# Scoping Study on future trends in passenger rail demand

**Final report to RSSB**

—

17 July 2017

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# Executive summary

# Executive summary

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## Introduction

This Scoping Study was undertaken by KPMG on behalf of the Rail Safety and Standards Board. The purpose of the Scoping Study was to:

— Review the range of market trends and disruptors [1] that have the potential to drive passenger rail demand over the short and longer term.

— Identify the market segments which are likely to be most affected by the most material market trends and disruptors.

— Examine potential data sources that could be used to explore the relationship between market trends and disruptors and rail demand by market segment.

The Scoping Study concludes by recommending a programme of work to explore the most important of these items in greater detail.

## Context

The rail sector in Great Britain has a long and well established tradition of forecasting the demand for rail services. The approach is based on evidence derived from econometric analysis of ticket sales data supported by bespoke market research. The evidence has evolved over time and is assembled in the industry's Passenger Demand Forecasting Handbook.

The approach has many advantages, not least on its use of detailed historical ticket sales data. There are however some well-documented shortcomings including the use of only a relatively limited set of explanatory variables and a relatively constrained approach to market segmentation.

Analysis of recent sales data shows a decline in the rate of growth in ticket sales but there are large variations across flows, reflecting variations local conditions. There are concerns across different parts of the rail sector that the factors responsible for driving changes in rail demand are not always well understood and that there is scope to take a fresh look at the evidence.

## Approach

The rail sector relies on good demand forecasts to support long term infrastructure decisions, medium term franchise investments and shorter term operations planning. Identifying opportunities for growth and exposure to risks of market contraction needs to take account of a complex set of factors influencing both demand and supply.

The rail network is operating at or close to capacity in many areas which introduces additional complexity to the forecasting challenge on top of the economic, social and technological changes that are disrupting both transport and non-transport markets.

To that end, we have undertaken a desk-based review of the potential impacts of 50 market trends and disruptors on demand and supply, considering their impact on transport needs and choices over time. The focus of the analysis is on the medium to longer term.

The analysis is qualitative in nature, identifying how a broad range of trends and disruptors could influence demand and supply, including political, social, economic, demographic, legal, digital technological and environmental drivers.

The next phase of work will need to explore these trends and disruptors in more detail, developing hypothesis to be tested and reaching conclusions on the strength and empirical validity of the relationships.

[1] We define a market disruptor as an innovation that creates a new market and eventually disrupts or displaces an existing market.

# Executive summary (cont.)

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### Six themes for further investigation

Given the complexity and interaction between trends and disruptors it is difficult to consider each in isolation and therefore we think it is more appropriate to consider and group trends and disruptors in terms of their impact on market outcomes and in particular the potential impact on the overall demand for travel and customer choice between modes. We have identified six themes to reflect possible outcomes.

### Transport needs

The impact of trends and disruptors on transport needs are likely to be material through their influence on economic and social activity, demographics and alternatives to travel. Important themes include:

**Theme 1.** Changes to the structure of the economy and labour markets including rates of employment, flexible working, productivity and new business models. The outlook for the economy and the role of transport is fundamental to understanding transport demand. Big changes are happening to the structure of the economy and even more change is expected. These changes are influencing the nature of work and the location of production and consumption, and transport needs

**Theme 2.** Changes to demographic profiles including household structure, migration, car ownership, urbanisation and household location, as well as changes in social trends including dispersed personal networks[2], changes to income distribution, participation in higher and further education, changing societal attitudes and expectations. Big changes are also happening to the structure of the population and many of these changes will continue to evolve. It is no longer sufficient to simply consider the impact of population numbers on rail demand, we need greater market segmentation to reflect changing socio-demographics.

**Theme 3.** Alternatives to travel including virtualisation, remote working, online education and healthcare, online shopping, goods distribution and home delivery by light goods vehicles and drones. Alternatives to travel are getting better and are a more integrated and accepted as part or modern living. The relationship between online activity/ digitalisation and trip generation and suppression is not well understood with extant data only showing part of the behavioural dynamics.

### Transport choices

The impact of trends and disruptors on competition and choice are likely to be material through their impact on quality and price of alternative modes, integration between modes and government policy and legislation. Important themes include:

**Theme 4.** Anticipated change in connected and automated vehicles, and propulsion systems, together with changes in the quality of public transport including high speed rail and digital railways. Technology is advancing rapidly with the potential to significantly disrupt the transport market. The complexities of travel decisions, together with the introduction of new choices are not well dealt with under the demand forecasting framework currently used in the sector.

**Theme 5.** Integration between modes through new technology, new business models and personalisation. This includes trends towards smart ticketing and Mobility as a Service, as well as the potential for greater real-time planning and coordination across modes of transport. Digitisation is already transforming transport and is set to continue. Enabled by digitisation, new business models are slowly shaping social attitudes and preferences.

**Theme 6.** Outlook for government policy, regulation, licensing and demand management. The introduction of new ways to pay for highways and changes to vehicle licencing, insurance, ownership and taxation are critical to the overall appeal of connected and autonomous vehicles. Although change is inevitable, government policy and regulation can influence and incentivise market efficiency and equity.

[2] Greater dispersal of personal networks arising from increased levels of residential migration between local authorities and regions within the UK.

# Executive summary (cont.)

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### Market segmentation considerations

Traditional analysis of rail revenue employs relatively crude segmentation by ticket type (full, season, reduced) mapped to journey purpose (business, commute, other). This has advantages in terms of its simplicity but the mapping is relatively crude and the segmentation lacks the flexibility to explore behavioural motivations and product innovation.

In reality, the railways serve a diverse customer base, travelling between diverse origins and destinations for diverse reasons at different times. This picture is complicated by the fact that individual customers often belong to multiple market segments with different transport requirements for different journeys and that the sector is characterised by significant levels of market churn as customers enter and exit the market.

The relative lack of sophistication in market segmentation constrains the sector's ability to accurately forecast trends. Improved market segmentation, taking account of changing customer tastes and preferences, offers the potential to avoid some of the systematic biases that are inevitably introduced with sub-optimal approaches to segmentation. It should be noted however that:

— Segmentation fit for one purpose may not be equally fit for another purpose. Clarity on the purpose of segmentation will be important.

— Segmentation needs to evolve as new segments emerge (eg. part-time commuters) and other fade (eg. young people with access to cars). Segmentation is therefore dynamic rather than static.

— Segmentation brings added complexity to the forecasting process, especially in the longer term which may require additional forecasting how segments will evolve. Segmentation has costs as well as benefits.

Whilst it is possible to think about segmentation in abstract in terms of geography, socio-demographics, journey purpose, journey type, lifestyles and behaviours, for example, the practicalities and statistical rigour associated with data analysis will determine what is achievable.

The impact of trends and disruptors on the propensity to travel by rail by different market segments has always been diverse and varied, but recent socio-economic trends such as flexible working and increased digitalisation are contributing further to the emergence of new travel behaviours.

Our review of available evidence has shown that economic characteristics such as employment status and sector as well as demographic factors such as age are associated with different patterns of travel behaviour. When developing a picture of demand it is therefore likely that we will need:

— More segmentation to reflect different needs and choices between people and personas (individuals with different behaviours at different times).

— More geographical detail to reflect local differences and the increased availability in geo-referenced data.

Important dimensions for segmentation are likely to include:

— Structure and location of economic activity and employment, including sectors and skills.

— Structure and location of households, including demographics, income distribution, life-stage and life-style.

— Flexibility to adopt alternatives to travel, including ability to work remotely.

— Attitudes to and take-up rates for new technology and business models.

— Attitudes to sharing / owning cars and other assets.

Importantly, market segmentation needs to account for differences between local environment reflecting quality and availability of services and also broader societal attitudes.  It is simply not sufficient just to consider how many people might be affected by a change, we also need to know who will be affected, where the are located and how they will be affected. This will require analysis of activities and choices at a very disaggregate level, arguably with hundreds if not thousands of segments - potentially at the level of individual customers.

# Executive summary (cont.)

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**Data considerations**

Much of the analysis supporting the PDFH framework is based on trend extrapolation at a relatively aggregate level and does not have the flexibility to consider individual decision-making processes and experiences. New approaches are required, for example, to:

— Segment customers

— Track individual customers over time

— Examine linked journeys and total travel requirements

— Explore clusters of similar behaviours and social norms

There is certainly scope to introduce more ‘choice-based’ and ‘activity-led’ approaches to modelling in the near term but there may also be opportunities to explore new data mining, machine learning and AI approaches.

There is no single source of data that will be suitable to meet the needs of the sector. Instead, data will need to be assembled from different sources to reflect the different influences on demand. The key here will be in the use of micro-data describing customer characteristics, attitudes and choices. The data will need to be geo-referenced to make sure that it describes local conditions and the actual choices people face.

Customer choices recording individual trips or groups of trips combined to form end-to-end journeys can be observed from travel diaries or passively via mobile location technologies. Publically available data on timetables, fares, road conditions, delays, congestion etc can be used to reconstruct the travel choices available for specific journeys to examine the sensitivities and trade-offs that are important to customers.

If this information can be combined with a better understanding of customer needs (ie. the activities they undertake) and their past experiences, a clearer and much richer picture of the factors driving demand will be able to be developed. This could be further enhanced by examining how individual tastes and preferences change over time and how they are influenced by reference groups and broader societal trends.

Whilst some insight can be achieved from reasoned argument and qualitative analysis, much of this is empirical. There is a need to develop clear hypothesis on travel behaviours and to test those hypothesis using accurate information about individual needs and choices in a holistic way.

Given the challenges on understanding transport needs and choices there are largely untapped data resources available to support new analysis, including ONS data, online travel information, mobile phone data and market research.

Among the most important of these is the National Travel Survey (NTS) carried out for the Office for National Statistics (ONS). The NTS includes very rich data on individual and household characteristics, their activities and transport choices. Whilst the recent work on Rail Demand Forecasting Estimation undertaken for the Department for Transport has made progress in this regard, much more could and should be done to explore the relationships between transport needs and economic and social activities, alternatives to travel and mode choices for multi-stage journeys.

One of main shortcomings of NTS data when looking at consumer choices is the lack of information on the prices and quality of the options available to individuals. In the past, analysts have tried to in-fill missing information with estimates based on more aggregate data and assumptions but the availability of online travel planning data means that more accurate data on the actual choices individuals face can be assembled.

A second shortcoming of NTS data is that it is based on household travel diaries with respondents completing diaries from memory. There is some evidence to suggest that some trips can be underreported. The availability of mobile phone location data offers potential to correct for potential bias, especially when coupled with ticket sales data. The use of mobile phone data is still in its infancy and has some well documented limitations including limitations in determining mode used, journey purpose and user characteristics.

Finally, it is important not to forget the role of market research in exploring attitudes to changing services and opportunities, potentially with greater innovation and use of mobile devices to present and capture questions and answers.

# Executive summary (cont.)



### Recommendations for further work

We have identified six themes for further analysis. The themes involve developing a better understanding of the need to travel and a better understanding of customer choices. The themes can be initially considered individually but will ultimately need to be considered together to examine the relative importance of each to rail demand. Recommendations for each theme are as follows, first looking at needs and then at choices. It is important to note that our recommendations focus on ‘what is needed’ and ‘why it is needed’ rather than the specifics on ‘how future work should be done’.

Changes to the structure of the **economy and labour markets** in particular will have implications for transport needs - driven not simply by the number of people in employment but the need for employees to travel to a fixed location on a regular basis. This will be influenced by the type of work and the role that the individual has within their employment. There are two aspects to understanding changes in rail demand in response to structural changes to the economy. Firstly, developing an economic activity-based appreciation of transport demand by industry sector and job type over time, and secondly, developing an understanding of how the structure of the economy could evolve under alternative future scenarios.

Changes to **socio-demographics** and societal trends are also like to have strong impacts on rail demand. It is no longer sufficient to simply consider the impact of population numbers on rail demand as we know that trip rates vary significantly between market segment and with market segment over time. Within the demographic theme, there are relatively well researched differences between older and younger people, those with high disposable incomes and those without them, those who live in build-up areas and those who don’t, as well as lifestyle and life-stage issues such the propensity to have a family, own a house and own a car.

As with the analysis of the economy and labour markets there are two aspects to understanding the impact of changing socio-demographics on rail demand. The first is to explore the relationship observed (eg. age, location) and unobserved (eg. values, attitudes, opinions and preferences) characteristics of individuals, their economic and social activities and their travel behaviour over time, and the second is to understand how demographic and social trends could evolve under alternative future scenarios.

**Alternatives to travel** are increasing, with greater acceptance of the benefits of remote working, virtualisation, the provision of online heath and education services, e-commerce in the form of online shopping and banking, as well as the rapid production and delivery of goods through 3D printing and efficient home delivery. Whilst data for some of the headline changes under this theme are available, the evidence on the relationship between specific demand drivers and rail demand is less well established. Increased acceptance and propensity to work remotely should arguably be considered as part of the review of economy and labour market structure. Other impacts such as the substitution of trips with online activities will likely need new market research to improve our understanding of the trade-offs that consumers consider although it is important to note that the NTS includes useful data in this regard.

Given the interplay between work and non-work activities, and the ability of households to substitute activities that involve personal travel for activities that do not involve personal travel there are advantages to taking a more holistic approach to assessing transport needs with reference to existing ONS data sets. New data will also likely be needed to help unpick the complexities associated with provision and take-up of online services and the efficient home/ remote delivery of goods.

# Executive summary (cont.)

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## Recommendations for further work (cont.)

