted 'U' distribution of travel time and internet use where those on the extreme ends of internet usage travel less (travel rises until >20 hours of internet use per week, where travel then begins to decline). They also identify that particular uses of the internet are polarising on the effects of trip-making. Uses such as online grocery shopping, online courses, and downloading/playing video games have a negative correlation with trip-making, while uses such as email, buying event tickets, personal banking, and finding information on goods and services have a positive correlation with trip-making. Kroesen & Handy (2015) find a positive correlation between social media use and likelihood of attending a concert in the

Netherlands, however the correlation is weak (R^2 = 0.06-0.13) and is restricted to 'concerts of popular music, pop, jazz, musical, or pop opera'. Delbosc & Currie (2015) find that daily social media contact results in a higher likelihood of seeing friends in person (6.7 times more likely), however they also find that daily telephone contact results in an even higher likelihood of seeing friends in person (9.9 times more likely). The authors conclude that increased use of social networks is associated with a higher likelihood of in-person contact, rather than decreasing it. It is important to note that the data sample in this study was limited to a non-representative intercept survey (n=215) conducted at nine locations in train stations and shopping centres in Australia.

SUMMARY AND GAPS

3.2.7. Overall, the insights from the 2014 Review have been largely reaffirmed while several new insights have been obtained. One area in which we did not find further evidence was regarding location patterns of young people, specifically regarding movements to cities (William & Jin 2013) or a decrease in 'visiting friends and relatives at private home' (VFRPH) travel.[9] Le Vine & Jones (2012) noted that about a third of the fall in car mileage among young men was in VFRPH trips. Both mileage and total number of trips was found to have an inverse relationship with each of living at home, being born outside the UK and living in London.

3.2.8. **Conclusions:** While much research on young people's travel trends has been undertaken since the last review, there remain several gaps in the literature regarding the travel behaviour of young people. There appears to be broad recognition of either a delay or a change in life cycle amongst young people. In the past, young people were quicker to find full-time employment, live on their own, get married and have children; however, there is limited evidence as to whether this reflects a delay in life cycle and associated travel behaviour, a change in life cycle or whether things will 'revert back' if, for example, economic conditions improve for young people. Whilst substantial evidence is emerging on variations in travel behaviour across different segments of young people, no analysis identified in the review has considered the simultaneous impact of all influences, e.g. age, gender, location, car ownership, immigration status. Without such analysis it is difficult to disentangle the impact of each effect, and therefore there is no current conclusive evidence on whether the changes in young people's travel are due to economic, demographic, technology or attitudinal changes. There is also much more evidence on young people's pro-environmental attitudes impacting travel behaviour, but the findings suggest that the overall impact on car use is minimal and there is no evidence that this is having a larger impact on car use now than in the past. Gaps remain in current understanding on how the impact of improvements in non-car modes, new travel alternatives (such as Uber, shared vehicles, etc.) and location decisions affect young people specifically within the UK.

3.3 DEVELOPMENTS IN LAND USE

3.3.1. The 2014 Review found evidence of substantial population increases in cities; that car ownership and car use are lower in urban areas relative to rural areas; and that young people were more likely to live in urban areas. There was little evidence identified on reasons or drivers for increasing urbanisation trends, although researchers noted policy objectives such as redeveloping brown-field sites and high-density urban area development. Nothing in the current review would contradict any of these findings.[10]

3.3.2. In fact, the work by Ball et al. (2016) supports further the wide variation in vehicle miles travelled by cars in different regions and areas in Britain. The authors quantify annual car mileage data across different geographical regions through the use of MOT data.[11] They find substantial variation in average car mileage values across different geographies, with London having substantially lower values than most other British regions. Moreover, larger differences are observed at more detailed levels of geographical analysis. They also observe a substantial tail in the distribution of car mileage, indicating a wide range of observations with very high mileage levels. They fuse the detailed car mileage data with UK 2011 Census data to explore how household and personal annual car mileage is distributed across the population. Again, they find substantial differences across areas. They also

[9] Work by Chattergee et al. (2018) notes that young people are living in more highly urbanised areas and this is having a greater impact on their commuting choices than previously seen, with greater use of public transport.

[10] One exception to this point is Berrington & Mikolai (2014), who find that young people living in urban areas other than London travel more car-miles than those in rural areas, but this was also contrary to other evidence for young people.

[11] The MOT test (Ministry of Transport or simply MOT) is an annual test of vehicle safety, road worthiness and exhaust emissions required in the UK for most vehicles over three years old. The analysis looks at car mileage across regions (11 regions), local authority districts/unitary authorities (380 in GB), Middle-layer Super Output Areas/Intermediate Geography Zones (8,480, 6,791 in England, 410 in Wales, 1,279 Intermediate Geography Zones in Scotland, typically with between 2000-4500 households per MSOA and 1000-2500 per IGZ in Scotland) and Lower-layer Super Output Areas (41,729: 32,844 in England, 1,909 in Wales, 6,976 Data Zones in Scotland, typically 500-800 households per LOSA and 200-500 households per Data Zone).

show that areas with the same mean can have very different internal distributions, emphasising the problems of analysis of aggregate data.

3.3.3. The current review does not find any evidence around the drivers of the continued urbanisation trends. However, on this topic, Focus and Christidis (2017) identify five potential drivers influencing land-use patterns, based on a literature review:

- Redevelopment of brown-field sites and inner city areas with high densities
- Retail and service development favouring urban localities rather than out-of-town sites[12]
- Inner city development of a type that becomes preferred by higher income groups and opinion formers, changing fashions away from suburbs
- Development of urban rail systems with consequential impacts on property values and attractiveness of locations well served by public transport[13]
- New cultural/social/technical patterns and preferences seen as influences on behaviour.

3.3.4. One of the key findings from the last review was that the relative impact of growing population in conurbations and cities was relatively small (based on the work by Headicar (2013)). This is contradicted in the current review.

3.3.5. Markedly, the work by Stapleton et al. (2017) finds that urbanisation was *highly significant* in explaining the levelling off of car travel, finding that a 1 per cent increase (decrease) in the proportion of the GB population living in the five largest cities was associated with a 1.7 per cent decrease (increase) in distance travelled over the period. In fact, these estimates are surprisingly high and the authors hypothesise that this may be because the variables are correlated with other variables not explicitly considered in the models.

3.3.6. In their literature review, Garceau et al. (2014) discuss the impact of density (population, employment or both) on car driving trends, finding that the evidence on residential densities and travel is inconclusive, with evidence that shows that vehicle ownership levels may be a mediating variable such that higher densities reduce car ownership, which result in lower car travel. They note that trip destination and land-use mixing, rather than trip origin densities, may be a more significant determinant of travel behaviour, with higher density destinations having a significant impact on decisions to walk, use public transport or car-pool.

3.3.7. **Conclusions:** Current research recognises the recent trends of increasing population growth in cities: that car ownership and car use are lower in urban areas relative to rural areas and that young people are more likely to live in urban areas. Contrary to the previous review, recent research indicates that urbanisation has a significant effect in explaining car traffic levels.

3.4 POPULATION STRUCTURE AND DEMOGRAPHICS

3.4.1. The following section discusses the impacts of population ageing, gender differences and immigration.

THE IMPACT OF POPULATION AGEING

3.4.2. The 2014 Review found evidence that population ageing was leading to lower levels of car travel, although older people were observed to have higher licence holding and to travel more than previous generations.

3.4.3. For this review, literature review work by Garceau et al. (2014) supports this supposition, citing evidence that driving increases with age and children, but decreases when children move out of the home and continues to decline throughout the remainder of one's life, although some of the research cited is itself getting quite old. Circella et al. (2016) note that in the US baby-boomers are transitioning into retirement with increased discretionary funds for leisure travel, but fewer commuting trips; they tend to drive more than seniors of previous generations – particularly women – but they drive less than during their peak driving years.

3.4.4. Further, Headicar and Stokes (2016) find that travel and driving have increased steadily amongst men and women over 60 years of age; although the car-driver mode share for older women is still half of that of men in England.

3.4.5. **Conclusions:** Similar to the 2014 Review it is observed that the population is ageing, leading to lower levels of car travel, although older people are travelling more than their predecessors did.

[12] A factor that seems to be a reversal of past trends.

[13] Presumably metro systems as well, as seen in Manchester.

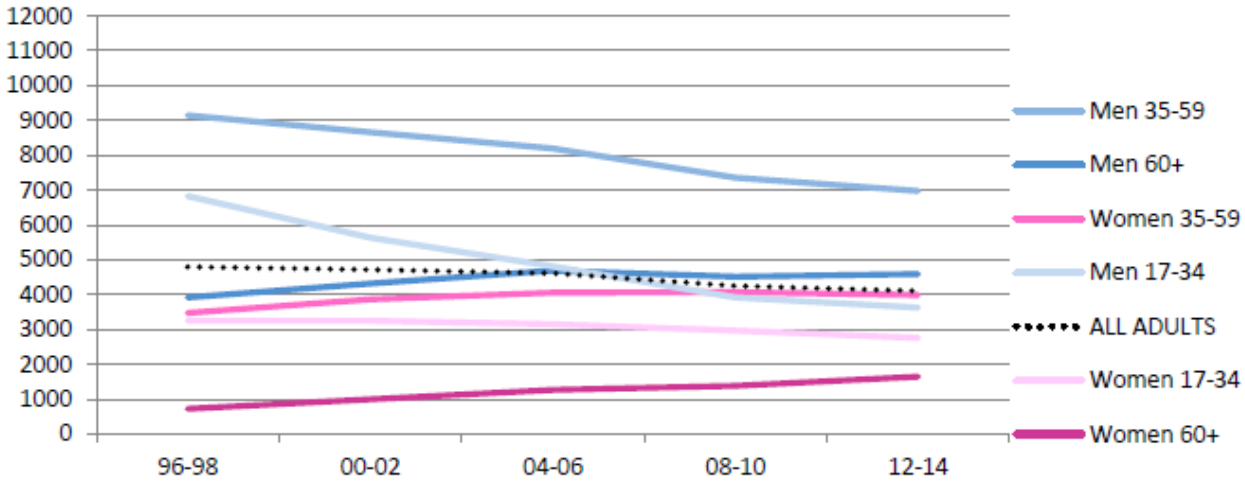
GENDER

3.4.6. The 2014 Review found evidence of reductions in the average car mileage by men in all age groups up to age 60, with higher percentage falls for younger age groups. By contrast, mileage for females was more or less unchanged for those between 16 and 29 years of age and increased for all age bands for females aged 30 years and above. However, despite these trends, men were still observed to drive significantly further than females.