There is scope to look more carefully at the actual travel choices that individuals face. Whilst there is a relatively well established body of evidence here, it is often partial in terms of its coverage and/ or based on anecdote or proxy data.

Instead we need to really understand the choices that individuals face. In the past this has relied on making use of travel diary or survey data for which data on travel alternatives is either (partially) self reported by the survey respondent or infilled by the analyst often using relatively crude assumptions.

With technology companies becoming increasingly sophisticated in providing detailed end-to-end journey times and costs by mode, this information could be combined with data on observed travel choices to build a better picture of the trade-offs that customers make.

There is an opportunity to take advantage of digitised travel information to reconstruct the transport choices that individuals face for specific end-to-end journeys at specific times that have either been recorded as part of travel surveys or are passively[3] collected by mobile location technologies.

The travel survey approach (such as use of the National Travel Survey) has advantages in that it also includes information about the individual (needed for market segmentation) and information on activities (needed to help understand travel flexibility). The mobile data approach has advantages in terms of scale.

Both approaches have clear advantages in looking at end-to-end journeys so that we can develop a better understanding of the impact that **journey complexity** has on choice, and both have advantages in the use of 'revealed preference' data for which the available choices can be enumerated and accurately described.

Given the relative strengths of each approach, there may be benefits to combining both under the same analytical framework. It is important to note however that the impact of emerging technologies, including the development of connected and autonomous vehicles, on rail demand clearly can not be observed and therefore market research methodologies will need to be used to further our understanding here.

The impact that changes to government **policy and regulations** could have on choices can be assessed via their impact on supply and largely viewed through the lens of price, quality and availability.

Given the interplay between modes, interactions between modes and government policy and regulation there is scope to look at these issues together by building a more holistic analysis of individuals transport choices over time. This analysis needs to be based on observed choices, in the context a detailed and accurate description of the travel alternatives that individuals face. This analysis should be structured to reflect the fact that individuals tastes and preferences vary over time and by location.

Ultimately the analysis of transport needs and transport choices should be considered together as part of wider consideration of household constraints and decision-making.

[3] Passive data collection is where customers have little awareness that data is being collected, they don't need to do anything. Active data collection on the other hand involves explicitly asking customers for information, preferences, and opinions.

# Executive summary (cont.)

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## Conclusions

Big changes are happening to the structure of the economy and the structure of society and even more changes are expected. Alternatives to travel are getting better and are a more accepted part of modern living. Technology is advancing rapidly with the potential to significantly disrupt the transport market. The impact of these trends and disruptors is likely already being felt in the rail sector yet there is very little known about the magnitude of their impacts.

Against this background, this Scoping Study has taken a fresh look at a range of factors that could influence rail demand, the market segments that could be affected, and the availability of data and research methodologies to help quantify the impacts. The Scoping Study has considered the potential impact of 50 trends and disruptors of rail demand and supply, grouping the impacts under six themes for further investigation. The themes cover transport needs and transport choices as follows:

| Transport needs | | | Transport choices | | |
|---|---|---|---|---|---|
| 1. Structure of the economy | 2. Socio-demographic factors | 3. Alternatives to travel | 4. Price, quality and availability of modes | 5. Integration between modes | 6. Policy and regulations |

Looking forward to the next phase of work it is important to bear in mind the following observations:

- The sector has a long tradition of evidence-based decision-making, largely based on the use of established research frameworks, developing hypothesis to be tested and reaching conclusions on the strength and statistical validity of the analysis. This approach has much to commend but there could also be benefits in exploring role of ‘new’ analytical methods, such as machine learning, especially for use in short term forecasting. Whichever approach is adopted it is important to have a clearly defined logic chain describing how rail demand could be influenced.
- The relative lack of sophistication in market segmentation constrains the sector’s ability to accurately forecast trends. Improved market segmentation based on needs and choices has the potential to improve forecasting but it is important to note that segments evolve over time and that segmentation fit for one purpose may not be equally fit for another purpose.  The choice of forecasting methodology is highly dependent on the forecasting purpose and time horizon. The further into the future that the forecasts are needed the more the forecasts will need to be based on economic and social structures relative to customer tastes and preferences.
- Finally, given the challenges on understanding transport needs and choices there are largely untapped data resources available to support new analysis. Arguably the most important of these is the National Travel Survey (NTS). Whilst data from mobile phones is getting better, there are still significant problems associated with its use for this type of work, not least with difficulties in identifying mode, journey purpose and characteristics of the customer.

A systematic exploration of the six themes that we have identified will take us a long way towards developing a better understanding of the short and longer term trends in rail demand.

# Section 1. Introduction

# Introduction

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## Introduction

This Scoping Study was undertaken by KPMG on behalf of the Rail Safety and Standards Board. The purpose of the Scoping Study was to:

— Review the range of market trends and disruptors[1] that have the potential to drive passenger rail demand over the short and longer term.

— Identify the market segments which are likely to be most affected by the most material market trends and disruptors.

— Examine potential data sources that could be used to explore the relationship between market trends and disruptors and rail demand by market segment.

The Scoping Study concludes by recommending a programme of work to explore the most important of these items in greater detail.

## Context

The context to the work, as noted in the Brief, is as follows:

> 'Planning for the future relies strongly on good predictions of future trends in rail usage. This in turn rests on a good understanding of the factors that drive passenger behaviour when making travel choices. There have been many societal changes in recent years that are likely to be drivers of passenger behaviour, and is important that the factors influencing demand are understood both qualitatively and quantitatively to inform planning decisions. Whilst the industry is mature in its approach to understanding the economic factors that influence travel demand, it is recognised that it has a long way to go in understanding the wider societal factors and emerging trends that play a role; and furthermore, how to incorporate these factors into their decision making.'

The rail sector in Great Britain has a long and well established tradition of forecasting the demand for rail services. The approach is based on evidence derived from econometric analysis of ticket sales data supported by bespoke market research. The evidence has evolved over time and is assembled in the industry's Passenger Demand Forecasting Handbook.

The approach has many advantages, not least on its use of detailed historical ticket sales data. There are however some well-documented shortcomings including the use of only a relatively limited set of explanatory variables and a relatively constrained approach to market segmentation.

Analysis of recent sales data shows a decline in the rate of growth in ticket sales but there are large variations across flows, reflecting variations local conditions and it will be important that the analysis covers local as well as national factors. There are concerns across different parts of the rail sector that the factors responsible for driving changes in rail demand are not always well understood and that there is scope to take a fresh look at the evidence.

# Introduction (cont.)

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**Structure of the report**

This report is structured as follows:

— Section 2 presents the methodology and analytical framework.

— Section 3 presents a long list of market trends and disruptors.

— Section 4 presents an impact assessment of market trends and disruptors.

— Section 5 considers the potential impact of six key themes on rail demand.

— Section 6 presents a summary and conclusions from the analysis.

In addition, Appendix 1 provides a description of the approach to market segmentation across different industries.

# Section 2.
# Methodology

# Analytical framework

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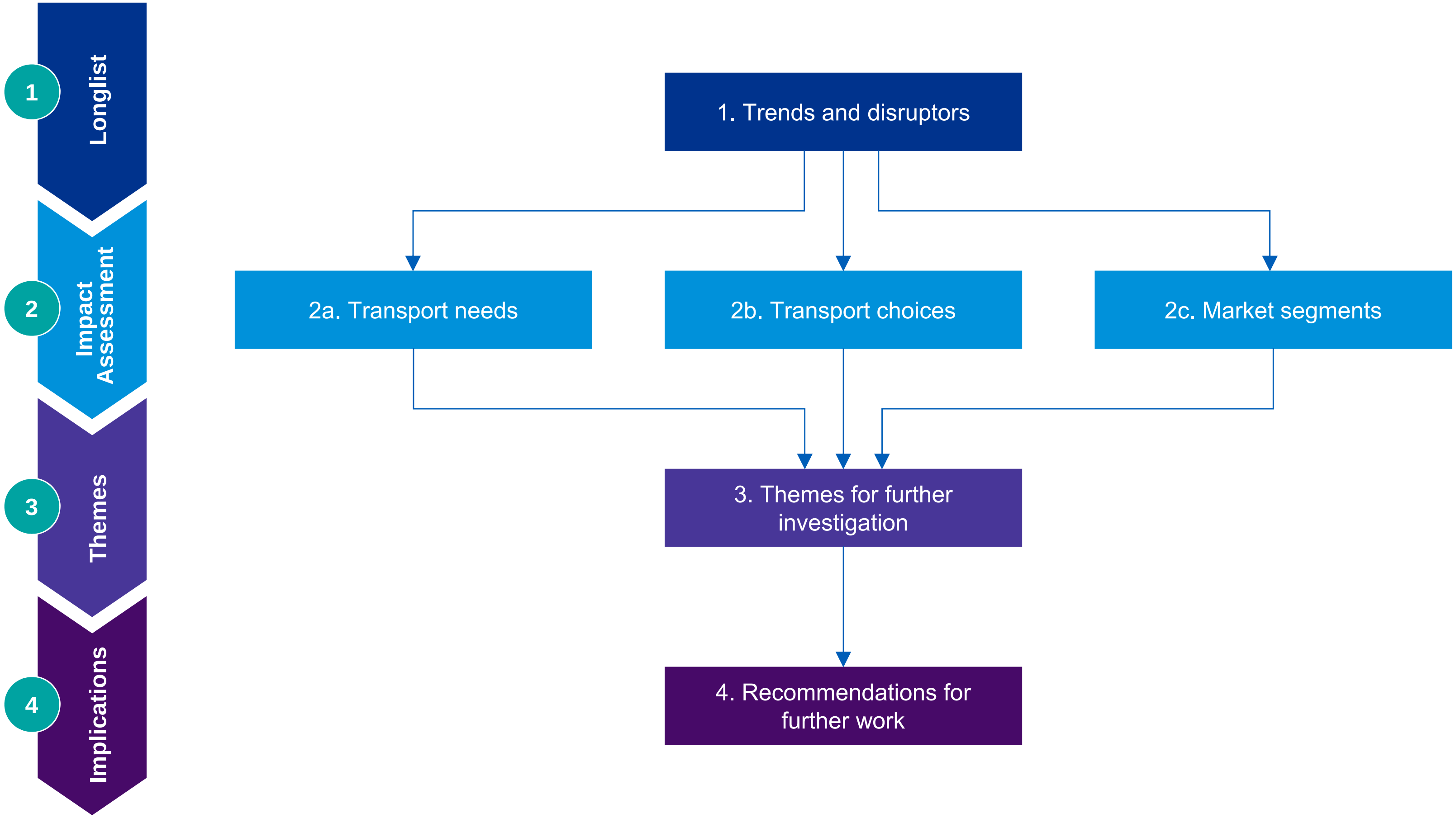
This Scoping Study centres on four integrated areas for investigation, informed by a consultation with experts across KPMG and other organisations. The areas include a review of trends and market disruptors, an impact assessment of these trends and disruptors on the rail market, shortlisting the most important themes for further review and consideration of the pros and cons of alternative approaches to market segmentation and analytics to better understand passenger rail demand. Summary descriptions of each of the four areas are provided overleaf.



# Analytical framework (cont.)

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### 1. Trends and disruptors

A key part of the Scoping Study is identifying key short and long term market trends and disruptors that may affect the need to travel, the attractiveness of rail as the preferred choice of travel and the impact on specific market segments. The trends and disruptors are structured under political, economic, social, technological, digital, legal and environmental headings. The trends and disruptors were deliberately selected to apply to all aspects of life and not simply those related to transport markets.

### 2. Impact assessment

We have undertaken an impact assessment looking at the impact of trends and disruptors on transport needs and choices:

— **2a Transport needs.** Transport needs are influenced by individual and organisational needs and desires to participate in economic and social activities, as well as the spatial distribution of the location of those activities. These depends not only on volumes of economic and social activity but also on land-use patterns, economic clustering and specialisation, and the availability of travel substitutes.

— **2b Transport choices.** Developing a better understanding of how individuals and organisations choose between available options is an important part of the framework. Understanding who and what influences their choices, including experience and perceptions, habit and inertia and decision-making styles all play a part in understanding the drivers of rail demand.

— **2c Market segments.** The impact of trends and disruptors on transport needs and choices will vary across market segments depending on individual tastes, preferences and constraints (eg. travel time and cost budgets). Identifying and explaining differences in propensity to travel between individuals, and their behavioural response to changing circumstances will be a key part of future analysis.

### 3. Themes for further investigation

Based on the findings of our impact assessment, we have grouped key trends into themes for further investigation. This has involved consideration of the current and future impact of the trends and disruptors, identification of market segments that are likely to be impacted most and exploration of alternative data sources to examine the themes in greater detail.

### 4. Recommendations for further work

Decision-making relies on good data and analytics to provide insight and evidence on the factors that drive rail demand across different market segments. Insight can be both qualitative and quantitative and based on ‘passively’ and ‘actively’ collected data. We have looked at new sources of data and analytical methods and considered how they could provide valuable insight into the influence of alternative themes on rail demand.

# Section 3.
# Trends and disruptors

# Introduction

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### Identifying trends and disruptors

We have undertaken an extensive desk-based review of the literature and held discussions with Subject Matter Experts to identify a range of market trends and disruptors. We have structured the analysis according to the following categories:

- Economic
- Demographic
- Social
- Political
- Legal
- Digital
- Technological
- Environmental.

In total, we have identified 50 market trends and disruptors that could directly or indirectly influence economic and social activities, and the transport choices available to customers. It is important to note that many of the market trends and disruptors belong to more than one category, for example, new environmental regulations could incentivise investment in technologies which in turn could impact on the structure of the economy, labour markets and social trends.