3.4.7. The evidence reviewed for this study generally concurs with these findings. Circella et al. (2016) reported that the gender gap in car mileage has reduced substantially in the US, noting that in 1969 women drove less than half the number of miles than men, whereas in 2009 women drove about 2/3 of the number of miles of men. Garceau et al. (2014) also noted evidence that suggested the rate of growth of travel for women (in the US) appears to be declining (although again, this is focussed on evidence from the US).

3.4.8. Headicar and Stokes (2016) find in England that men under 60 years of age have experienced large falls in the amount of car travel per year (measured as car miles per year), particularly those under 35 years of age. Women under 60 years of age show a much more stable level of car travel, with some small decreases in 2012-2014. Moreover, the car-driver mode share has increased amongst women aged over 35 years (from 48 per cent to 55 per cent) but fallen for women under 35 years of age (from 45 per cent to 42 per cent). But this fall is much less than that observed for men under 35 years of age (where the car-driver mode share dropped from 67 per cent to 51 per cent). As in the US, Headicar and Stokes (2016) also show evidence that there remains a gap in the car mileage levels between men and women.

Figure 2 Car driver miles per person per year by age and gender 1996-98 to 2012-14



Source: Headicar and Stokes (2016)

3.4.9. **Conclusions**: Car mileage levels are still declining for men under 60 years of age, but they have stabilised for women. But there remains a substantial gap in car mileage levels between men and women.

IMMIGRATION

3.4.10. The 2014 Review found evidence of significant increases in immigration, with increases in immigration (and the national population more generally) being concentrated in conurbations and cities, and especially in London. Evidence was also provided that people born outside Britain tend to use cars less.

3.4.11. For the current review, Headicar and Stokes (2016) provide a summary on travel behaviour of international migrants and ethnic minorities from analysis of NTS data (in Appendix B of their report).[14] They find:

- For younger people, living in a household with a car is appreciably lower for those born outside the UK, but for older age groups this makes less of a difference (and gender has little effect).
- Licence holding by non-white people born outside the UK is appreciably lower than for other groups, across all age bands, particularly for non-white women.

[14] NTS includes information on country of birth and ethnic group. The Headicar and Stokes (xxxx) work looks at whether people are white or non-white and whether they are born in the UK.

- When considering total travel, mileage by non-whites born outside the UK is generally lower than other groups, although this trend is not evident for men of working age; however, when considering car travel only, the differences are greater, with driving mileage by non-white women born outside the UK being especially low.

3.4.12. Headicar and Stokes (2016) note that some of these differences are attributable to the concentration of migrants and non-white UK-born people living in large cities where the need for a car is less (noting that half of all non-white people and a third of all white people born outside the UK live in London). However, no analysis is undertaken to quantify the influence of immigration over and above other characteristics. Furthermore, they note that differences in licence holding by ethnicity and country of origin persist within individual area types.

3.4.13. **Conclusion:** Differences in travel behaviour by international migrants and ethnic minorities appear to persist and may continue to have a substantial impact on expected car mileage levels.

EMPLOYMENT LEVELS AND PATTERNS

3.4.14. In the 2014 Review little evidence was found on how employment levels or different types of employment, by industry type or employment type (such as full-time employment, part-time employment or self-employment), influenced car mileage. The one exception to this was the observation by Headicar (2013) that service employment levels have driven urbanisation trends, which have had subsequent impacts on car travel trends.

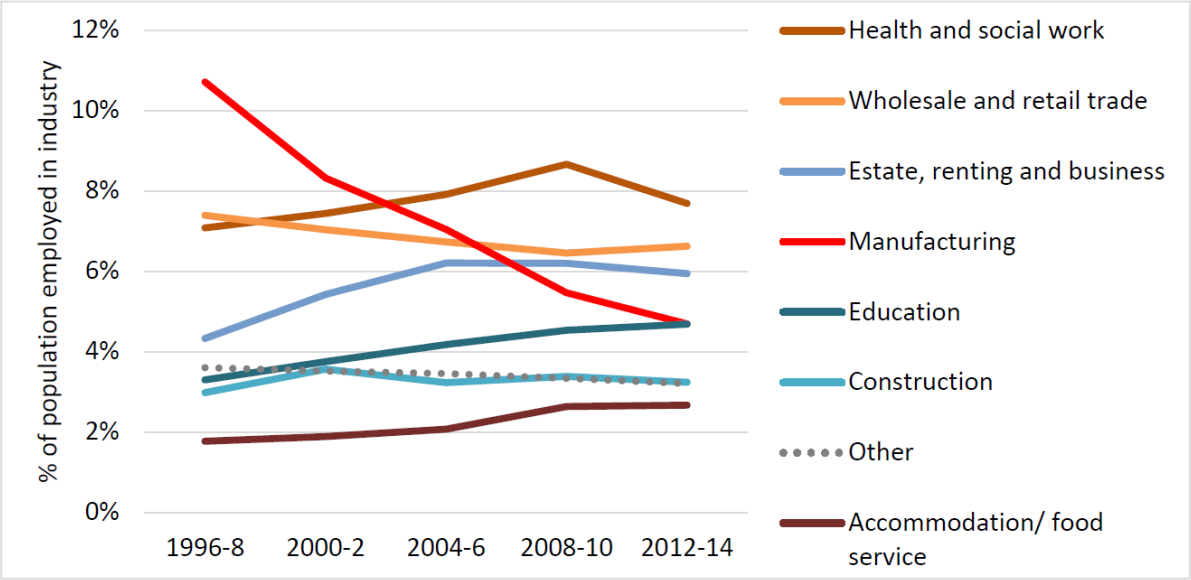
3.4.15. Since that review, the DfT has published a comprehensive report on commuting trends in England, covering the period from 1988 to 2015 (DfT 2016). Key findings from this report include:

- Whilst commuter trips account for only 16 per cent of (personal) journeys made in England, these trips place a disproportionate burden on the transport network because of the relative length of these journeys, which means that they are responsible for about a fifth of all miles travelled. They also tend to be concentrated on congested radial routes in and out of major cities as well as being undertaken when the network is busy, predominantly the AM and PM peak periods.
- Since the late 1980s the number of commuting trips that people make is declining. Reasons identified for this trend include: (i) workers are commuting to work fewer days per week, (ii) there has been growth in trip-chaining[15], (iii) 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, (iv) growth in working from home, both occasionally and on a regular basis, (v) an increase in the number of people who are not observed to travel to work in the NTS work diary week (even though they report that they are employed and do not work from home), and (vi) increases in part-time employment and self-employment, both of which are associated with reduced numbers of commuting journeys. It is not clear which of these are the most important in terms of explaining the decrease in commuting travel.
- Overall, car driving has declined a little since 2008 (although again this may be a result of the trip-chaining issue identified earlier); commuting as a car passenger has also declined, with corresponding growth in the use of National Rail and London Underground.
- Commuters are travelling further (average distances have increased over time) and the time spent commuting has also increased; according to DfT (2016) these trends appear to be explained by changes in commuting behaviour by part-time workers.
- There has been a lengthening in the duration of people's work – with people arriving several minutes earlier, on average, and leaving slightly later in the afternoon – but this is counterbalanced by the number of hours per week worked declining, with a small rebound since 2011.
- There has been a decrease in the share of workers classified as 'manual' workers, and they are less likely to travel in the peak periods.

3.4.16. On the last point, Headicar and Stokes (2016) provide a graph showing changes in selected industry sectors between1996-98 and 2012-14 identified from NTS data, repeated in Figure 3 below. This figure illustrates the sharp decline in manufacturing employment, which has halved since 1995.

[15] Trip chaining refers to the situation where people combine two or more trips for different purposes, such as dropping children off at school on the way to work. In the analysis for this study, such a trip would not be counted as a commute trip. Therefore, increases in trip chaining would reduce the number of commute trips counted. Moreover, trip-chained journeys are more likely to be made by car. Analysing tours – i.e. return journeys from home to what is called a "primary destination" – would have reduced this issue, because the work destination would be categorised as the primary destination.

Figure 3 Employment in selected industrial sectors 1996-98 to 2012-14



Source: Headicar and Stokes (2016)

3.4.17. DfT (2016) also provides a useful description of the changes in the composition of the workforce, noting that: (i) the absolute number of workers is increasing; (ii) much of the growth in employment from 2010 has been in the form of self-employment; (iii) there are more men than women working, although the number of men working decreased more markedly in 2008 than the rate for women; (iv) part-time working has continued to grow, and there has been an increasing tendency for men to work on a part-time basis; (v) the number of young workers (those under 24 years of age) decreased in 2008 and began to recover in the 2010s; (vi) there has been growth in "professional" and "associate professional/technical" employment and decreases in proportions of workers in "administrative/secretarial" jobs, "skilled trades" and "process/plant/machine operators".

3.4.18. **Conclusion:** It appears that the number of commute journeys is declining, although this conclusion is influenced substantially by the treatment of trip-chained trips in the analysis – that is, more complex commute journeys with stops, i.e. dropping a child off at school on the work journey or stopping at a shop on the way home – that have not been counted as commute journeys. However, it is also observed that workers are commuting fewer days to work, that increasing numbers of people are working from home, as well as more structural employment changes like growth in the number of workers who do not have a fixed usual workplace (and hence who are not categorised as commuters), an increase in the number of people who are not observed to travel to work in the NTS work diary week, as well as increases in part-time and self-employment. Employment patterns are likely to continue to be important in explaining car traffic levels.

3.5 INFORMATION TECHNOLOGY

3.5.1. The 2014 Review noted that Internet technology improved substantially between 1995 and 2010, and that there was some evidence that telecommuting reduced car usage, but that the impact of e-commerce and social media on travel was unclear (and that much of the evidence came from the US). This section compares the evidence reviewed for the 2014 Review with more current evidence.

TELECOMMUTING

3.5.2. In the 2014 Review the key publication around the influence of telecommuting on commute travel was undertaken by White et al. (2007) in Britain. They found:

- On average, 2.6 per cent of workers worked mainly from home, 7.5 per cent worked from home at least once a week and 23 per cent sometimes worked from home (based on estimates from the Labour Force Survey). They found similar estimates from the NTS.
- Those in middle to senior management positions and the 'nomadic workforce' were more likely to work from home.

- People who worked from home tended to travel less, although there could be some offsetting effects because of additional journeys undertaken from home on days when people worked from home, although these tended to be relatively short so that a substantial net reduction was observed.
- The relationship between working from home (telecommuting) and trip lengths was unclear. Workers who telecommuted tended to make longer journeys compared to the average reported by working-age. However, the authors noted that there is not a simple relationship between commuting and business travel and telecommuting, probably because of the association between working at home and greater average distances between home and work, which in turn is related to income and occupation. They also expect correlation between income and greater travel distances.

3.5.3. No paper reviewed for the current study dealt specifically with telecommuting. However, as noted in the previous section, DfT (2016) find that commuting journeys have been declining since the late nineties for a number of reasons, including people travelling to work fewer days per week (although this is for a number of reasons – such as working from home, not working in the survey week, increased part-time work and self-employment). They also find that professionals were more likely to work from home occasionally (in 2008 16 per cent reported doing so), followed by employers/managers (14 per cent) and self-employed non-professionals (8 per cent). Manual and personal service workers were the least likely to telecommute (at less than 1 per cent each).

3.5.3.1 **Conclusions**: The evidence on telecommuting suggests that the amount of telecommuting is increasing, but that this is limited to certain occupations. While people who worked from home tended to make fewer journeys, the impact of telecommuting on total travel was not clear, because workers who telecommuted tended to make longer journeys on average. Overall, there is a gap in evidence identified in this review on telecommuting trends. This may be able to be addressed by a more targeted literature search specifically on telecommuting, or it may be that more research in this area is required.[16]

IMPACT OF E-COMMERCE AND SOCIAL MEDIA ON TRAVEL

3.5.4. In the 2014 Review, the assessment was that the impact of information and communication technology (ICT) was unclear. One of the problems in measuring the impact of ICT on travel is that national travel surveys tend not to collect information on ICT ownership, nor on substitution of trips by forms of telecommunication, except for working from home. For example, these surveys tend not to collect information on home shopping habits or social media use. However, since 2002 the NTS has collected information on whether respondents receive home deliveries of various kinds of goods, finding that households ordering goods for delivery increased from 64 per cent to 80 per cent between 2002 and 2014 and the proportion ordering food and drink, excluding takeaways, has increased from 22 per cent to 36 per cent (Headicar and Stokes 2016). However, such findings do not quantify whether ICT acts as a substitute for travel nor whether the overall amount of travel associated with accessing these goods and services has increased, decreased or stayed the same.

3.5.5. In this regard and since the previous review, Le Vine et al. (2014c) have undertaken research in this area using microdata from the Scottish household survey that provides a unique, large-scale, nationally representative data set that includes both a travel diary instrument and a pseudo diary of participation in online activity. They find that the net effect of Internet usage is *positively associated with increased car travel* (measured as car driving distance per day) across all segments (men/women, across three age categories), although the marginal effect of time online was negatively associated with car use (in other words, spending large amounts of time online is, all else equal, associated with less car driving mileage). This is consistent with Mokhtarian's hypothesis that on balance telecommunications and transportation are net complements, rather than substitutes (Mokhtarian 2002).

3.5.6. **Conclusions:** Recent evidence suggests that ICT is a complement, rather than a substitute, to travel, but the evidence base is small. There is a substantial gap in evidence on this important topic. This gap may be able to be addressed by a more targeted literature search, but probably requires more studies using data reflecting both travel and ICT activities, like that used by Le Vine et al. (2014).

3.6 USE OF COMPANY CARS

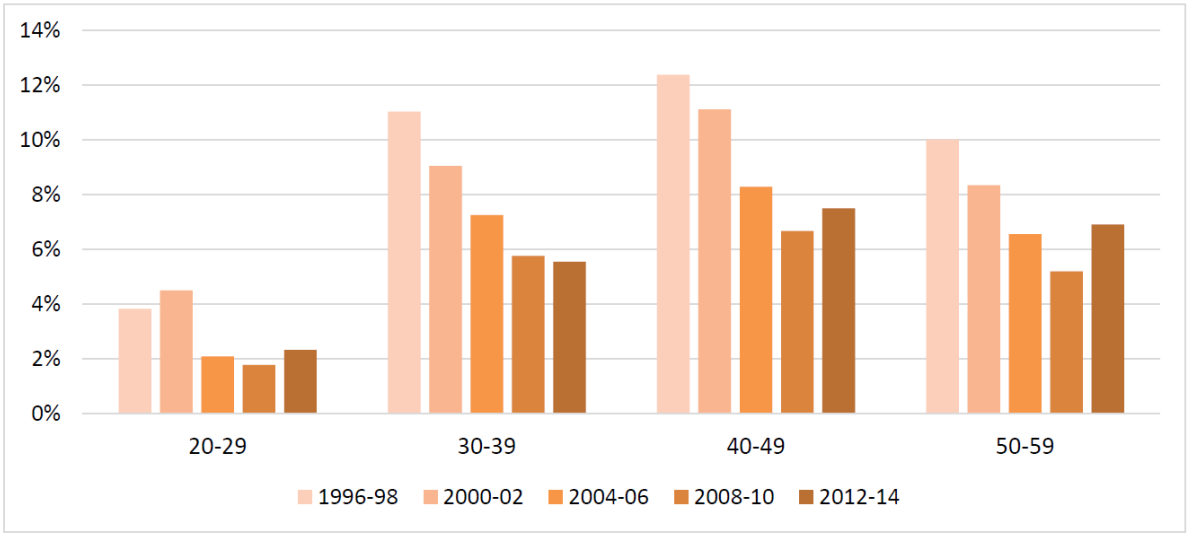
3.6.1. The issue of company cars was reported in the 2014 Review, where detailed information on the decline in company car ownership and associated car mileage, particularly for men, was picked up in the 'On the Move' report by Le Vine and others (2012). Since that period access to a company car has stabilised and even grown

[16] We reiterate that the search terms here were focussed on papers looking at changes in road traffic trends more generally and it was not possible, in the timescales for this research to undertake separate searches on each of the factors of interest.

slightly, but company car mileage has continued to fall through the recession and thereafter, albeit at a slower rate (Headicar and Stokes 2016).

3.6.2. Headicar and Stokes (2016) show the trends in company car ownership for men by age group, showing the slight increase in company car ownership in 2012-14, see Figure 4. They note that 'company car ownership has been and remains a male dominated activity' and 'that no more than 2 per cent of women of working age had access to a company car'.

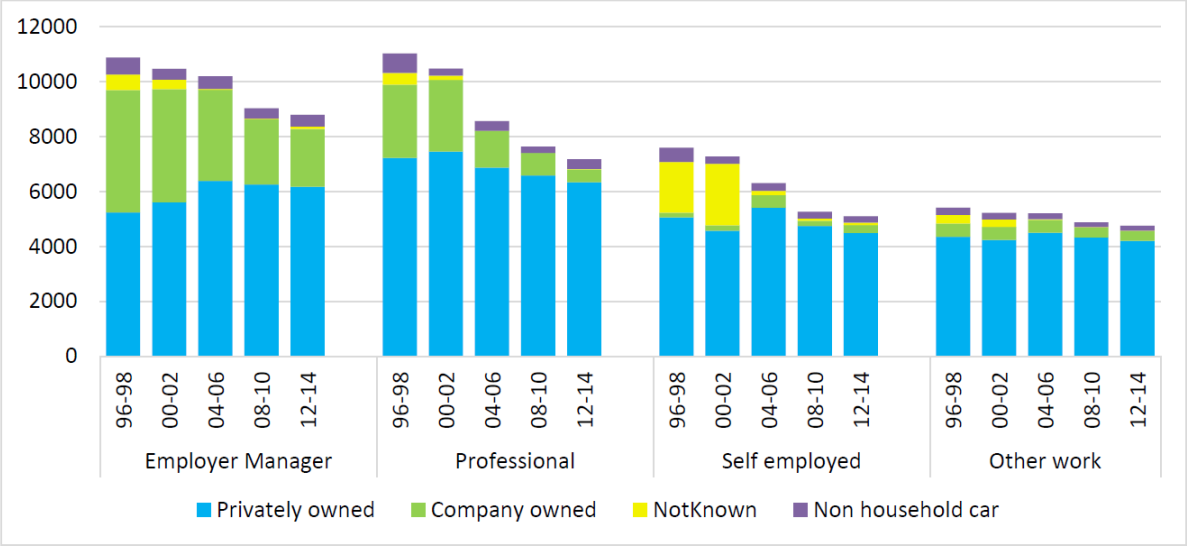
Figure 4 Percentage of men by age with company car access, 1996-98 to 2012-14



Source: Headicar and Stokes (2016)

3.6.3. In terms of the types of workers who have company cars, Headicar and Stokes (2016) note that company cars were predominantly used by higher paid workers (employers and managers and professional workers) and that employers and managers have tended to substitute company car mileage by private mileage whilst professionals have decreased all forms of mileage, as shown in Figure 5.