In the remainder of this section of the report we provide a short description of each trend and disruptor.

# Summary

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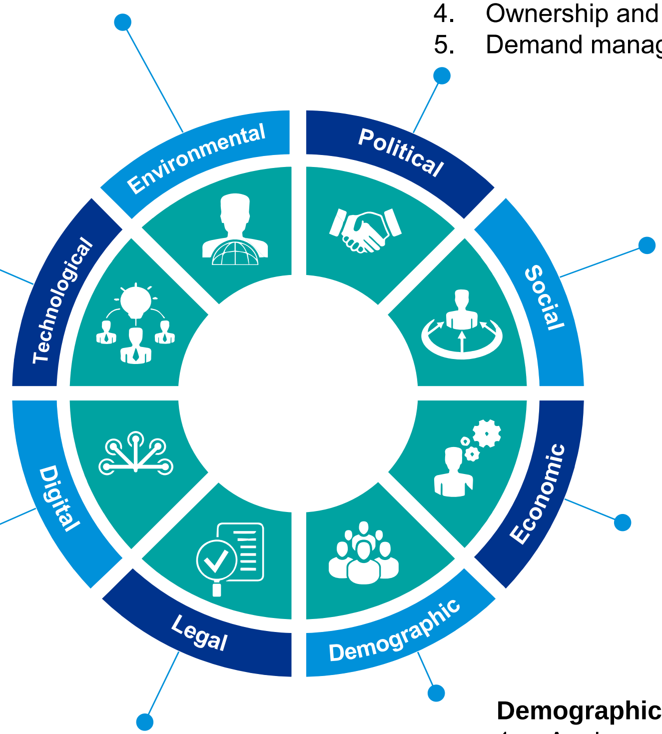
**Environmental**
1. Climate change
2. Clean air
3. Scarce resources

**Political**
1. Globalisation
2. Devolution
3. Pressures on public spending
4. Ownership and regulation
5. Demand management

**Technological**
1. Connected vehicles
2. Autonomous vehicles
3. Electric vehicles
4. Micro-mobility solutions
5. Autonomous trains
6. Advanced signal controls
7. High Speed Rail
8. Hyperloop
9. Automation and robotics
10. 3D printing
11. Drones

**Social**
1. Sharing economy
2. Immediacy
3. Personalisation
4. Reduction in trip rates
5. Change in car ownership
6. Increased focus on health
7. Change in attitudes towards public transport
8. Dispersal of personal networks




**Digital**
1. Mobility as a Service
2. Smart and integrated mobility
3. Increased use of internet on mobiles
4. Data and analytics
5. Personalised advertising
6. Internet of things
7. Virtual Reality
8. Augmented reality
9. Blockchain
10. Facial recognition and use of biometric digital data
11. Artificial Intelligence

**Economic**
1. Gig economy
2. Flexible working
3. New business models
4. Increased productivity through automation
5. Changes to the job market
6. Growing inequalities

**Legal**
1. Changes to economic regulation
2. Changes safety and standards regulation
3. Cyber security

**Demographic**
1. Ageing population
2. Growing population
3. Smaller family units
4. Urbanisation

# Trends and disruptors (cont.)

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## Economic

— **Gig economy/ flexible working**. Increased flexible working or work-from-home options will reduce the demand of home-office travel, having an impact on rail demand. Innovation in pricing could be important in this market.

— **New business models.** With new business models in transport (vehicle sharing, car-pooling, etc.) changing the face of door-to-door mobility, rail demand could be impacted either positively or negatively.

— Increased productivity through **automation**. Driverless and automatic trains in the future will provide efficient and reliable solutions to passenger transport, while allowing people to be more productive in their journeys. Greater automation in the production of goods and services could reduce employment and reduce the demand for transport.

— **New jobs** created and some jobs becoming obsolete. Depending on whether new jobs will be created to replace obsolete jobs in the economy, rail demand will either grow or decline. If the employed population shrinks, the need to travel to work may decrease. The location of new jobs will have important implications for transport networks as will changes in the type of occupation and economic status.

— Growing **inequalities**. Income distribution has important implications for rail demand, with affordability influencing discretionary demand in particular.

## Demographic

— **Ageing population**. An ageing population will affect priorities across society and the economy, including transport. Those who have recently retired tend to be relatively more active than those who have been retired longer. Age of retirement is increasing.

— **Growing population**. Increases in population will put additional pressure on existing transport infrastructure including rail by growing the demand for travel. The UK population is predicted to grow from 64 million to 77 million by 2050. Location of new housing likely to be important.

— **Smaller families**. Smaller households are more likely to not own cars and depend upon public transport for travelling.

— **Urbanisation and centralisation**. With more people living in larger cities, there is an ever greater need for efficient transport solutions. Will the dominance of London continue relative to other major UK cities.

# Trends and disruptors (cont.)

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## Social

- Increased acceptance of the **sharing economy**. Sharing cars or carpooling may encourage commuters to switch to rail when they can save time in their journey to and from station, however they may also encourage modal shift to cars. Sharing assets may help spread the fixed costs of the asset leading to a reduction in cost to users.
- Customers placing higher value on **immediacy and personalisation**. Customers may increasingly value convenience in booking journeys and personalised services. If the rail industry does not offer these, rail demand could decline in favour of on-demand and personalised transport.
- Long term decline in trip rates for shopping, visiting friends and commuting and business trips. Long term decline in trip distance and trip journey time.
- Change in **car ownership**. Younger people move away from owning cars and increase their use of shared vehicles and public transport. Changes in the provision of company cars also have important implications for public transport use.
- Increased **focus on heath -** travel by bike or on foot to and from rail stations may increase the attractiveness of public transport use.
- **Changing attitudes to public transport** more generally may influence use.
- **Dispersal of personal networks**. Greater migration between regions, following increased participation in higher education.

## Political

- **Globalisation**. The strength of the UK economy and levels of employment are influenced by international trade. Net migration is likely to also have an impact on transport markets.
- **Devolution**. Greater national and local accountability could fast-track better passenger services, although much will depend on available budgets.
- **Pressures on public spending**. Reduced spending could negatively affect the rail industry as well as the economy.
- **Ownership and regulation of transport services**. Bus Services Act gives additional power to local authorities to have greater influence on local public transport. Greater vertical integration/alliancing between infrastructure provider and train operators may lead to improved operating performance.
- **Demand management**. Road user charges and restrictions to car access into city centres could improve rail's relative attractiveness.

# Trends and disruptors (cont.)

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## Legal

- **Economic regulation of markets.** Economic regulation can drive efficiency and innovation in transport markets by providing incentives for owners and managers of assets to behave in more desirable ways.
- **Safety and standards regulation**, especially in regard to autonomous vehicles. Will regulation keep up with change or create a drag on change?
- Increased reliance of digital technologies will require advances in **cyber security** to keep systems functioning.

## Digital

- **Mobility as a Service (MaaS)** is the integration of various forms of transport services into a single mobility service accessible on demand. By providing integrated end-to-end trip planning, booking of electronic tickets and payment services, travelling by rail will be easier and more efficient.
- **Smart and integrated mobility**. New technology enabled multi-modal integration of transport could change the way rail services are used.
- **Increased use of internet on mobile phones**. Passengers may increasingly expect businesses and transport operators to embed this technology in their services, providing a one-stop platform for all rail services in the future with integrated information and ticketing.
- **Data and analytics.** Improved information through data and analytics will help improve forecasting, reliability and increase efficiency.
- **Personalised advertising**. New technologies allowing for personal advertising, for instance through social media, may be more successful at targeting customers and influencing their behaviour.
- **Internet of Things**. IoT will make smart trains a reality, improving operational efficiency, passenger service experience and providing increased capacity. This is also likely to increase demand.
- **Virtual and augmented reality**. A rapidly evolving technology, it could change how we work and interact.
- **Blockchain**.   Blockchain is a ‘distributed ledger’ technology. It has the potential disrupt the structure and operation of many different markets across the economy by increasing the level of trust between economic agents, dramatically reducing the cost of commercial transactions.
- **Facial recognition and digital use of biometric data**. New technologies for personal identification could revolutionise ticketing.

# Trends and disruptors (cont.)

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## Technological

- **Connected vehicles.** Connected vehicles' use of radio traffic information systems, dynamic navigation and vehicle-to-vehicle communication have the potential to improve traffic management by reducing delays and road congestion, while also improving safety.
- **Autonomous vehicles.** As AV technology becomes fully operational, cars may become a safer and more attractive mode of travelling, negatively impacting rail demand.
- **Electric vehicles.** Electric vehicles will make car travel more environmentally friendly, reducing fuel tax revenue.
- **Micro-mobility solutions.** A wider variety of personal solutions may be further developed in the future.
- **Autonomous trains.** Driverless trains are increasingly implemented in metro systems but may take a long time to enter the rail market.
- **Advanced signal control.** New signal controlling systems will increase the operational efficiency of the railways.
- **High speed rail** (HS2 and Northern Powerhouse Rail). High speed rail may encourage more people to travel by train as new fast routes become available. This could have a significant impact on travel behaviour.
- **Hyperloop.** Still in early stages of development, transport planners are looking at Hyperloop as a way of connecting cities like Manchester, Liverpool, Leeds and Sheffield to each other and London.
- **Automation and robotics.** Artificial Intelligence is evolving quickly and it could have potentially a large scale impact on the job market.
- **3D printing.** 3D printing could reduce the need to transport goods changing travel behaviour.
- **Drones.** Unmanned aircraft is increasingly being used for transporting goods.

## Environmental

- **Climate change.** As rising global emissions and climate change pose a threat to the environment, the need of the hour is a more resilient transport system with tighter environmental regulations.
- **Clean air** requirements in urban areas may lead to demand management of private vehicles.
- **Increased consumption of energy and resources.** The consumption of resources is increasing putting pressure on technologies to become more energy efficient.

# Section 4. Impact assessment

# Introduction

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In this section we briefly consider the impact of each market trend and disruptor on the underlying need to travel, the availability and competitiveness of travel choices by market segment.

### Transport needs

We consider how each of the trends and disruptors could influence the nature, frequency and location of economic and social activities and the subsequent need to travel. The analysis focuses on employment-related, employer-related and other activities. For example, will trends and disruptors impact on the number, type and location of jobs that local economies can sustain? Will the location of jobs be more geographically dispersed or more concentrated in specialist clusters? Will employment contracts continue to be relatively uniform (9 to 5, Monday to Friday) or will they be more varied? Will demographic changes continue to drive increases in demand? Will technological advances such as virtualisation and additive manufacturing (eg. 3D printing) reduce the need to travel?

### Transport choices

Many of the trends and disruptors that we identified in Section 3 will influence the quality and price of travel options impacting on choices and behaviours. In addition, product and service innovation, the availability and quality of information on travel choices, changing attitudes and external influences on choices could all influence competition and choice. For example, how will vehicle automation influence the preferred choice of mode for short and long distance journeys? Will a greater willingness to share assets impact on vehicle ownership and reduce use costs by spreading ownership costs across multiple users? Will greater integration between modes enabled by digital technologies promote a more informed choice of the right mode for the journey? Will legislation and regulation facilitate and promote change or create a drag on progress?

### Market segmentation

The propensity to travel clearly varies between individuals based on their transport needs, constraints (eg. travel time and cost budgets), and their tastes and preferences. Identifying and explaining differences in propensity to travel between individuals, and their behavioural response to changing circumstances will help improve our understanding of demand. For example, changes to income distribution could impact of travel cost budgets for discretionary travel and relatively stable travel time budgets could mean that new rail demand comes from modal transfer more than pure trip generation. Faced with the sorts of changes to economic and social activities and the travel choices that could be triggered by market trends and disruptors, there is a need to go back to basics when it comes to market segmentation asking:

- How many people will be affected?
- Who will be affected?
- Where do those who are affected live and work?
- How are they likely to be affected?

# Economic trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Gig economy/ flexible working** | — **Uncertain.** Flexible working may increase levels of employment and economic activity, but activity may be focused on local areas and reduce needs to travel long distances. | — **Negative.** Self employed generally more reliant on personal travel. | — Segmentation by industrial sector and employment group likely to be important |
| **2. New business models** | — **Uncertain.** Intermediary platforms such as AirBnB, Uber, and Deliveroo create new economic activity and connect local people and businesses more effectively. | — **Negative.** Activities enabled by these businesses tend to rely on personal transportation. | — Segmentation by industrial sector and employment group likely to be important |
| **3. Increased productivity through automation** | — **Positive.** Increased productivity may result in higher incomes and travel. | — **Positive.** Higher income workers may make more trips by rail. | — Segmentation by industrial sector and employment group likely to be important |
| **4. Changes to the job market** | — **Negative**. Automation of tasks may lead to reduced employment in a range of sectors reducing transport demand, unless new economic sectors and roles evolve. | — **Uncertain.** Impact on mode choice uncertain. Dependent on the location of job losses. | — Segmentation by industrial sector and employment group likely to be important |
| **5. Growing income distribution** | — **Uncertain.** Changes to the labour market and rising house prices may result in increased inequality, increasing the travel needs of some and reducing the travel needs of others. | — **Positive.** Increased numbers of high income households could increase demand for rail travel within those segments. | — Income segmentation likely to be important |

**Summary**

The impact of the economic trends on transport demand is uncertain. The increased automation of some activities and the growth of intermediary platforms for taxi, hotel and food services for example have had major impacts on parts of the economy and created significant new economic activity. However these activities have tended to be quite localised and low skilled – suggesting that the impacts on transport demands could be negative. In general the growth of these forms of self employment is also reliant on personal transportation rather than public transport modes.

Changes to the structure of the economy and labour markets are expected to be material, driven by almost all of the 50 trends and disruptors identified above. The rail sector will need to understand how these trends and disruptors will impact on the economic output, employment, productivity, location of production, inward investment and markets served for each industrial sector. This will help to develop a picture of the number of people affected, the location of their employment, the type work undertaken and their basic need to travel to work or during the course of work.

# Demographic trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Ageing population** | — **Positive**. Age is correlated with higher, income, wealth and leisure time.<br>— **Negative.** Trip rates for retired people are generally lower (peaking around 30-40). Older people tend to make more leisure trips and fewer works trips. | — **Uncertain.** Age cohorts will have some inertia on travel behaviour. High driving licence holding and car ownership likely to follow middle aged cohort to retirement. | — Segmentation by age and gender. Requirement to have multiple segments within retired category to reflect different 'stages' of later life. |
| **2. Growing population** | — **Positive.** Higher population levels will generate more trips but strength of relationship will be important. | — **Uncertain.** Mode choice potentially influenced by capacity to cope with additional demand. | — Segmentation by geography to reflect changing demographics and land use. |
| **3. Smaller family units** | — **Uncertain.** Smaller families have less scope for economies in activities and trip chaining potentially leading to more trips overall. | — **Positive.** Smaller families are less likely to own cars and more likely to travel by public transport. | — Segmentation by household structure, reflecting life-style and life-stage |
| **4. Urbanisation and centralisation** | — **Negative.** Urban dwellers make fewer trips, and travel shorter distances on average potentially as a result of higher population densities. Concentration of economic activity in core areas may result in less longer distance travel. | — **Positive.** Urban dwellers are less likely to own a car. | — Segmentation by location, population density and dwelling type. |

**Summary**

Demographic trends are likely to be broadly positive for rail demand with a growing population increasing overall demand for travel. This may be offset slightly by higher levels of urbanisation for the larger metropolitan areas – though city dwellers are less likely to drive and therefore more likely to travel by rail. The impact of an aging population is not clear but could be significant as a major demographic trend. Smaller families may also be more likely to travel by rail.

Changes to the demographic structure of the UK presents challenges to understanding future trends in rail demand. As with changes to the structure of the economy and labour markets, there is a need to understand not only how many people will be affected, who they are (eg. income, age, cohort), where they live and work, pressures to relocate (eg. migration and immigration) and how their travel patterns may be affected by their environment and experience. This will require much finer levels of market segmentation than has been applied historically together with a much greater understanding of the uncertainties associated with population forecasts and cohort analysis.

# Social trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Sharing economy** | — **Uncertain.** Greater sharing of assets and less ownership of assets. Impact on cost of ownership and use and possible transport demand if shared ownership leads to falling costs. | — **Positive.** Lower levels of car ownership.<br>— **Negative.** Lower costs as ownership costs spread over multiple users. | — Segmentation by geographical location (car clubs located in urban areas), age and lifestyle, as well as propensity to adopt new technologies. |
| **2. Immediacy** | — **Positive.** Greater levels of transport demand to meet consumer demands for immediate service and delivery, but some of this met by home delivery and online services. | — **Uncertain.** Needs most likely to be met by personalised modes. | — Segmentation by geographical location, age and lifestyle, as well as propensity to adopt new technologies. |
| **3. Personalisation** | — **Uncertain.** Greater business focus on catering to personal requirements could improve attractiveness of customer experience | — **Uncertain.** Competitive position of modes could be impacted by journey customisation. | — Segmentation by geographical location, age and lifestyle, as well as propensity to adopt new technologies. |
| **4. Changes in vehicle ownership/ reduction in company car ownership** | — **Negative.** Lower levels of licence holding and car ownership amongst the young, and lower levels of company car provision reducing demand for travel. | — **Positive.** Lower propensity to own and use cars has a potentially positive impact on rail demand. | — Segmentation by geographical location, age and lifestyle, as well as availability of company vehicles. |
| **5. Increase focus on health** | — **Positive.** Promotion of active lifestyles and leisure related activities. | — **Uncertain.** Potential increase in walking and cycling. | — Segmentation by geographical location, age and lifestyle. |
| **6. Dispersal of personal networks** | — **Positive.** Increase internal migration with dispersal of personal networks and increased demand. | — **Positive.** For leisure based trips. | — Migrants and immigrants, graduate destinations post university. |

**Summary**

Social trends appear likely to have a range of broadly positive impacts on rail demand. This is related to falls in levels of licence holding and car ownership amongst the young which are likely to increase the use of other modes for travel, combined with general increases in travel for leisure and health purposes and improvements in the perception of public transport amongst the young. Increasing demand for immediate and personalised services is likely to be served by other types of transport.

Social trends are closely related to demographic trends and are influenced by the structure of labour markets. Differences in preferences and attitudes can be used alongside observable characteristics to shape market segments. Key aspects here will be propensity to take-up new technology, propensity to own or share a car or fleet of vehicles and the propensity to relocate or migrate.

# Political trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Globalisation** | — **Positive.** Increasing trade flows and demand for international transport for goods and services. Inward migration increased population. | — **Positive.** Airport surface access service linked to international trade. | — Segmentation to capture international business travel and travel patterns amongst migrants. Airport access services. |
| **2. Regional devolution** | — **Positive.** Potential increase in focus on infrastructure investment but reliant on funding from the centre. | — **Uncertain.** Highway congestion and air pollution a concern for many local decision-makers. The may lead to investment in public transport and rail | — Major cities. All users. Impact will depend on sensitivity of demand to changes in prices and quality by segment. |
| **3. Pressures on public spending** | — **Negative.** Capital investment in infrastructure is currently a priority policy area but pressure on revenue expenditure may limit services in some areas. | — **Negative.** Network Rail spending cuts together with rising costs (overspends) could result in lower investment in the network. | — All users. Impact will depend on sensitivity of demand to changes in prices and quality by segment. |
| **4. Ownership and regulation** | — **Uncertain.** Changes to ownership and regulation of transport infrastructure and services not likely to directly impact transport needs. | — **Uncertain.** Changes to ownership and regulation of transport infrastructure and services are complex and context specific. | — All users. Impact will depend on sensitivity of demand to changes in prices and quality by segment. |
| **5. Demand management** | — **Negative.** Potential for major impacts on location decisions and travel patterns in areas of congestion such as major cities. | — **Positive.** Road user charging could reduce the attractiveness of private transport. | — All users. All users. Impact will depend on sensitivity of demand to changes in prices and quality by segment. |

**Summary**

The overall impacts of the political trends are wide ranging, complex and uncertain. Demand management has the potential to significantly increase the relative attractiveness of rail. On the other hand bus franchises – If successfully funded and developed – could make bus trips more attractive and potentially more coordinated with rail services. Globalisation could also have a significant impact on the general demand for travel, depending on its overall impact on economic activity in the UK.

Political trends are likely to influence the market for rail both directly and indirectly, shaping the structure and location of economic activity, influencing the location of households and firms, and changing the relative attractiveness of modes through investment, taxation and regulatory policies. Market segmentation relating to political trends is largely covered as part of economic, demographic and social segmentation.

# Legal trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Changes to economic regulation** | — **Uncertain**. There is potential for increasing competition in rail. The reform of the roads sector may increase investment and improve efficiency. | — **Positive**. Increased competition in rail may increase the attractiveness of rail.<br>— **Negative.** Reform of Highways England may improve the attractiveness of road travel. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. |
| **2. Changes to safety standards** | — **Positive.** Improvements to transport safety will likely stimulate demand. | — **Positive.** Improvements in safety are likely to increase attractiveness of rail. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. |
| **3. Cyber security** | — **Positive.** See safety. | — **Positive.** See safety | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. |
| **4. Brexit – Legal and policy implications** | — **Uncertain.** Brexit may result in change and reform to a range of laws including competitive and regulatory policy. It may also need to changes in net migration and international trade. | — **Uncertain.** May result in changes to competition in rail and other business. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. |


**Summary**

The impact of legal trends on transport demand and the attractiveness of rail are likely to be relatively limited being related to technical and safety issues. Increased competition, or broader changes to the market structure of the industry could have positive effects on demand, but are highly uncertain. The legal implications of Brexit could be very significant for the sector and may enable major changes to competition and regulatory policy amongst other things. The impacts of this are very hard to predict but could result for example in reduced competition for rail franchise services.

As with political trends, legal trends are likely to influence the market for rail both directly and indirectly, shaping the structure and location of economic activity and changing the relative attractiveness of modes through investment, taxation and regulatory policies. Market segmentation relating to legal trends is largely covered as part of economic, demographic and social segmentation.

# Digital trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Mobility as a Service** | — **Positive.** Improved information and ticketing may encourage passengers to make more trips. | — **Positive.** Potential to significant improve trip planning services and information for public transport as well as better account management | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. Emphasis on tech-savvy, early adopters. |
| **2. Smart and integrated ticketing** | — **Positive.** Integrated ticketing likely to encourage users to make more public transport trips. | — **Positive.** Likely to improve users experience of public transport. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. Emphasis on tech-savvy, early adopters. |
| **3. Increased use of internet on mobile phones** | — **Positive.** Improved information may encourage passengers to make more public transport trips. | — **Positive.** Use of mobile ticketing and purchase options will improve user experience. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. Emphasis on tech-savvy, early adopters. |
| **4. More advanced data and analytics** | — **Positive.** Improved analytics may help to improve general business planning and forecasting, leading to improved pricing and service levels. | — **Positive.** Improved analytics may help to improve general business planning and forecasting. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment |
| **5. Personalised advertising** | — **Positive.** Targeted marketing and promotion could increase demand and influence behaviours. | — **Positive.** Increased use of personal advertising make increase effectiveness. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment. Emphasis on tech-savvy, early adopters. |

**Summary**

Digital technologies are and will continue to disrupt much of the economy, shaping labour markets, social activities and the transport choices we make. Digital will also influence the supply of transport services through vehicle control and network management, and provide alternatives to travel in the form of enhanced video conferencing facilities, remote working, online healthcare and education, for example. Innovation in information and ticketing, facial recognition and other forms of tech could significantly improve the passenger experience. There is a need to understand how different sectors of the economy and different groups of customers could adopt and use new technologies and how that could influence activities and behaviours.

# Digital trends and disruptors (cont.)

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **6. Internet of things** | — **Uncertain.** No clear impact on transport needs. | — **Positive.** Innovation may improve rail user experience and reduce costs. | — Whole population |
| **7. Virtual reality** | — **Negative.** May reduce need to travel. | — **Positive.** Innovation may improve rail user experience. | — Segmentation based on propensity to adopt new technologies likely to be important. |
| **8. Blockchain** | — **Positive.** Reduce the cost of transacting, increasing trade and transport demand. | — **Uncertain.** | — No clear market segmentation identified. |
| **9. Facial recognition and biometric data** | — **Positive.** Potential improvements to payment and security, improving customer experience. | — **Positive.** Potential improvements to payment and security, improving customer experience | — Whole population |
| **10. Artificial Intelligence** | — **Negative.** Possible job losses could lead to less transport demand. | — **Negative.** Possible job losses could lead to less transport demand. | — Segmentation by employment group and industry sector. |


**Summary**

Digital technologies are and will continue to disrupt much of the economy, shaping labour markets, social activities and the transport choices we make. Digital will also influence the supply of transport services through vehicle control and network management, and provide alternatives to travel in the form of enhanced video conferencing facilities, remote working, online healthcare and education, for example. Innovation in information and ticketing, facial recognition and other forms of tech could significantly improve the passenger experience. There is a need to understand how different sectors of the economy and different groups of customers could adopt and use new technologies and how that could influence activities and behaviours.

# Technological trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Connected vehicles** | — **Uncertain.** Will improve information within cars and driving experience, potentially increasing demand for travel. | — **Negative.** Will improve driver experience and encourage greater use of cars. | — Car owners<br>— Business trips |
| **2. Autonomous vehicles** | — **Positive.** Autonomous vehicles may reduce the cost of travelling by car and could be highly disruptive for taxi and logistics businesses. Likely to encourage new trips and enable new activities whilst travelling. | — **Negative.** May significantly improve the attractiveness of car travel – Particularly for long distance trips. | — Car owners<br>— Long distance travellers |
| **3. Electric vehicles** | — **Uncertain.** Will improve efficiency and environmental impacts but not clear it will change demand for travel. | — **Negative.** Will reduce cost and improve perceptions of car travel. | — Car owners<br>— Environmentally conscious |
| **4. Micro-mobility solutions** | — **Positive.** New modes such as new era electric bikes could encourage new forms of travel (leisure/fitness). | — **Negative.** New mode could be highly attractive for short urban trips. | — Early adopters<br>— Fitness conscious<br>— Urban dwellers<br>— Short trips |
| **5. Autonomous trains** | — **Uncertain.** | — **Positive.** Could result in improvements to reliability and efficiency, but may have negative impact on perceptions. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment |
| **6. Advanced signal controls** | — **Uncertain.** | — **Positive.** Improve capacity, frequency and punctuality. | — Impact will depend on sensitivity of demand to changes in prices and quality by segment |
| **7. High Speed Rail** | — **Positive.** Will create range of new travel opportunities and influence investment and location decisions across the UK. | — **Positive.** Integration between rail and HSR will improve options and perceptions of rail travel. | — High value of time passengers |

# Technological trends and disruptors (cont.)

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **8. Hyperloop** | — **Uncertain.** Technology unproved, no serious proposals for development in UK. | — **Positive.** Could revolutionise rail travel. | — Long distance/international travellers |
| **9. Automation and robotics** | — **Negative.** Automation of low skill jobs could lead to high levels of unemployment and the automation of delivery services removing the need to travel for shopping etc. | — **Positive.** Greater automation of the passenger journey may reduce costs and improve experience of rail travel. This impact may also occur for other modes. | — Whole population<br>— Tech savvy<br>— Tech novice<br>— Low skill sectors |
| **10. 3D printing** | — **Uncertain.** Technology could reduce costs throughout the economy and alter the supply chain for a range of industries. | — **Uncertain.** Application to rail travel not clear. | — Whole population |
| **11. Drones** | — **Negative.** Use of drones for logistics and other purposes could remove the need for travel. | — **No impact.** Drones unlikely to be used for personnel travel. | — Whole population<br>— Low skill sectors<br>— Construction/surveyor related jobs |

**Summary**

Technological innovations could have significant impacts on travel demand. New modes including autonomous and connected vehicles, and micro-mobility solutions will reduce transport costs and encourage new forms of travel. HSR will improve transport connectivity throughout the country and have major impacts on regional investment and location decisions. On the other hand, drones and the automation of working processes has the potential to reduce the need for labour in numerous business processes and eliminate the need for personal travel across a whole range of business and personal activities.