Figure 5 Driver miles per person per year by occupation and type of ownership, 1996-98 to 2012-14



Source: Headicar and Stokes, 2016

3.6.4. **Conclusions:** Key changes to the taxation structure for company cars have probably played out and therefore significant changes in company car ownership are unlikely. As noted by Headicar and Stokes (2016) 'company car ownership has been and remains a male dominated activity' and 'no more than 2 per cent of women of working age had access to a company car'.

3.7 SUBSTITUTES

3.7.1. Here we consider different substitutes that could impact car mileage, including mode shifts to public transport or new alternatives and increasing car occupancy, as well as substitution of trips to different destinations, i.e. increases in international travel.

3.7.2. The 2014 Review identified little evidence about the impact of substitutes influencing car mileage levels. One exception was the observation by Le Vine et al. (2013), about substitution between company car and rail travel for business travel for men.

3.7.3. Similarly, little new evidence was identified in the current review. Headicar and Stokes (2016) present trends in aggregate distances travelled by different modes, showing that travel by car has declined while travel by other modes has increased, noting that amongst non-car modes the biggest increases occurred for London Buses and Underground and in National Rail. This same pattern is reported by Le Vine et al. (2014) for commuter travel, where they note that the majority of commuting journeys are made by car, as a driver, and that the proportion of car journeys increased during the 1990s and up to 2005-07 and then declined slightly. Whereas walking and travelling as a passenger are the next two most popular modes, both have decreased over time (but these downward trends have now stabilised). In contrast, the number of commute journeys by rail, London Underground and local buses has increased over time (although they also note that the increase in bus is the net effect of a significant increase in London and an overall decline elsewhere).

3.7.4. Circella et al. (2016) provide some evidence from the US noting that car mode shares have decreased from 87.8 per cent in 1990 to 83.4 per cent in 2009 (after reaching a maximum of 89.3 per cent in 1995) while the percentage of person-trips made by public transport rose from 1.8 per cent to 1.9 per cent and walking rose from 1.2 per cent to 1.4 per cent in the same period (Santos et al. 2011). It is not clear how much of this may be explained by demographic changes or increasing urbanisation. Circella et al. (2016) also report research by Buehler and Hamre (2014) that finds that Americans have become increasingly multimodal. They note that the share of total trips made with new shared mobility services is small, but the popularity of these services is expected to bring large effects on future passenger travel.

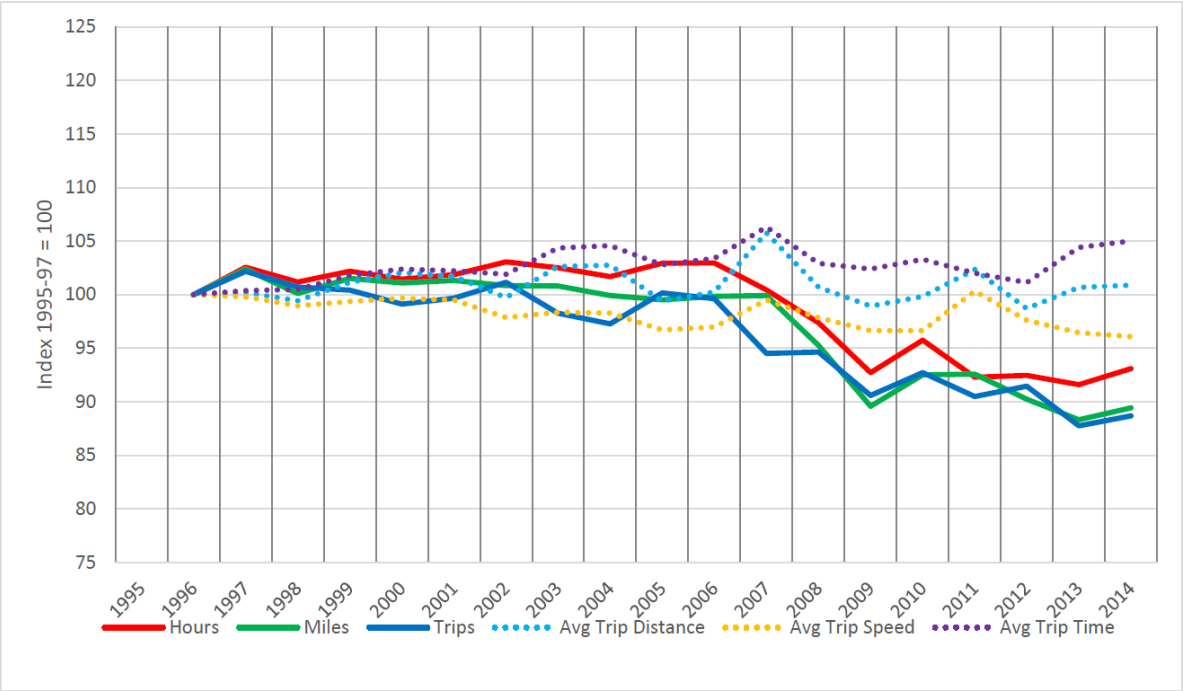
3.7.5. Conclusion: It appears that there may be some mode substitution effects, but the information is very aggregate, so the evidence is not clear about the sizes of the effects across different geographical areas, nor is it clear to the extent that these are driven by changes in population, employment changes and changes in the use of company cars. Little evidence has been identified looking at the impacts of new modes or services, e.g. car sharing on car travel**.**

3.8 SUPPLY EFFECTS

3.8.1. In the 2014 Review very little evidence was found on the impact of supply effects on car travel demand, leading to a conclusion that increasing congestion may have contributed to the levelling off of miles travelled, but there was no direct evidence on the size of this impact.

3.8.2. Evidence by Headicar and Stokes (2016) from the current review shows changes in car driver trips, distance, journey times and speeds over time (see Figure 6). Between 1996 and 2006, they observe a small decline in the number of trips, stable journey lengths and somewhat increased journey times and reduced journey speeds. They attribute the increases in journey time and slowing speeds to population increases more generally, and increases in commercial traffic, which would contribute to increased congestion. After 2006 they observe a pronounced drop in car trips, impacting distance and, with stabilising speeds, journey time.

Figure 6 Car driver trips, distance and hours travelled per person, indexed 1995-2014



Source: Headicar and Stokes (2016)

3.8.3. **Conclusion:** There is very little evidence on how network supply effects, for example through congestion, have influenced road travel trends. This appears to be a significant evidence gap.

3.9 ATTITUDES TO THE CAR

3.9.1. With the exception of young people's attitudes (discussed in Section 3.2) no evidence was identified on changing attitudes to the car. As in the 2014 Review, this remains a gap.

3.10 MARKET SATURATION

3.10.1. In the 2014 Review little evidence was presented on whether car ownership or usage may be approaching saturation levels. Again, in this review, little evidence has been uncovered.

3.10.2. Bastian et al. (2016) provide evidence of GDP elasticities over time, in the countries investigated. They suggest that this would be consistent with a saturation of car use and car ownership in the highest income segments, and that this trend has been going on for decades. The analysis of Grimmal et al. (2013) also finds evidence of saturation effects for the highest income groups. However, they also note that there is scope for substantial increases for lower income groups.

3.10.3. **Conclusion:** There is little evidence of car usage saturation effects, except perhaps for those with the highest incomes. This remains an evidence gap.

3.11 FREIGHT TRAVEL TRENDS

3.11.1. Different from the review undertaken in 2014, this review incorporated evidence on freight travel trends, both for vans and light goods vehicles (LGVs) and heavy goods vehicles (HGVs).

EVIDENCE ON TRENDS FOR LGVS AND VANS

3.11.2. The review incorporated three papers discussing road traffic trends for LGVs and vans.

3.11.3. Clarke et al. (2014) analysed van travel trends for the total van fleet using vehicle licensing statistics sourced from the DfT. Vans account for 14 per cent of travel on UK roads compared to 5 per cent for HGVs but the van market is not well understood. The number of vans rose rapidly between 1994 and 2012 and a number of reasons for this are suggested:

- Increasing use of just-in-time deliveries
- More perishable deliveries
- Difficulties hiring HGV drivers
- Operating restrictions on HGVs in urban areas
- Internet shopping
- Growth in number of households
- Increase in rapid-response servicing, e.g. to fix a boiler
- Use of more technological and communication equipment.

3.11.4. The increasing tendency to use vans in place of HGVs is inefficient for road space – replacing an HGV with vans requires an additional 639 per cent of road space (assuming that the HGV is full and goes to the final destination). Van activity can be segmented into employed dedicated drivers (e.g. couriers), employed tradesmen (e.g. electrical engineers), self-employed tradesmen (e.g. builders), self-employed dedicated drivers (e.g. furniture removal) and people-carrying van drivers (e.g. taxi drivers). The largest user of vans is construction, accounting for 31 per cent of veh-km, with wholesale & retail trade, repairs and hotels accounting for another 20 per cent.

3.11.5. Allen et al. (2017) also provide a good overview of van demand and qualitative factors that explain recent growth in van mileage. They note that van ownership is more fragmented than HGV ownership, with 51 per cent of vans registered to private individuals in 2015, and the 200 largest van fleets accounting for just 9 per cent of all vans. Van kilometrage comprises 36 per cent commute, 30 per cent collection and delivery, 25 per cent servicing and 8 per cent personal, thus commuting has an important share (data from the DfT Company Van Survey (2003-2005) and the DfT Survey of Privately Owned Vans (2002-2003). These shares illustrate that both personal and business travel need to be properly represented in order to explain total van mileage.