Generally the technical innovations will improve efficiency and the passenger experience in rail, although this impact may be more significant in other modes – Particularly for car which has the greatest potential to benefit from automation. For example automated vehicles could make car much more attractive for long distance journeys and reduce one of the current advantages of rail travel – The ability to engage in other activities whilst travelling.

Trends in technology are likely to influence the market for rail both directly and indirectly, shaping the structure and location of economic activity, influencing the location of households and firms, and changing the relative attractiveness of modes by changing prices and quality. Market segmentation relating to technological change will largely be covered as part of economic, demographic and social segmentation, with a particular focus on early adopters.

# Environmental trends and disruptors

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| Trends and disruptors | Transport needs | Transport choices (rail) | Market segmentation |
|---|---|---|---|
| **1. Climate change** | — **Negative.** Policy response to climate change may create pressure to reduce travel and carbon emissions. | — **Positive.** Carbon emission from rail are relatively low. | — Whole population<br>— Car drivers<br>— Environmentally conscious |
| **2. Clean air** | — **Negative.** Policy response to poor air quality may create pressure to reduce travel and air pollutants. | — **Positive.** Air pollution from rail is relatively low. | — Whole population<br>— Car drivers<br>— Urban dwellers<br>— Environmentally conscious |
| **3. Scarce resources** | — **Negative.** Reduction in energy supplies – Oil and gas – Could increase prices and the relative cost of travel across modes. | — **Positive.** Rail is a relatively energy efficient mode of travel. | — Whole population<br>— Car drivers<br>— Environmentally conscious |

**Summary**

The impact of environmental trends will depend on government policy response to these issues which could include for example the use of taxes, congestion charges, vehicle replacement schemes, clean air zones, carbon trading schemes etc. In general these polices will reduce transport demand by increasing costs. Rail is a relatively green mode of transport and therefore would become a more attractive form of transport. In terms of market segmentation, it is possible that some policies will impact on certain transport users more than other and these can be considered as part of the segmentation of economic, demographic and social groups.

# Impact assessment - Discussion

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Market trends and disruptors are expected to impact on economic and social activities and the transport market in general. Some of these trends will impact on transport needs, either positively or negatively, and some will influence the price, quality and availability of transport alternatives. Given the complexity and interaction between trends and disruptors it is difficult to consider each in isolation and therefore we think it is more appropriate to consider and group trends and disruptors in terms of their impact on market outcomes and in particular the potential impact on the demand for travel and customer choice between modes. We have identified six themes to reflect possible outcomes as follows.

| | | |
|---|---|---|
| Transport needs | **1. Changes to the structure of the economy** | Changes to the structure of the economy including rates of employment, self employment, home working, growth and decline of different sectors and skills and the potential impact of automation and new business models could dramatically change trip rates and patterns of travel. New ways of working may also affect individuals travel behaviour. The outlook for the economy and the role of transport is fundamental to understanding transport demand. |
| | **2. Changes in socio-demographic factors** | Population growth is a key driver of transport demand and is likely to continue, although there is some uncertainty over rates of future migration for example. There are also a range of wider socio-demographic factors which are likely to be important for overall demand including the aging population, later marriage and family formation and increasing urbanisation. |
| | **3. Alternatives and substitutes for transport** | Innovation and new technology may lead to a variety of new technologies which may create alternatives and substitutes to travel. These include improved communications and virtualisation, which might enable people to work remotely, the proliferation of online services such as education, banking or shopping service, and other more uncertain technology such as 3D printing which could revolutionise manufacturing. |
| Transport choices | **4. Changes in price, quality and availability of transport modes** | There are a range of 'new' transport modes which are likely to enter the market over the future. These include: connected and autonomous vehicles, High Speed Rail, Hyperloop, drones and micro-mobility solutions for example. These modes could have major impacts on the competitive position of rail. Understanding the impacts of this theme will be very important for the future of the rail industry. |
| | **5. Improving integration between modes** | New technology, data and the proliferation of mobile phones and smart devices is leading to much greater integration between modes of transport. This includes trends towards smart ticketing and Mobility as a Service, as well as the potential for greater real-time planning and coordination across modes of transport. This could have a major impact on the attractiveness of public transport modes for example by reducing uncertainty about travel times and delays. |
| | **6. Outlook for policy and regulation** | The policy response to the trends and disruptors could have a significant impact and influence on the relative choice across different modes. For example, the introduction of road user charges and changes to vehicle licencing, insurance, ownership and taxation are critical to the overall appeal of connected and autonomous vehicles (and drones). Changes to bus and rail markets such as the introduction of franchising could also be important. |

# Section 5.
# Six themes for further investigation

# Introduction

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In Section 4 we considered the potential impacts of 50 market trends and disruptors on transport needs and customer choice. The interactions between individual trends and disruptors are complex and to keep the analysis manageable, we have identified six themes reflecting market outcomes in terms of transport needs and transport choices.

### Transport needs

The impact of trends and disruptors on transport needs are likely to be material through their influence on economic and social activity, demographics and alternatives to travel. Important themes include:

— **Theme 1**. Changes to the structure of the economy and labour markets.

— **Theme 2**. Changes to demographic profiles including household structure, migration, urbanisation and household location, as well as changes in social trends including dispersed personal networks, changes to income distribution, participation in education, changing societal attitudes and expectations.

— **Theme 3**. Alternatives to travel including virtualisation, remote working, online education and healthcare, goods distribution and home delivery by light goods vehicles and drones.

### Transport choices

The impact of trends and disruptors on Transport choices are likely to be material through their impact on quality and price of alternative modes, integration between modes and government policy and legislation. Important themes include:

— **Theme 4**. Anticipated change in connected and automated vehicles, and propulsion systems, together with changes in the quality of public transport including high speed rail and digital railways.

— **Theme 5**. Integration between modes through new technology, new business models and personalisation.

— **Theme 6**. Outlook for government policy, regulation, licensing and demand management.

In the remainder of this section of the report, for each theme we:

— Describe the theme including identifying what trends and disruptors are part of it and why we think it is important.

— Review evidence to the magnitude to the changes that have recently occurred, including a commentary on how the trends and disruptors within the theme could have impacted on recent rail trends.

— Provide a view on what might happen with this theme in the future, including the identification of alternative scenarios.

— Identify who the trends and disruptors within the theme are likely to impact most, thereby defining the market segments.

— Review the type and availability of data that we would need to provide evidence on the scale and scope of future changes.

# Section 5.1 Transport needs

# Introduction

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In recent years, there has been **a steadily falling trend in trip rates** (Figure 1). Explaining this trend is at the heart of this work. It is however important to note that substantial variations in trip rates exist between geographical areas, market segments and modes, for example.

In addition to changes to how much people travel, **public transport use has increased over the last decade**, as reflected in average trips distance travelled per person by private and public modes (Figures 2 and 3).

However, **rail passenger growth is slowing down** – 2016/17 growth was 0.8%, the lowest level of growth since 2009/10, according to the latest ORR statistics. This decline is driven by a decrease in passengers in London and the South East, where passenger trips declined by 0.5%. In addition to this, season ticket sales fell for the first time by 2.9%, while advance ticket sales grew by 9.7%.

In this section we explore how transport demand could vary as a result of changes to underlying economic and socio-demographic trends, as well as the availability of alternatives to travel.

**Figure 1: Average trips per person per year (NTS)**

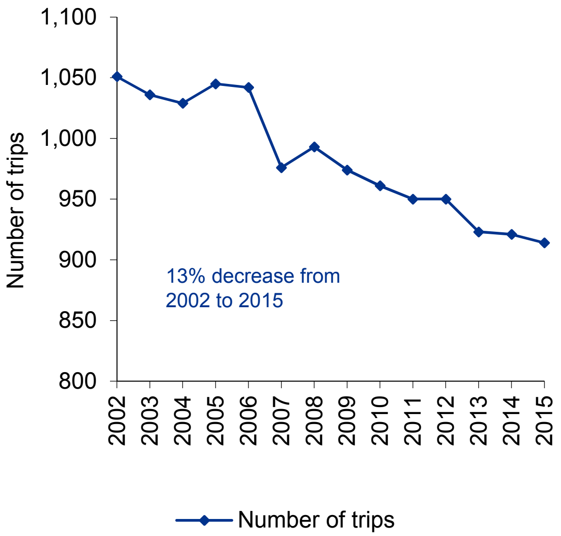



**Figure 2: Average trips per person by public and private mode (NTS)**

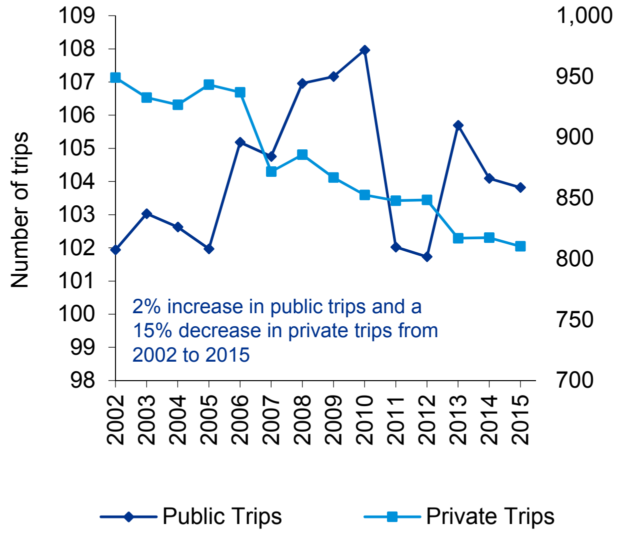
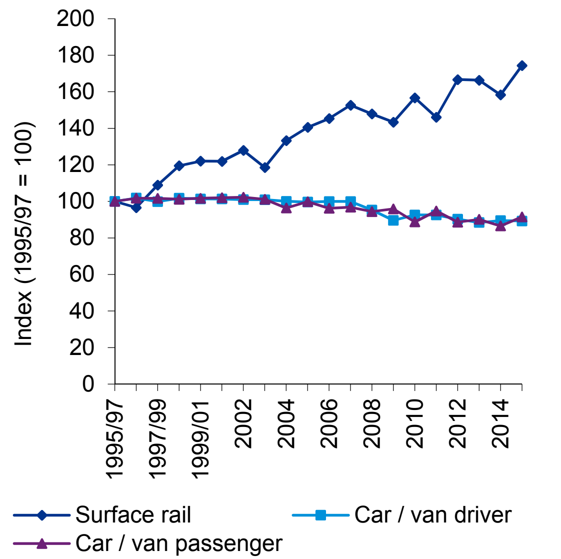



**Figure 3: Average distance travelled by mode (NTS)**



# Theme 1. Changes to the structure of the economy

# Description

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### What economic trends are likely to be important

Demand for travel depends in large part on the volume, type and location of economic activity. In turn these determine the level and type of employment, the activities workers engage in and the journeys they make.

The range of trends and disruptors reviewed in Section 4 suggest that material changes are happening to the structure of the economy and labour markets. For example:

— The development of new technology including automation, robotics and digitalisation, has the potential to increase output, reduce employment, increase productivity and change the location of production and consumption.

— Demographic trends, a general ageing of the population and a potential underfunding of pension funds may mean that people need to continue to work into their late 60s and potentially beyond.

— New asset-light business models, centred on the sharing economy, digitalisation and blockchain for example, could fragment labour markets

— Increases in productivity in some industrial sectors and increasing fragmentation of labour markets in other sectors could broaden income distributions.

All of these will likely have a profound impact on the level and type of employment impacting commuting and business travel. In addition, leisure travel could also be indirectly affected as employment activities decrease and leisure time increases. This is where income distribution is likely to play a key role, as increased leisure time will only result in increased travel if disposable incomes do not decrease as a result of reduced employment, for instance through 'Universal Basic Income' policies.

Developing a better understanding of changes to the structure of the economy and to the structure of labour markets must be a priority for those seeking to understand the future of rail demand.

**Key trends**

— Automation, robotics and digitalisation;

— Longer working lives;

— New business models;

— More flexible/ fragmented working;

— Changes in income distribution.

# Evidence

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## What evidence there is on these trends

The drivers of changes to the structure of the economy and labour markets are relatively well documented but nevertheless relatively uncertain. Market trends and disruptors require close monitoring to understand their impact on employment and on the need to travel.

Forecasts looking at **automation** estimate that or 30% of current jobs could be lost as a result of this technology (PwC 2016). Other studies estimate that up to 45% of the tasks currently performed by people could be automated with current technologies (McKinsey 2016). There is a risk that the number of jobs available may decrease affecting commuter travel and possibly leisure travel, as people have more leisure time. This is also likely to affect the sectoral composition of employment, as the share of highly skilled jobs increases, as these are harder to replace by Artificial Intelligence.

With regards to **flexible working**, statistics show that work patters are changing. A recent study found that we are reaching a tipping point in this trend and that by 2020, 70% of organisations will have adopted mobile working (Lancaster University Work Foundation, 2016). As more people work from home, they will travel less for commuting purposes – currently only 49% of full time workers commute 5 days a week and 17% were not travelling to work at all (ITC 2014).

In addition, it is estimated that 20-30% of the working age population in Europe and the US engage in some form of independent work through **the gig economy** (McKinsey Global Institute 2016), which may have a positive impact on travel demand although travel patterns may change substantially. The gig economy is growing as evidenced by the growing amount of online platforms where people can advertise their services and could be contributing to increased economic activity rates, which have steadily grown since 2004 from 76.1% to 77.7% in the UK (Annual Population Survey).

An aging population, coupled with underfunded pensions, will increase pressure for people working, perhaps into their late 60s and beyond. These pressures may increase the size of the labour force although it is noted that the increase in participation in further and higher education is also delaying the time at which many young people are available for work.

The recent Rail Demand Forecasting study for the Department for Transport found evidence of different propensities to travel across sectors – those working in manufacturing, wholesale business, construction and health/social care sectors are less likely to travel by rail, whereas those involved in the finance sector (for commuting and other travel) and real estate (for business) are more likely to travel by rail. It also found that age is also a key variable – this study shows that the propensity to travel by rail by age varies except for business travel. Other factors such as increased urbanisation may also gradually change preferences in terms of travel, which will be a key issue to research.

Another study produced by the Independent Transport Commission (2016) found through regression analysis that economic factors, especially employment status and occupation, are more important than demographic factors in determining people’s propensity to travel and drive. However, both demographic and economic factors are only able to explain a quarter of the variation in travel patterns, suggesting that changes in individual behaviour need to be further explored.

In summary, these forecasts predict a possible reduction in employment levels, a change in the composition of employment and a move away from fixed contracts and working schedules to flexible working hours and freelancing. Further questions remain regarding the impact of changes in location of economic activity and the role of face-to-face interactions in business relationships. These will determine the frequency of travel and average distance travelled.

## Economic structure

# Evidence (cont.)

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Although these predictions show that the impacts of these trends will be felt in the medium term, the latest employment statistics already provide evidence for a move towards increased share of employment in highly skilled professional jobs and occupations.

Figure 4 shows that over the last six years professional, business and Information and technology sectors have grown the most in terms of total employment in the UK. This is also reflected in occupation data between 2004 and 2016 (Figure 5), which shows that professional and technical occupations have increased their share of employment while the share of administrative, machine operative and elementary jobs have decreased. Parallel to this, the proportion of self-employed people has steadily grown over the last decade (Figure 6).

**Figure 4: Employment CAGR (2009-2015) by sector in Great Britain (BRES)**

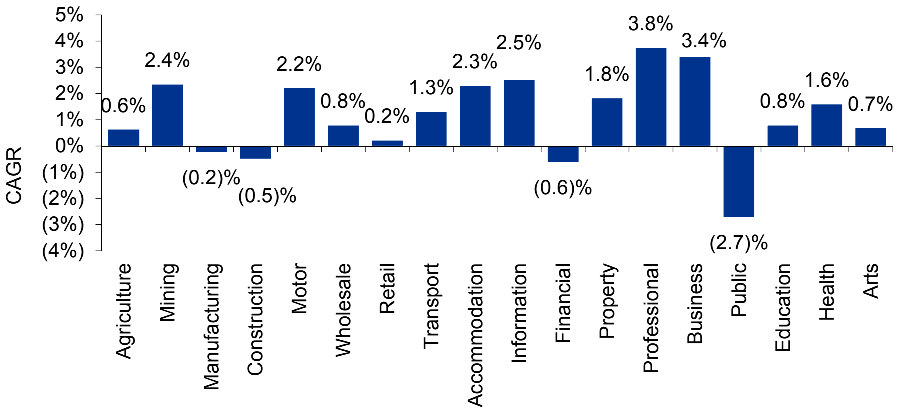



**Figure 6: Proportion of employees and self-employed out of UK Population aged 16-64 (APS)**

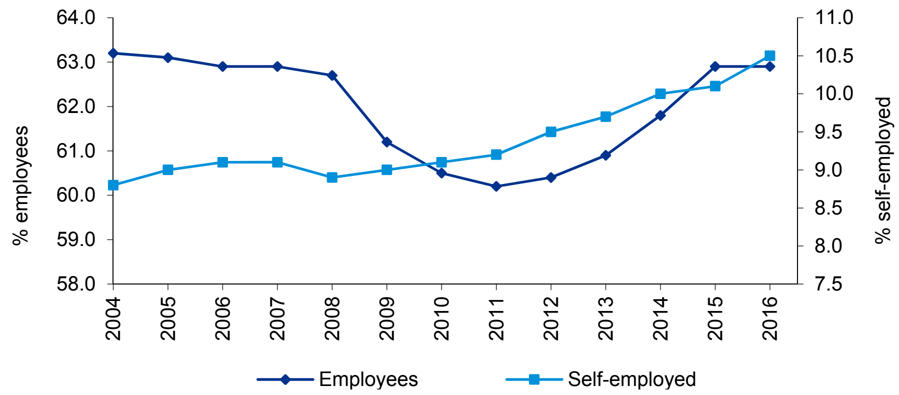
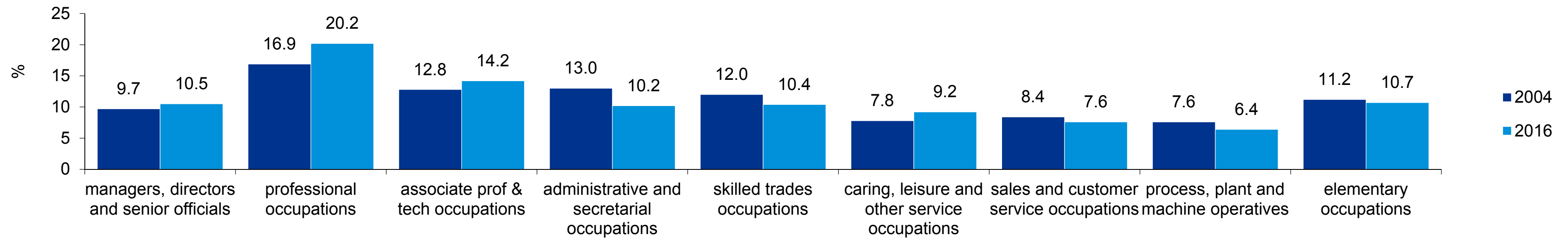



**Figure 5: Share of employment by occupation in the UK (APS)**



## Economic structure

# Evidence (cont.)

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### How will these trends impact travel demand

Based on the forecasts and latest employment statistics showing an increase in the share of people taking up flexible working, we might expect to see a reduction in traditional Monday to Friday commuting (Figure 7).

Travel statistics from the last decade show a clear and steady reduction in commuting trips per person over time. This is also reflected in rail travel, where we observe a reduction in season ticket trips as a proportion of total trips over the last seven years (Figure 8). This is likely to be a reflection of changing employment patterns.

**Figure 7: Compound Annual Growth Rate in Trips per person by journey purpose (1995-2015) (NTS)**

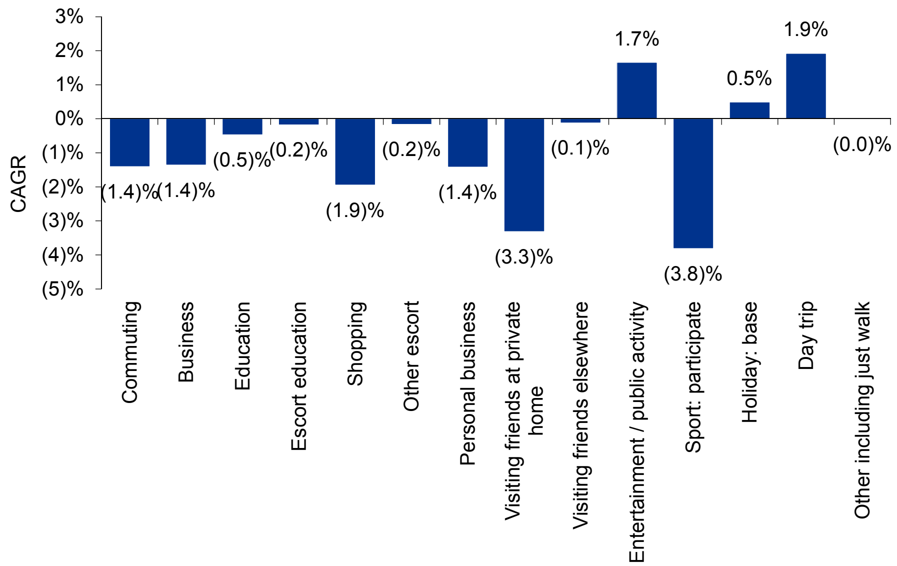
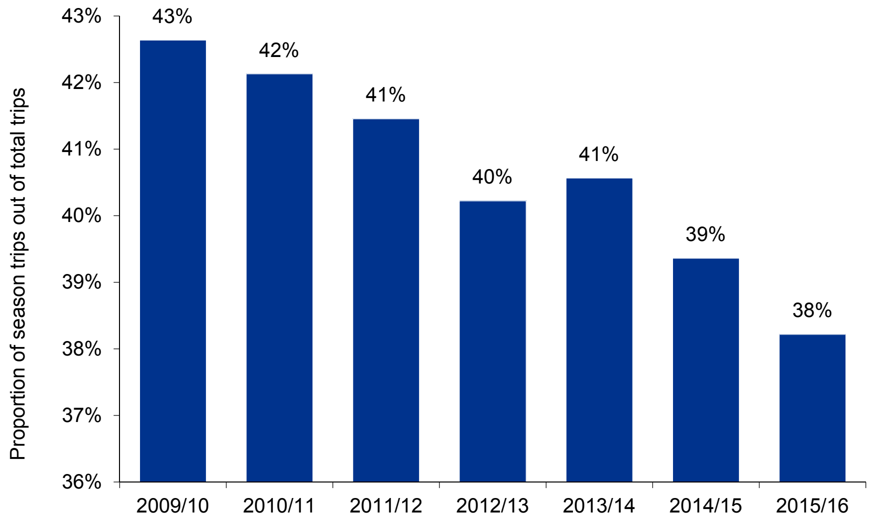



**Figure 8: Season ticket entries as a proportion of total station entries (ORR)**




Going forward, we may expect to see a further decrease in commuting and use of season tickets, as people travel less and more flexibly in response to changes in employment patterns and levels. In this context, a key question to ask is: how will changes to the structure of the UK economy and labour market impact on travel demand?

# Evidence (cont.)

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Figure 9 shows that over time trips per person have decreased for all types of employment (full-time, part-time and self-employed), with self-employed people showing the largest decrease over time (CAGR of (3.3)% from 2002 to 2015). A possible explanation for this is technological progress, as better internet connections and video conferencing technologies enable people to work from home or remotely, without the need to travel to an office. Figure 10 shows that distance travelled has increased over time for commuters.