3.11.6. Vans have got larger and heavier over time, with heavy vans (2.5-3.5 tonnes) comprising 23 per cent of fleet in 1990, rising to 54 per cent in 2015. Overall, van ownership increased by 48 per cent between 2000 and 2015. Allen et al. (2017) make a number of hypotheses on factors driving this trend:

- Growth in smaller, more frequent collections and deliveries to companies (just-in-time distribution)
- Growth in online shopping and home delivery operations
- Growth in demand for express and parcel services
- Outsourcing of service functions to specialist companies
- Development and use of more technological and communications equipment that requires installation, planned servicing and emergency repairs
- Installation and maintenance of new telecommunications networks
- Increase in rapid-response servicing (e.g. computer repairs)
- Growth in UK construction industry
- Increasing home renovations and improvements in the UK
- Growth in population and the number of households
- Economic growth, employment growth and formation rate of new businesses
- Less stringent regulatory regime for LGVs compared to HGVs
- Shortage of HGV drivers compared to LGV drivers.

3.11.7. These factors correspond fairly well to those suggested in Clarke et al. (2014). Total van usage is forecast to grow more strongly than car usage, and further research would be valuable to quantify the relative contribution of different drivers to overall van mileage.

3.11.8. Lastly, Braithwaite (2017) considered the implications of Internet shopping growth on the van fleet and traffic activity. He reports that the share of vans used for parcel, post and grocery delivery is 4 per cent of the vans on the road and 10 per cent of van mileage, thus while important this sector does not dominate van mileage. Moreover, he notes that the van fleet has grown more rapidly than the economy over the 2003-2015 period, with annual growth rates of 2.8 per cent for large vans, 5.3 per cent for medium vans and 6.1 per cent for small vans. In total, vans comprised 14 per cent of traffic in 2010 (consistent with the estimate made by Clarke et al. (2014), as reported above); this is forecast to rise to 21 per cent by 2040. A comparison of 2002 and 2015 NTS data shows than on average people are making 39 fewer shopping trips per year, an 18 per cent reduction, and overall the evidence suggests that online shopping has probably led to a modest reduction in overall mileage. Braithwaite suggests further research would be valuable to understand how different sectors are driving van mileage.

3.11.9. **Conclusions:** Van mileage is growing more strongly than car mileage. While there is recent evidence on the overall van levels (from vehicle licensing statistics) and qualitative insight into the drivers of recent growth, there

is little recent quantitative evidence on the details of the van market. The Company Van Survey and Survey of Privately Owned Vans are now 15 years old and should be repeated.

EVIDENCE ON HGV TRENDS

3.11.10. The study by Piecyk et al. (2013) discusses HGV trends. They report that historically the relationship between GDP and HGV demand has been close, and illustrate this close relationship for HGV tonne-kms over the 1980 to 1997 period. However, between 1997 and 2007 GDP grew by 37 per cent but tonne-km grew by only 5 per cent. A separate 2007 study used data to assess the relative importance of three factors to explain this weakening relationship:

- Increased penetration of UK haulage market by foreign operators whose tonne-km do not appear in the statistics explained 33 per cent of the observed decoupling[17]
- Decline of road share of freight market due to mode shift to rail and water explained 22 per cent, in particular evidence that HGV lost mode share following privatisation of rail freight services in 1996
- Increases in the real cost of road freight transport explained 12 per cent, with fuel costs likely to be the main component.

3.11.11. Diminishing rate of spatial concentration, erosion of industrial activity to other countries, increasing share of service activities in the composition of GDP, and the geographical location of the country limiting the amount of European transit freight movements, were also believed to have a 'very significant' (even though impossible to quantify) impact.

3.11.12. To this list we could add shift from HGVs to vans, noting that more vans are required to move a given weight than HGVs, so the impact on vehicle mileage is greater than the impact on tonne kms. Given that GDP is a key input to forecasting freight demand, further research would be valuable to understand the relative contribution of these different factors on HGV usage.

3.11.13. DfT registration statistics show that between 1991 and 2001 the numbers of the lightest (3.5-7 tonnes) and heaviest (over 41 tonnes) HGVs increased whereas in all intermediate weight categories the numbers of HGVs declined. The largest decline of 41 per cent was observed in the 31-41 tonne band.

3.11.14. **Conclusions:** Historically there has been a close relationship between GDP and HGV demand, however recently that relationship appears to have weakened. This is an area where further data and research is required.

[17] Travel by foreign operators will be included in road counts but not in the CSRGT survey, which is what needs to be used for more detailed analysis of HGVs.

4 SUMMARY OF FINDINGS AND EVIDENCE GAPS

4.1 SUMMARY OF FINDINGS

4.1.1. The literature reviewed for this study provides further evidence to that reported in the 2014 Review on key trends influencing car mileage, and factors driving these trends. It also provided evidence on factors influencing vans, LGVs and HGVs, which were not covered in the 2014 Review. Below we summarise the key findings from the current review:

- While many researchers have acknowledged that the 2008 recession and changes in fuel prices have impacted road traffic trends, there has been a question of whether these are able to explain the decline in car traffic observed in the 2000s. This is an area where there has been substantial work since the 2014 Review. Bastian et al. (2016), Stapleton et al. (2017) and Grimal et al. (2013) provide valuable evidence, across a number of countries, of the importance of these factors in explaining much of the levelling-off of car traffic observed in the 2000s. The implications of this work are that these factors remain of vital importance in explaining changes in traffic trends and that increases in income and reductions in the cost of fuel would have the opposite effect and lead to increases in road travel. There is also evidence that car travel demand may be influenced by other factors (as discussed below), particularly the locations where people live. But, it is premature to say that these are more important than traditional economic factors. Moreover, many of these factors may themselves be linked to economic factors, e.g. reductions in driving levels for young people, changes in employment patterns, etc.
- The overall trend of reduced driving levels for young people remains as a factor in the overall decrease in car use (Berrington & Mikolai 2014). Many factors influencing this change in behaviour have been identified, including economic conditions and car costs (Le Vine & Polak 2014; Klein & Smart 2017), changes in demographics and socio-economics (Wu et al. 2017; Le Vine & Polak 2014; Le Vine et al. 2014b; Berrington & Mikolai 2014), geographic shifts (Le Vine & Jones 2012) and attitudes (Wu et al. 2017; Kroesen & Handy 2015; Levine & Jones 2014). Current evidence suggests that increased use of technology is a complement to travel for young people, rather than a factor for the decrease in car use (Le Vine et. al 2014b; Delbosc & Currie 2015; Kroesen & Handy 2015). The largest gap in evidence related to young people's car use is in quantifying the relative impacts of these influences.
- There is strong agreement with the 2014 Review that since the 1990s there have been substantial population increases in cities; that car ownership and car use are lower in urban areas relative to rural areas; and that young people are more likely to live in urban areas. Contrary to the previous review, recent research indicates that urbanisation has a significant effect in explaining car traffic levels (based on work undertaken by Stapleton et al. 2017 in Britain).
- There is high agreement on a number of demographic changes. First, like the 2014 Review, the current study finds evidence that the population is ageing, leading to lower levels of car travel, although older people are travelling more than their predecessors. Second, that car mileage levels are still declining for men under 60 years of age, but they have stabilised for women under 60 years of age. But there is still a substantial gap in car mileage levels between men and women. Third, differences in travel behaviour by international migrants and ethnic minorities persist – whereby these groups travel much less by car – and may continue to have a substantial impact on expected car mileage levels.
- A substantial piece of work by DfT (2016) has been undertaken on commuting patterns, which shows that the number of commute journeys has been declining, although this conclusion is influenced substantially by the treatment of trip-chained trips in the analysis – that is, more complex commute journeys with stops e.g. dropping a child off at school on the work journey or stopping at a shop on the way home – that have not been counted as commute journeys. However, it is also observed that workers are commuting fewer days to work, that increasing numbers of people are working from home, as well as more structural employment changes like growth in the number of workers who do not have a fixed usual workplace (and hence who are not categorised as commuters), an increase in the number of people who are not observed to travel to work in the NTS work diary week, as well as increases in part-time and self-employment. Employment patterns are likely to continue to be important in explaining car traffic levels.
- The evidence on telecommuting suggests that the amount of telecommuting is increasing, but that this is limited to certain occupations. The impact of telecommuting on trip lengths is not clear.
- Recent evidence suggests that ICT is a complement, rather than a substitute, to travel, but the evidence base is small.
- Key changes to the taxation structure for company cars have probably played out and therefore significant changes in company car ownership are unlikely. As noted by Headicar and Stokes (2016) 'company car

ownership has been and remains a male dominated activity' and 'no more than 2 per cent of women of working age had access to a company car'.

- It appears that there have been some mode substitution effects over the last 15-20 years, but it is not clear to what extent these are driven by changes in population and employment location and structure and changes in the use of company cars. Little evidence has been identified looking at the impacts of new modes, e.g. car sharing, on car travel.
- There is very little evidence in the papers reviewed for this study on how network supply effects, for example through congestion, have influenced road travel trends.
- We found little evidence on the impact of attitudinal changes towards car travel and car mileage patterns.
- We also find little evidence of car usage saturation effects, except perhaps for those with the highest incomes (Bastian et al. 2016; Grimmal et al. 2013).
- Van mileage is growing more strongly than car mileage. While there is recent evidence on the overall van levels (from vehicle licencing statistics) and qualitative insight into the drivers of recent growth, there is little recent quantitative evidence on the details of the van market.
- Whilst historically there has been a close relationship between GDP and HGV demand, recently that relationship appears to have weakened.
- However, interrelationships between influencing factors are not taken into account

4.1.2. In general, substantial evidence is emerging on variations in travel behaviour across different segments of the travelling population; however, very little analysis identified in the review has considered the impacts of all influences – for example, age, gender, location, car ownership and immigration status – simultaneously. Without such analysis there is a risk of overstating the impact of individual factors.

4.1.3. The impact of immigration is a good example. The work of Headicar and Stokes (2016) notes that some of these differences are attributable to the concentration of migrants and non-white UK-born people living in large cities, where the need for a car is less (noting that half of all non-white people and a third of all white people born outside the UK live in London). However, no analysis is undertaken to quantify the influence of immigration over and above other characteristics. Without considering location it is possible that the impact of immigration on travel may be overstated. Moreover, it is likely that international migrants are younger and poorer than the overall population on average, as well as being more likely to live in dense urban areas. Further, the evidence from this review indicates that each of these three factors substantially impacts to reduce car ownership rates and car travel.

4.1.4. Similar analysis is required to understand the interrelationships in factors influencing the travel of young people, where they too may be more likely to live in urban centres, have less wealth and better access to public transport. Without analysis taking account of these interrelationships it is difficult to disentangle the impact of each effect for different segments of the travelling population. We therefore do not yet have conclusive evidence on whether the changes in young people's travel are due to economic, demographic, technology or attitudinal changes.

4.2 FURTHER CAVEATS

4.2.1. This study reviews 24 papers published after 2012 that were identified by contacting researchers who are currently working in the area, and through a systematic literature search. For consistency with the 2014 Review and because of timescale and budget limitations, the search terms used in the systematic search were defined to pick up papers discussing car traffic trends more generally, rather than focussing on specific areas of interest, for example telecommuting. It is possible that we have therefore missed papers on specific topics of interest, particularly telecommuting, ICT and employment structures on car travel and influences on freight travel. This risk is mitigated by the two-pronged approach that was used to identify relevant research – specifically by contacting a range of experts, particularly focussed on UK experts – and through discussion with our experts of both the papers identified for review and the findings themselves. Nonetheless, it may be valuable to undertake further work with more targeted searches for (international) literature in key areas of interest.

4.3 EVIDENCE GAPS AND FURTHER RESEARCH

4.3.1. The most important overall insight from this review of studies is that any formal analysis of the determinants of travel trends needs to be very comprehensive in the range of explanatory variables that are **explicitly and simultaneously** considered within its quantitative analysis. The methodology would need to take full account of the potential inter-correlations between such explanatory factors and to consider certain factors (such as car-ownership) as intermediate endogenous influences, rather than as exogenous external influences. Moreover, appropriate spatial segmentation is needed to capture the difference in incidences and location trends of person types, as well as all potential differences in the supply and demand trends across different area types. A simple

split into: London/other urban/rural is unlikely to be sufficient. We emphasise that the reliability of findings based on working with only a subset of the relevant influences may be questionable. These requirements suggest that newer tools, such as Structural Equation Models (SEM) and related methods, are likely to be needed in order to handle the high levels of correlation among the potential exogenous explanatory variables.

4.3.2. Below, we set out, in no particular order, other important gaps in the evidence base reviewed for this study.

1. There would be benefit to taking a more detailed approach in a cross-cutting fashion to examine the influence of area-type. A significant proportion of all of the influences (listed in Table 1.1) will have incidences or contexts that differ between area-types, including: parking costs and availability; income profiles; income net of housing costs; population age profiles; proportion of immigrants; rate of part-time working; availability of modal substitutes; and many more. Analyses that examine these influences individually or in groups, but without adopting a suitable segmentation by area type, are unlikely to be able to draw reliable conclusions on the true relative importance of each individual influence. In particular there needs to be a suitable distinction throughout between: influences and trends (including population and employment growth trends) in dense urban (inner city) areas; as opposed to in lower density suburban or smaller urban areas; or in rural areas. A simple urban/rural split is not adequate.
2. Whilst there has been work on the impact of employment on commuting travel, more work should be undertaken to understand better telecommuting trends, including on the frequency of telecommuting, and how this varies by job types, across geographical areas and the quality of information and communication technology, as well as the impact of telecommuting on commute trip lengths.
3. Recent evidence suggests that ICT may be a complement, rather than a substitute, to travel, but the evidence base is small. There is a substantial gap in evidence on this important topic. As noted above, there may be more international literature on this topic that may be picked up with a more targeted literature review.
4. There is still little (quantitative) evidence on the impact of different costs, including the cost of insurance, learning to drive, operating costs, parking costs, etc. on the decision of young people to get a driving licence.
5. There is little evidence on the impact of mode substitution effects on car mileage and specifically the impacts of new modes or services, e.g. car sharing, on car travel. It will be important that surveys that collect travel diary data be expanded to pick up travel by these new services to allow future tracking of their influence.
6. There is little evidence on how network supply effects, for example through congestion, have influenced road travel trends. Analysis of supply effects would benefit from explicit consideration of the very different congestion circumstances encountered across the range between dense urban areas, where there are many competitive substitutes for car, through to rural areas where substitutes are few. Without explicitly considering these different spatial contexts the low levels found in aggregate national-level responses may be masking contrasting strong responses in specific area types that balance out in aggregate at present. For example, mode substitution, supply effects due to congestion and lack of parking spaces will each act to force down car growth in dense urban areas, but this reduction would be off-set by rapid growth in rural areas in which these influences are largely irrelevant. Such influences need to be analysed within the contexts where they are relevant and have reasonably homogeneous impacts and not just averaged with other areas of little relevance.
7. There is little evidence of car usage saturation effects, except perhaps for those with the highest incomes.
8. There is a need to understand better how attitudes to car travel are changing and how these impact car ownership and use.
9. Given that van mileage is growing more strongly than car mileage, there is a need to collect more up-to-date data describing the characteristics of the van market.
10. Further, more research is required on influences affecting HGV demand.

4.3.3. Additionally, we emphasise the valuable work provided by Bastian et al. (2016), Stapleton et al. (2017) and Grimal et al. (2013) undertaken since the 2014 Review quantifying the importance of traditional economic and location effects on travel demand. Given the importance in understanding how traditional factors may influence demand we would recommend continued work exploring the extent to which these factors are able to quantify on-going changes in car travel demand and road travel demand more generally (including vans, LGVs and HGVs). However, we note that all of this work has been undertaken using aggregate data, which has limitations. We would therefore also recommend that similar work be undertaken to go back and explore whether disaggregate models are able to replicate the effects of known changes in exogenous variables, both for the total travel market as for different travel segments.

Appendix A

REFERENCES

REFERENCES

Aparicio, Angel. 2016. "Exploring Recent Long-distance Passenger Travel Trends in Europe." *Transportation Research Procedia* 14: pp.3199-3208.

Allen, Julian, Maja Piecyk and Marzena Piotrowska. 2016. "*An Analysis of Road Freight in London and Britain: Traffic, Activity and Sustainability*." University of Westminster.

Ball, S. D., P. Emmerson, J. Anable, S. Cairns, R. E. Wilson and T. Chatterton. 2016. "*Understanding Variation in Car Use: Exploration of Statistical Metrics at Differing Spatial Scales Using Data from Every Private Car Registered in Great Britain*." Transport Research Laboratory.

Bastian, Anne, Maria Börjesson, and Jonas Eliasson. 2016. "Explaining "peak car" with economic variables." *Transportation Research Part A: Policy and Practice* 88:pp 236-250.

Berrington, Ann and Julia Mikolai. 2014. "*Young Adults' License Holding and Driving Behaviour in the UK Full Findings*." RAC Foundation.

Braithwaite, Alan. 2017. "*The Implications of Internet Shopping Growth on the Van Fleet and Traffic Activity*." RAC Foundation.

Chattergee, K., P. Goodwin, T. Schwanen, B. Clark, J. Jain, S. Melia, J. Middleton, A. Plyushteva, M. Ricci, G. Santos and G. Stokes. 2018. Young People's Travel – What's Changed and Why? Review and Analysis, The Centre for Transport & Society, UWE Bristol and Transport Studies Unit, Oxford. As of 16 March, 2018: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/673176/young-peoples-travel-whats-changed.pdf

Circella, Giovanni, Kate Tiedeman, Susan Handy, Farzad Alemi and Patricia Mokhtarian. 2016. "*What Affects U.S. Passenger Travel? Current Trends and Future Perspectives*." National Center for Sustainable Transportation, University of California, Davis.

Clarke, Johnson, Nankivell and Turpin. 2014. "*Van Travel Trends in Great Britain*." RAC Foundation.

Delbosc, A. and G. Currie. 2015. "Does Information and Communication Technology Complement or Replace Social Travel." *Transportation Research Record: Journal of the Transportation Research Board (2531)*: pp.76-82.

Department for Transport (DfT). 2015. "*Understanding the drivers of road travel: current trends in and factors behind roads use*." Department for Transport. As of 22 December, 2017: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/395722/understanding-the-drivers-road_travel.pdf

DfT. 2016. "*Commuting trends in England: 1988-2014*." Department for Transport.

Engström, Rikard. 2016. "The Roads' Role in the Freight Transport System." *Transportation Research Procedia* 14: pp.1443-1452.

Focas, Caralampo and Panayotis Christidis. 2017. "Peak Car in Europe?". *Transportation Research Procedia* 25: pp.531-550.

Garceau, Timothy J., Carol Atkinson-Palombo, and Norman Garrick. 2014. "Peak Travel and the Decoupling of Vehicle Travel from the Economy: A Synthesis of the Literature." *Transportation Research Record: Journal of the Transportation Research Board* (2412): pp.41-48.

Goodwin, P., J. Dargay and M. Hanly. 2004. Elasticities of road traffic and fuel consumption with respect to price and income: a review. *Transport Reviews* 24: pp.275-292.

Grimal, Richard, Roger Collet, and Jean-Loup Madre. 2013. "Is the Stagnation of Individual Car Travel a General Phenomenon in France? A Time-Series Analysis by Zone of Residence and Standard of Living." *Transport Reviews* 33 (3):pp 291-309.