**Figure 9: Trips per person by employment status (NTS 0411)**

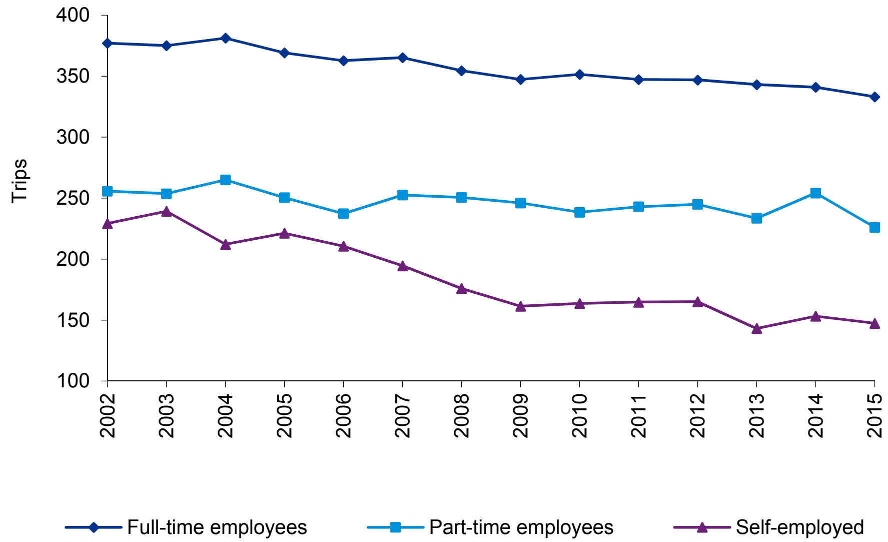
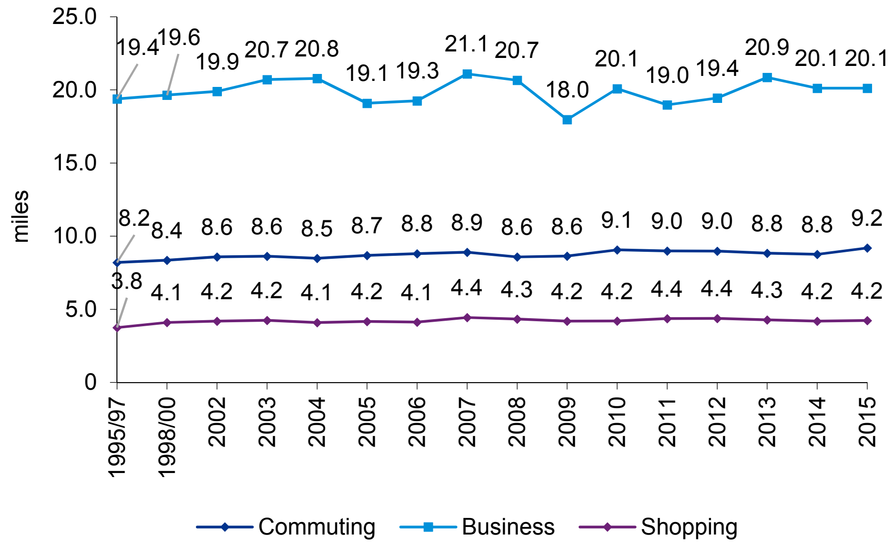



**Figure 10: Average journey length in England by journey purpose (NTS)**



# Evidence (cont.)

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The timing of people travel is a key aspect of transport planning as it directly influences the need for policies to address crowding and congestion to better manage capacity.  In addition to changes in the number of trips and distance travelled a potential behavioural response to changing circumstances in to change departure times, although there is little evidence at the moment that flexible working is changing commute patterns.

A recent study on rail demand forecasting (ITS *et al*, 2016) found evidence of different propensities to travel across sectors – those working in manufacturing, wholesale business, construction and health/social care sectors are less likely to travel by rail, whereas those involved in the finance sector (for commuting and other travel) and real estate (for business) are more likely to travel by rail. It also found that age is also a key variable – this study shows that the propensity to travel by rail by age varies except for business travel. Other factors such as increased urbanisation may also gradually change preferences in terms of travel, which will be a key issue to research.

Another study produced by the Independent Transport Commission (2016) found through regression analysis that economic factors, especially employment status and occupation are more important than demographic factors in determining people's propensity to travel and drive. However, both demographic and economic factors are only able to explain a quarter of the variation in travel patterns, suggesting that changes in individual behaviour need to be further explored.

# Outlook

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### Impacts over time

Below we set out a timeline summarising the forecasts presented to give an indication of when these trends will have their largest impact on the economy. In the short term, we expect to see gradual increases in the gig economy, flexible working and new business models. And in the long term, we can expect the economy to be significantly affected by these trends.

In the case of automation, current trends show an accelerating path in the implementation of this technology, and it is likely that over the next ten/fifteen years significant changes take place in how businesses operate and the composition of employment..

**Shorter term impact**

— Gig Economy – New mobile and digital technologies already provide a platform for people to offer ad-hoc services (eg. TaskRabbit website)

— Flexible working – Since 2014, 20 million workers in the UK have flexible working rights. By 2020, most employers are expected to offer this option.

— The retirement age reaches 66 years old by 2020.

**Longer term impact**

— Automation – With the rate of technological change accelerating, over the next 10-15 years automation is expected to have a significant impact across industries.

— Oxford University estimates that around 30% of existing UK jobs could be at potential risk of automation by the early 2030s. The Bank of England estimates that robotic automation will eliminate 15 million jobs from the United Kingdom economy in the next 20 years.

— Retirement age reaches 67 years old in 2028.

**2017**

**2020**

**2030**

### Key uncertainties

There is a discussion amongst economists and others as to what the impact of automation is going to be. Whereas the impact of the gig economy and flexible working is likely to continue its trend, automation could rapidly disrupt the economy and reduce substantially employment opportunities that may not be fully compensated by the creation of new jobs or training and welfare policies.

In this context, at least two scenarios may be considered:

— High productivity and automation scenario – automation is rapidly implemented over the next 15 years and unemployment increases substantially, thus having a significant negative impact on commuter travel.

— Inclusive growth scenario – automation makes some jobs obsolete but leads to the creation of new jobs, which, thanks to new training policies, keep employment levels stable.

# Market segmentation

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## Implications for market segmentation

In the context of the changing structure of the economy and labour markets there is a need to consider: how many people will be affected, who will be affected, where those people live and work and how they are likely to be affected.

Getting a better handle on the structure of the economy, the number and type of jobs available, and the location of employment is central to understanding patterns of commuting and business related travel. This will require a meticulous analysis of the outlook for each industrial sector, identifying those sectors that are or could be in decline in response to market trends and disruptors, those that are growing or are expected to grow and those that are likely to be stable. The analysis will need to consider potential economic outcomes in terms of the value of output produced, the number and types of jobs available, wage rates and production locations, which can be used in conjunction with evidence on trip making (for example by employment sector, job type, income and location) to understand how the 'future of work' will influence transport needs.

**Industrial sectors**

Detailed picture of structure of the economy by industry segment and geographical location

**Market trends and disruptors**

- Demographic
- Technological and Digital
- Social
- Legal
- Environmental
- Economic
- Political

**Potential economic outcomes**

- GVA
- Number and type of jobs
- Productivity and wages
- Location of production
- Inward investment
- Markets served

**Impact on transport needs**

- International/ Airport Access
- Intercity
- Regional
- Urban/Suburban

# Data considerations

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## What data is needed

Analysis of the potential impact that changes to the structure of the economy could have on rail demand will need a detailed understanding of changes to the economy, changes to labour markets and the relationship between key economic metrics and rail demand.

### Changes to economic structure

Economic activity by industrial sector and geographical location (local authority level or below), including metrics on output, employment and productivity, but also patterns of business related travel. Forecasts of how economic activity could change under alternative future scenarios.

A key economic consideration particularly relevant to rail travel is the future of the high street (relative to online sales) and the future of office based employment located in urban centres relative to remote working.

### Changes to labour market structure

Number and type of jobs by industrial sector and geographical location, including metrics on labour force size, unemployment, migration, wages, hours worked, employment location, employment status and occupation. Forecasts of how the structure of labour markets change under alternative future scenarios.

### Changes to rail demand

Typical travel patterns for commuting and employer's business, by industrial sector, geographical location and employment type, considered in conjunction with socio-demographic characteristics, identifying changes in travel patterns, household and employment location within cohorts over time. The first step will be understanding the impact of historical changes to economic structure and labour markets on rail demand, then to develop scenarios for how economic structures and labour markets could develop in the future. This highlights a challenge in forecasting explanatory variables.

## Potential data sources

The Office for National Statistics are useful sources of reference here including: Census/ Annual Population Survey, Annual Household Survey, Annual Survey of Hours and Earnings, Labour Force Survey and National Travel Survey. The National Travel Survey in particular contains information on individual and household travel activity together with information of economic activity and status. There has been some work in this area developing trip rate models which include information on economic status of households and individuals but much more could be done. Even less work has been done on the application of trip rate model to examine the impact of changing economic and labour market structures at a local level. This application will require the use of "planning data" (eg. information on population, employment and income) at a spatially detailed level. Whilst there are many commercial providers of this type of data and forecasts under 'business as usual' conditions (eg. Experian or CACI), the data and forecasts will need to be developed to reflect the key uncertainties and alternative scenarios on the future of the UK economy and structure of the labour market at a local level. A potentially useful example of the sort of analysis needed is provided in the Northern Powerhouse Independent Economic Review undertaken for Transport for the North (2016).

# Theme 2. Socio-demographic structure

# Description

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### What socio-demographic trends are likely to be important

Changes in the population mix as a result of trends in birth rates, life expectancy and both regional and international migration are key to estimating both demand for travel and mode choice, and the importance and difficulty in getting these estimates right at a local level are often understated.

Over the last decades, population has been growing rapidly in the UK, partly as a result of immigration and increased life expectancy. The latter coupled with lower birth rates has also led to an ageing population. Not only is our population bigger and older, but also more concentrated in larger cities, with urbanisation being one of the key trends in demographics in the UK as well as across the globe.

In addition to this, people have been studying for longer and delaying when to start a family, which affects people's need to travel and preferences on modes. There is a question as to whether this is one of the reasons shaping changes in people's travel behaviour – for instance, as young people get used to using public transport for their long student lives, they may continue to use these when they buy a car.

A bigger, older and more urban population is likely to have different needs and preferences in terms of travel. In particular, we expect to see an increased preference for mass and public transportation and modes offering improved transport quality for people with reduced mobility.

**Key trends**

— Growing population;

— Later marriage and smaller families;

— Family/personal network dispersion;

— Longer education periods;

— Ageing population and longer lives;

— Urbanisation, household location;

— Changes in car ownership.

# Evidence

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### What evidence there is on these trends

Population statistics clearly show that population as a whole is increasing and that the proportion of people at older ages is on the rise – the proportion of people over 65 has been growing over the last 40 years. This is forecast to increase as a result of life expectancy steadily increasing – 24% of UK citizens will be 65 and over by 2035, up from 17% in 2011, according to the latest ONS projections.

**Figure 11 – UK population estimates and projections (1960-2030) (ONS)**

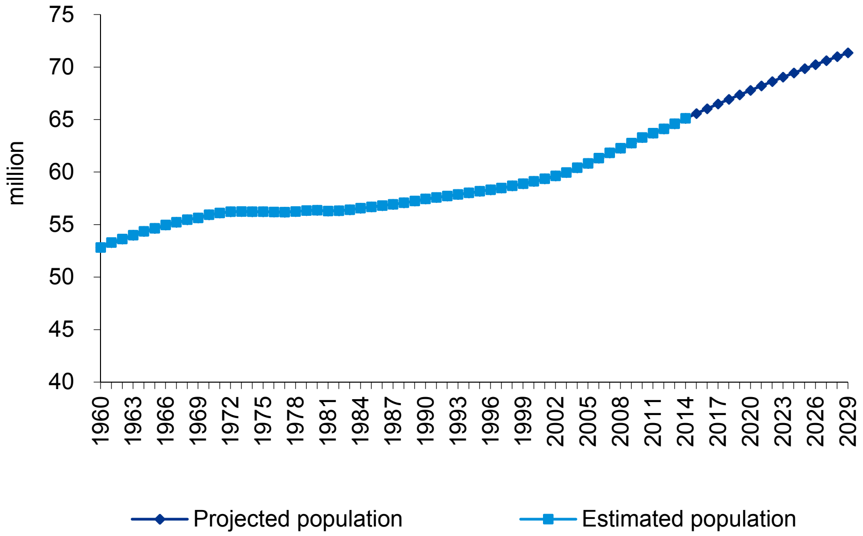
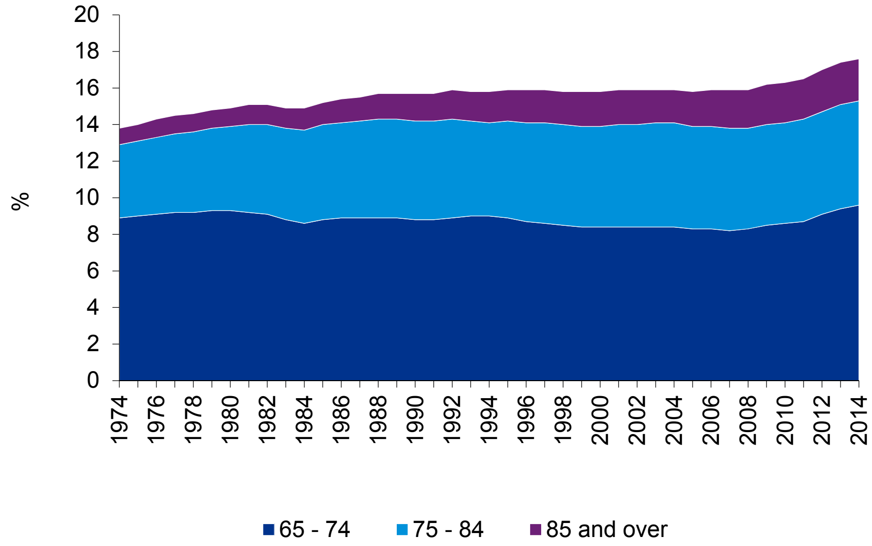



**Figure 12 – Proportion of people at older ages in the UK (1974-2014) (ONS)**



# Evidence (cont.)

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Over the last decades, the data shows that the UK has become **increasingly urbanised** with the larger cities and London in particular projected to be growing the fastest over the coming years according to the ONS.