Headicar, Peter. 2013. "The Changing Spatial Distribution of the Population in England: Its Nature and Significance for 'Peak Car'." *Transport Reviews* 33 (3): pp.310-324.

Headicar, P. and G. Stokes. 2016. "*On the Move 2: Making Sense of Travel Trends in England: 1995-2014*." Research on behalf of the Independent Travel Commission.

Klein, Nicholas J., and Michael J. Smart. 2017. "Millennials and car ownership: Less money, fewer cars." *Transport Policy* 53: pp.20-29.

Kroesen, Maarten, and Susan L. Handy. 2015. "Is the Rise of the E-Society Responsible for the Decline in Car Use by Young Adults? Results from the Netherlands." *Transportation Research Record: Journal of the Transportation Research Board* (2496): pp.28–35.

Le Vine, S., & P. Jones. 2012. *On the Move: Making Sense of Car and Train Travel Trends in Britain*. RAC Foundation.

Le Vine, S., P. Jones & J. Polak. 2013. 'The Contribution of Benefit-in-Kind Taxation Policy in Britain to the "Peak Car" Phenomenon.' Transport Reviews 33 (5): pp.526–547.

Le Vine, Scott and John Polak. 2014. "Factors Associated with Young Adults Delaying and Forgoing Driving Licenses: Results from Britain." *Traffic Injury Prevention*, 15:8: pp.794-800.

Le Vine, Scott, Peter Jones, Martin Lee-Gosselin and John Polak. 2014a. "Is Heightened Environmental Sensitivity Responsible for Drop in Young Adults' Rates of Driver's License Acquisition?" *Transportation Research Record: Journal of the Transportation Research Board* (2465): pp.73–78.

Le Vine, Scott, Charilaos Latinopoulos, and John Polak. 2014b. "What is the relationship between online activity and driving-license-holding amongst young adults?" *Transportation* (41): pp.1071–1098.

Le Vine, Scott, Charilaos Latinopoulos, and John Polak. 2014c. "Establishing the Links Between Online Activity and Car Use: Evidence from a Combined Travel Diary and Online-Activity Pseudodiary Data Set." *Transportation Research Record: Journal of the Transportation Research Board* (2405): pp.68–77.

McDonald, Noreen, Giulio Mattioli and Greg Marsden. 2017. "Understanding the Impact of the Changing Labour Market on Millennial Mobility: A Study of UK Experience." *Transportation Research Record: Journal of the Transportation Research Board.*

Mokhtarian, P. 2002. "Telecommunications and Travel: The Case for Complementarity." *Industrial Ecology*, Vol. 6, No. 2, 2002, pp.43–57. As of 10 January, 2018, available at: http://onlinelibrary.wiley.com/doi/10.1162/108819802763471771/abstract

Nordbakke, Susanne, Fridulv Sagberg, and Fredrik Gregersen. 2016. The end of passion? Changes in driving license rate and driving rate among young people. In *Slutt på lidenskapen? Endringer i førerkortandel og bilbruk blant ungdom*: Institute of Transport Economics (TØI)

Piecyk, Maja and Alan McKinnon. 2013. "*SRF Roadmap – Part 1: Road Freight Transport in the UK*." Heriot Watt University and the University of Cambridge.

Rohr, C. and J. Fox. 2014. *Evidence review of car traffic levels in Britain: A rapid evidence assessment*, Santa Monica, Calif.: RAND Corporation, RR-887-DFT. As of 20/01/2015: http://www.rand.org/pubs/research_reports/RR887.html

Stapleton, Lee, Steve Sorrell, and Tim Schwanen. 2017. "Peak car and increasing rebound: A closer look at car travel trends in Great Britain." *Transportation Research Part D: Transport and Environment* 53: pp.217-233.

Streit, T, C.E. Allier, C. Weiss, B. Chlond and P. Vortisch. 2015. "Changes in Variability and Flexibility of Individual Travel in Germany: Trends and Drivers." *Transportation Research Record: Journal of the Transportation Research Board (2496): pp.10-19.*

White, P., G. Christodoulou, R. Mackett, H. Titheridge, R. Thoreau & J. Polak. 2007. 'The Role of Teleworking in Britain: Its Implications for the Transport System and Economic Evaluation. ' European Transport Conference, The Netherlands.

Williams, I. & Y. Jin. 2013. 'The Impacts of Urban Densification of Transport.' Slide presentation, European Transport Conference, Frankfurt.

Wu, Guoqiang, Jinhyun Hong and Piyushimita Vonu Thakuriah, 2017. "The Role of the Internet in Shaping Young Adults' Attitude, Travel Choices and Sustainable Lifestyles: A Longitudinal Perspective." Presented at the 96th Annual Meeting of the Transportation Research Board, January 8-12, 2017.

Appendix B

SEARCH PROTOCOL

SEARCH PROTOCOL

For this study it was agreed that we would use a similar search strategy to that used in the previous 2014 study. In that study we focussed on evidence published between 1995 and 2013; in the current study we focus on studies published after that time. To ensure that we didn't miss any articles published in 2013 we focussed on studies published from 2012. It is noteworthy that the 2014 study focussed on studies undertaken in the UK and studies focussed on passenger car demand; for the current study we agreed to extend the search criteria to countries similar to the UK and to incorporate freight studies.

SEARCH STRATEGIES TESTED

We tested two different search strategies: one repeating the search undertaken in 2013-2014 (with some minor amendments) and one incorporating more terms to pick up studies looking at freight demand.

SEARCH STRATEGY 1

Original search terms

Peak car OR peak travel OR travel trends OR traffic trends OR traffic drivers OR car use OR car reduction OR reduction car OR car travel OR decreases* car OR vehicle miles travelled OR annual distance travelled OR car dependency OR car travel behaviour OR car travel behaviour

Original tests

In the previous study we ran three tests (shown below). Ultimately, we used the file generated with option 1, without any further filtering:

Original Option 1: Search 1 terms only

Original Option 2: Search 1 terms and 'automobiles' as a subject/controlled vocabulary term

Original Option 3: Search 1 terms plus additional (AND) terms: automobile travel OR automobile demand OR car travel OR car demand OR automobile ownership OR car ownership

In the previous study, the option 1 search strategy generated 2,802 articles, of which 236 were on freight.

Further tests

Given the changes in car traffic trends, we recommended that we test the original search terms, with no further filtering, i.e. Original Option 1, plus to add a term to pick up traffic growth, i.e.:

New Option 1: Search 1 terms plus OR traffic growth

Also, given the increased interest in international literature, it would be useful to test what happens if we also include synonyms for car, i.e. automobile or auto.

New Option 2: Search 1 terms, plus synonyms for car, i.e. automobile or auto

SEARCH STRATEGY 2

Search strategy 1 (as agreed from tests), plus additional terms to pick up freight travel, i.e.:

PLUS

OR ((freight OR lorry OR truck OR commercial traffic OR goods vehicle* OR van* OR light duty vehicle*) AND trend*)

OR ((freight OR lorry OR truck OR commercial traffic OR goods vehicle* OR van* OR light duty vehicle*) AND demand*)

INCLUSION CRITERIA AND DATABASES

The inclusion criteria for papers are summarised in the following table.

Inclusion criteria

Criterion	Value
Published in or after year	2012
Language	English only
Location of study	UK, Europe, OECD
Type of publication	Journal article, conference abstract/paper, PhD thesis, high quality agency report
Study type	Quantitative empirical analyses, preferably with comparator, modelling studies
Scope	Car travel on the strategic road network, Road freight transport

DATABASES

Academic (subscription) databases	TRID

FINDINGS

Rerunning the original search terms generated 1,224 relevant citations published since 2012, and including the term 'traffic growth' (New Option 1) increased the number of relevant citations to 1,335. Allowing automobile and auto synonyms increased the number of relevant citations to 22,961, which was judged to be far too many papers to review in the timescales and budget. Adding in the freight terms (filtered for passenger or freight transportation) also increased the number of citations to an unmanageable number (12,263). It was noted that the original search terms generated a number of freight studies in the original study (and that these were dropped because the focus originally was on passenger traffic). We therefore expected to find freight studies with the original search terms.

We compared the citations identified from the systematic search against the papers and reports provided by experts who were contacted independent of the systematic search. The search found only 4 of the 11 papers provided by experts. Looking at the papers it is judged that this is because many of the papers are focussed on specific factors influencing travel trends and not travel trends explicitly (the search terms were defined to identify papers focussed on explaining travel trends).

No.	Paper	Found in search?
1	David Metz (2013) Peak Car and Beyond: The Fourth Era of Travel, Transport Reviews: A Transnational Transdisciplinary Journal, 33:3, 255-270, DOI: 10.1080/01441647.2013.800615	Yes
2	Le Vine, S., Jones, P.M., and Polak, J.W. (2013) 'The contribution of benefit-in-kind taxation policy in Britain to the 'Peak Car' phenomenon' Transport Reviews 33(5) 1-22.	Yes
3	Le Vine S and Polak J.W. (2014) 'Factors associated with young adults delaying and forgoing driving licenses: Results from Britain' Traffic Injury Prevention 15(3) 794-800.	
4	Le Vine, S., Jones, P.M., Lee-Gosselin, M. and Polak, J.W. (2014) 'Is heightened environmental sensitivity responsible for the drop in young adults rates of driving license acquisition? ' Transportation Research Record. 2465 73-78.	
5	Le Vine, S., Chen, B. and Polak, J.W. (2014) 'Does the income elasticity of road traffic depend on the source of income?' Transportation Research A 67(4) 15-29.	
6	Le Vine, S., Latinopoulos, C. and Polak, J.W. (2014) 'What is the relationship between online activity and driving-license-holding amongst young adults?' Transportation 41(5) 1071-1098.Le Vine, S., Latinopoulos, C. and Polak,	

7	J.W. (2014) 'Establishing the linkages between online activity and car use: Evidence from combined travel diary and online-activity pseudo-diary data set ' Transportation Research Record 2405 68-77.	Yes
8	Le Vine, S., Latinopoulos, C. and Polak, J.W. (2014) 'What is the relationship between online activity and driving-license-holding amongst young adults?' Transportation 41(5) 1071-1098.	
9	Le Vine, S., Latinopoulos, C. and Polak, J.W. (2014) 'Establishing the linkages between online activity and car use: Evidence from combined travel diary and online-activity pseudo-diary data set ' Transportation Research Record 2405 68-77.	
10	Le Vine, S., Latinopoulos, C. and Polak, J.W. (2016) 'Analysis of the relationship between internet usage and allocation of time for personal travel and out of home activities: Case study of Scotland in 2005/6', Travel Behaviour and Society 4 49-59.	
11	Stokes, G. (2013) The Prospects for Future Levels of Car Access and Use, Transport Reviews.	Yes

On the basis of the finding from the different search strategies we recommended that we retain the original search terms, with the addition of 'traffic growth', which provides 1,298 relevant citations for review.

DEVELOPING THE LONGLIST AND SHORTLIST OF PAPERS TO BE REVIEWED

The 1,298 relevant citations were reviewed by a senior researcher who identified a longlist of 114 papers, including the papers, articles and reports provided by experts. Three senior members of the team went through the list scoring them as either highly relevant (green), relevant (amber) or not relevant (red), based on their relevance in terms of providing evidence on traffic trends for Britain and the strategic road network, more specifically. Papers that focussed on evidence on road travel trends in urban areas were judged as being less relevant, given the required focus on the SRN. A further consideration was to ensure that the recommended papers covered the range of different factors that could influence road traffic trends, both for car travel and freight.

On the basis of this assessment 25 papers were recommended for review to the DfT (see list below, paper numbers 1-25). Ten of the 25 papers covered factors influencing young people. The DfT requested that we drop one of the papers on young people to include a paper on another topic to provide a somewhat better distribution across the topics of interest. Examination of the papers indicated that all were published since 2014 and six of the ten were based on research from the UK. The papers dealt with a range of issues around potential influences around changes in young people's travel, including economic and demographic changes, the use of information and communication technologies (ICT) and attitudinal changes. Further examination of the papers indicated that the Nordbakke et al. (2016) paper was not written in English and therefore this paper was dropped, reducing the number of papers on young people's travel by one. Also, the Circella et al. (2016) paper was picked up twice, with two different titles. It was therefore only counted once. Further, the review of the Engstrom (2016) paper indicated that it did not contain relevant information on freight trends. This left very few papers on freight. At the workshop two further papers were recommended by project experts (no 25 and 26), bringing the number of papers reviewed to 24.

Paper No.*	Paper information	Topic	Country
1 (2)	Wu, Guoqiang, Jinhyun Hong and Piyushimita Vonu Thakuriah. 2017. "The Role of the Internet in Shaping Young Adults' Attitude, Travel Choices and Sustainable Lifestyles: A Longitudinal Perspective." Presented at the 96th Annual Meeting of the Transportation Research Board, January 8-12, 2017.	Young people	UK
2 (4)	Stapleton, Lee, Steve Sorrell, and Tim Schwanen. 2017. "Peak car and increasing rebound: A closer look at car travel trends in Great Britain." *Transportation Research Part D: Transport and Environment* 53:pp 217-233.	General Trends/ drivers	UK
3 (5)	McDonald, Noreen, Giulio Mattioli and Greg Marsden. 2017. "Understanding the Impact of the Changing Labour Market on Millennial Mobility: A Study of UK Experience." *Transportation Research Record: Journal of the Transportation Research Board.*	Young people	UK

4 (9)	Klein, Nicholas J. and Michael J. Smart. 2017. "Millennials and car ownership: Less money, fewer cars." *Transport Policy* 53:pp 20-29.	Young people	USA
5 (10)	Focas, Caralampo and Panayotis Christidis. 2017. "Peak Car in Europe?". *Transportation Research Procedia* 25: pp 531–550.	General Trends/ drivers	Europe
6 (13)	Nordbakke, Susanne, Fridulv Sagberg, and Fredrik Gregersen. 2016. The end of passion? Changes in driving license rate and driving rate among young people. In *Slutt på lidenskapen? Endringer i førerkortandel og bilbruk blant ungdom*: Institute of Transport Economics (TØI)	Young people	Europe
7 (17)	Engström, Rikard. 2016. "The Roads' Role in the Freight Transport System." *Transportation Research Procedia* 14: pp 1443-1452.	Vans/ freight	Europe
8 (18)	Circella, Giovanni, Kate Tiedeman, Susan Handy, Farzad Alemi and Patricia Mokhtarian. 2016. "What Affects U.S. Passenger Travel? Current Trends and Future Perspectives." National Center for Sustainable Transportation, University of California, Davis.	General Trends/ drivers	USA
9 (19)	Bastian, Anne, Maria Börjesson, and Jonas Eliasson. 2016. "Explaining "peak car" with economic variables." *Transportation Research Part A: Policy and Practice* 88:pp 236-250.	General Trends/ drivers	Europe
10 (20)	Ball, S. D., P. Emmerson, J. Anable, S. Cairns, R. E. Wilson and T. Chatterton. 2016. "Understanding Variation in Car Use: Exploration of Statistical Metrics at Differing Spatial Scales Using Data from Every Private Car Registered in Great Britain." Transport Research Laboratory.	General Trends/ drivers	UK
11 (21)	Aparicio, Angel. 2016. "Exploring Recent Long-distance Passenger Travel Trends in Europe." *Transportation Research Procedia* 14: pp 3199-3208.	Long-distance travel	Europe
12 (28)	Kroesen, Maarten and Susan L. Handy. 2015. "Is the Rise of the E-Society Responsible for the Decline in Car Use by Young Adults? Results from the Netherlands." *Transportation Research Record: Journal of the Transportation Research Board* (2496):pp 28–35.	Young people	Europe
13 (42)	Le Vine, Scott, Charilaos Latinopoulos, and John Polak. 2014. "Establishing the Links Between Online Activity and Car Use: Evidence from a Combined Travel Diary and Online-Activity Pseudodiary Data Set." *Transportation Research Record: Journal of the Transportation Research Board* (2405):pp 68–77.	Online activity	UK
14 (43)	Garceau, Timothy J., Carol Atkinson-Palombo, and Norman Garrick. 2014. "Peak Travel and the Decoupling of Vehicle Travel from the Economy: A Synthesis of the Literature." *Transportation Research Record: Journal of the Transportation Research Board* (2412):pp 41–48.	General Trends/ drivers	USA
15 (59)	Grimal, Richard, Roger Collet, and Jean-Loup Madre. 2013. "Is the Stagnation of Individual Car Travel a General Phenomenon in France? A Time-Series Analysis by Zone of Residence and Standard of Living." *Transport Reviews* 33 (3):pp 291-309.	General Trends/ drivers	Europe
16 (94)	Delbosc, A. and G. Currie. 2015. "Does Information and Communication Technology Complement or Replace Social Travel." *Transportation Research Record: Journal of the Transportation Research Board (2531): pp 76-82.*	Young people	Other
17 (99)	Streit, T, C.E. Allier, C. Weiss, B. Chlond and P. Vortisch. 2015. "Changes in Variability and Flexibility of Individual Travel in Germany: Trends and Drivers." *Transportation Research Record: Journal of the Transportation Research Board (2496): pp 10-19.*	Online activity	Europe
18 (100)	Le Vine, Scott and John Polak. 2014. "Factors Associated with Young Adults Delaying and Forgoing Driving Licenses: Results from Britain." *Traffic Injury Prevention*, 15:8, pp 794-800.	Young people	UK

19 (101)	Le Vine, Scott, Peter Jones, Martin Lee-Gosselin and John Polak. 2014. "Is Heightened Environmental Sensitivity Responsible for Drop in Young Adults' Rates of Driver's License Acquisition?" *Transportation Research Record: Journal of the Transportation Research Board* (2465): pp. 73–78.	Young people	UK
20 (103)	Le Vine, Scott, Charilaos Latinopoulos, and John Polak. 2014. " What is the relationship between online activity and driving-license-holding amongst young adults?" Transportation (41): pp:1071–1098.	Young people	UK
21 (106)	Braithwaite, Alan. 2017. "The Implications of Internet Shopping Growth on the Van Fleet and Traffic Activity." RAC Foundation.	Vans	UK
22 (107)	Clarke, Johnson, Nankivell and Turpin. 2014. "Van Travel Trends in Great Britain." RAC Foundation.	Vans	UK
23 (112)	Headicar, P. and G. Stokes. 2016. "On the Move 2: Making Sense of Travel Trends in England: 1995-2014." Research on behalf of the Independent Travel Commission.	General Trends/ drivers	UK
24 (113)	Berrington, Ann and Julia Mikolai. 2014. "Young Adults' License Holding and Driving Behaviour in the UK Full Findings." RAC Foundation.	Young people	UK
25	Allen, Julian, Maja Piecyk and Marzena Piotrowska. 2016. "An Analysis of Road Freight in London and Britain: Traffic, Activity and Sustainability." University of Westminster.	Freight	UK
26	Piecyk, Maja and Alan McKinnon. 2013. "SRF Roadmap – Part 1: Road Freight Transport in the UK." Heriot Watt University and the University of Cambridge.	Freight	UK

* Papers are not numbered in any particular order and the number in brackets reflects the paper number from the longlist of papers. Papers highlighted in green were dropped from the review for reasons set out above.

4.3.4. In addition, the DfT publication "Commuting trends in England: 1988-2014" was reviewed (Le Vine et al. 2017).

The Victoria
150-182 The Quays
Salford, Manchester
M50 3SP

wsp.com