**Figure 13: Proportion of Urban population in the UK (World Bank)**

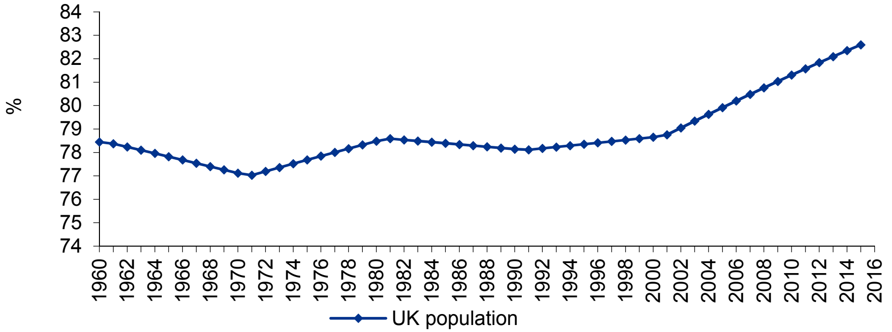
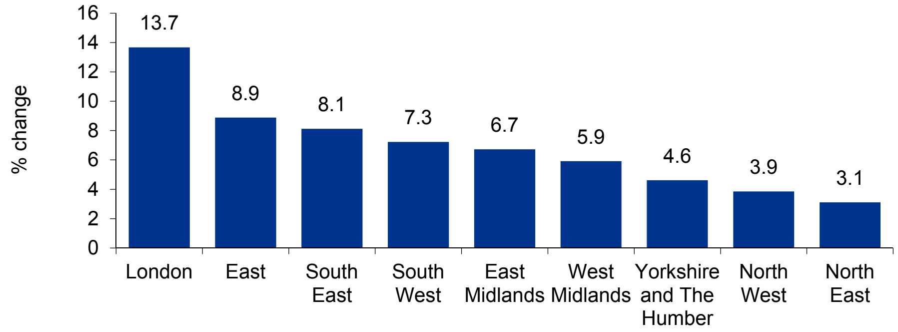



**Figure 14: Projected change in population by region 2014-2024 (ONS)**




In addition to an **older and more urban population**, there is a slowly increasing trend in smaller households, with one person households and lone parent households increasing as a proportion of total households. This is likely to be partly driven by people getting married later. The location of households, longer distance commuting, dispersal of personal networks are all likely to impact on transport needs.

**Figure 15: Proportion of household types (ONS)**

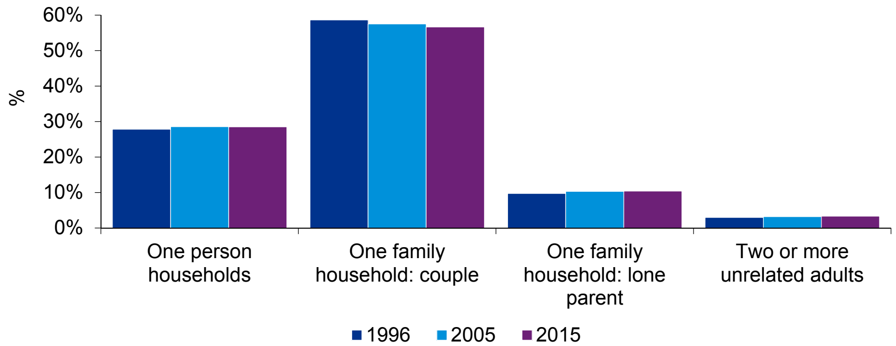
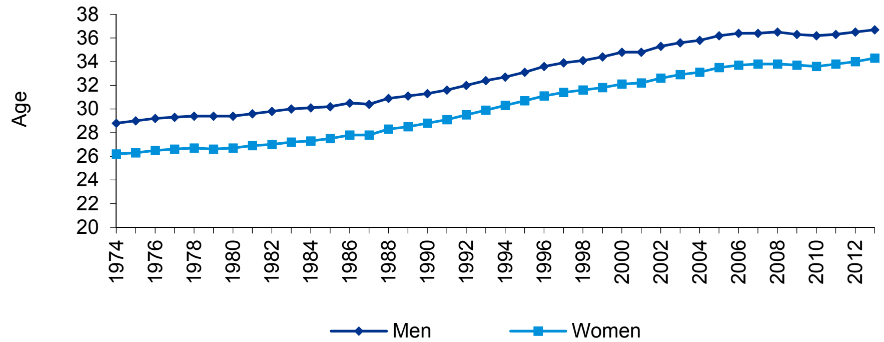



**Figure 16: Average marriage age (ONS)**



# Evidence (cont.)

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As might be expected, patterns of car ownership have and are likely to continue to have a significant impact on the travel market as a whole. Leaving aside issues relating to connected and autonomous vehicles which we consider under Theme 4 there are complex issues to understand in the market for conventional vehicles, including discussions on market saturation, delayed licence holding and vehicle ownership amongst younger people and increased levels of ownership amongst seniors.

In addition to the complexities of licence holding and vehicle ownership are complexities associated with vehicle use – car driving mileage per adult has declined significantly over the period 1995-2014 (ITC, 2016).

Research by Gordon Stokes at Oxford University shows interesting changes in car user behaviour, in particular that:

- Higher income men drive less than they used to, a trend that is more pronounced amongst younger people.
- Driving data by employment status shows that miles travelled has decreased amongst full time employees, compared to retired people or part-time employees.
- The proportion of young people (20 to 29 years old) holding driving licenses has decreased not only in the UK, but all across Europe, showing that it is a common trend across the developed world. This has been driven to a large extent by the cost of driving, including the cost of learning, buying a car and insurance.
- People who learn to drive later in life, drive less.

Changes in the provision of company cars have also been show to have material impacts on the rail market (Le Vine and Jones, 2015) and the historic correlations between incomes/costs and travel are weakening (ITC, 2016).

Changing behaviour among under-30s has made a particularly significant contribution to the overall trends, with young men less likely to use the car, and a slowing rate of growth in car use among young women coupled with a dramatic increase in their rail travel (ITC, 2015).

A recent global survey of 8,000 people by Capgemini (2017) shows that ride-sharing and on-demand taxi apps are considered a viable alternative to car ownership by 34% of people, up from 29% last year.

**Figure 17: Household car availability by household income quintile: England, 1995/97 and 2015 (NTS 0703)**

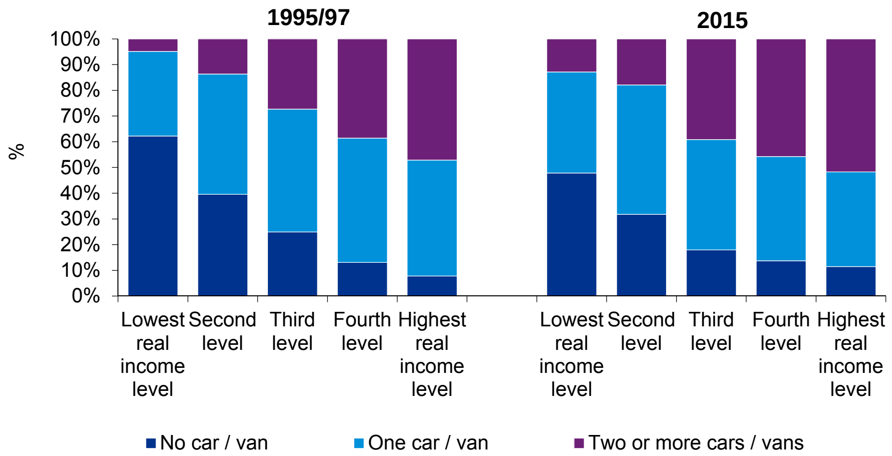
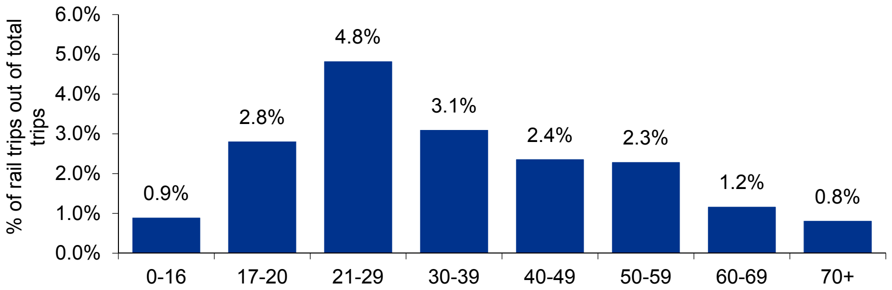



**Figure 18: Proportion of rail trips out of average trips per person by age (NTS)**



# Outlook

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### Impacts over time

Demographic changes take place over time. Over the next 15 years, we can expect current trends to continue their current trajectory, and by 2030 we expect the UK population to be larger, with a higher proportion of people over 65 years old, live mostly in bigger cities, in smaller households and with a lower number of cars per household.

There is a debate as to whether we have reached peak car ownership and new technologies (eg. autonomous vehicles), business models (eg. car clubs) as well as policies (eg. road pricing) will play a key role in determining this. An issue we return to under Theme 4.

Uncertainties remain around the location of population as this will depend on where economic activity is attracted to, which in turn will depend on investments and policies. It will also depend on the location of new housing as part of the government's policy on the housing market (DCLG, 2017).


### Key uncertainties

Although demographic trends seem to follow a linear trend, there are some uncertainties around how socio-demographic changes may impact travel behaviour. Whereas we expect population to continue growing older and more urban, one of the key uncertainties is whether car ownership and car travel will significantly go down for the population as a whole as new generations show a higher propensity to use public transport.

At an aggregate level demographic forecasts are thought to be relatively robust but at a local level demographic trends are much harder to predict reflecting changes to local economic conditions, patterns of migration and local societal trends.

# Market segmentation

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### Implications for market segmentation

With regards to socio-demographics, current rail demand forecasting methodologies take population growth and car ownership into account. But travel statistics show that additional demographic factors may help explain different behaviours in terms of travel, especially at a local level.

As with the analysis of changing structure of the economy and labour markets there is a need to consider: how many people will be affected, who will be affected, where those people live and work and how they are likely to be affected by trends and disruptors.

Getting a better handle on the structure of the population at a local level will be an increasingly important part of understanding trends in rail demand. This will need to take account of differences in age, gender, personal income, migration, car ownership, and geographical location as well as factors relating to employment status. Within each of these dimensions there is a need to look more carefully at behavioural patterns to identify sub-groups, for example by groups identified by stage of retirement, participation in higher and further education, household structure, healthcare related activities and dispersal of personal networks.

Some of the differences in travel behaviour between individuals may not be able to be explained with reference to the observed characteristics of the individual and may need to be linked to past behaviour and/or spatial correlations reflecting local attitudes and behaviours. Segmentation by psychographics (eg. personality, values, opinions, attitudes, interests, and lifestyles) may be helpful in this regard.

It is also important to note that travel behaviour even within relatively well defined market segments is not stable over time. Recent work by Transport for London on long-term trends in travel behaviour, using a cross-sectional cohort analysis of London residents' trip rates, car ownership and work-related travel, examines the ways in which people of different ages have changed their travel, both across 'generations' (i.e. as a cross section) and within their own generation, i.e. as a 'cohort', over time (TfL, 2014). TfL's work exposes the 'often considerable dynamism of travel behaviour change and underlines the importance of looking below aggregate-level trends in seeking to understand, explain and influence the causative factors underlying them'.

# Data considerations



## What data is needed

Analysis of the potential impact that changes to socio-demographics could have on rail demand will need a detailed understanding of changes to the structure and location of the population and the relationship between key socio-demographic segments and rail demand. As with data considerations related to the structure of the economy, much of the insight from socio-demographic data will be driven by creative data analytics at a local level.

### Changes to the socio-demographic structure

Changes to the socio-demographic structure will need to consider numbers of people and households, differences in age, gender, personal and household income, migration, household structure, car ownership, and geographical location as well as this factors relating to employment status, all at a local level. The analysis will need to consider sub-groups within each of these dimensions to take account of lifestyle and activity-related differences.

### Differences in travel behaviour related to socio-demographics

An important area for investigation will be to look for patterns in behaviour that are not readily linked to the observed characteristics of the individual or household. The type of disaggregate analysis included in the RDFE Study (ITS *et al*, 2016) is an important contribution but this should be extended to consider behavioural patterns over time and across different geographies. We know that people are influenced by those around them and by their past experiences and this information should be taken into account when looking at future trends.

## Potential data sources

Much of this work can be undertaken using data from ONS including Census/ Annual Population Survey, Annual Household Survey and National Travel Survey but there are also instances where exploratory market research may be needed to provided insight into how behaviours may change in response to various trends and disruptors.

The National Travel Survey in particular contains information on individual and household travel activity together with information on individual and household socio-demographics and location. As noted above there has been some work in this area developing trip rate models (ITS *et al*, 2016, WSP, 2009) which include information on household structure and location but more could be done to test specific hypothesis on household structure, income, car ownership and location. Relatively less work has been done on the application of these models to examine the impact of historical changes on aggregate demand for rail travel and on the development of future scenarios to test how these changes could evolve.

Note: The NTS is a long running survey which uses a high-quality methodology to collect a broad range of information on travel behaviours at the England level. The methodology has been broadly unchanged over several decades meaning that trends can be monitored. Figures are weighted to be representative of the population. However, like any statistical source, the NTS has its limitations, largely but not exclusively related to sample size. Further details of the survey are available of the UK Data Service website (https://www.ukdataservice.ac.uk/).

# Theme 3. Alternatives/ substitutes to travel

# Description



### What alternatives to travel are likely to be important

In addition to changing economic and socio-demographic structures influencing the need to travel, there are existing and new technological trends that may reduce the need to travel. These include virtualisation, remote working, 3D printing, and online services such as education, banking or shopping delivered by road or potentially in the future by drones. All these trends allow people to:

— Engage in activities from any location provided they have a good internet connection and a device to connect to the internet;

— Produce new good or items with limited infrastructure (eg. 3D printing);

— Transport goods and provide services without the need for a physical person to travel (eg. drones).

These technologies are highly attractive for customers as they are able to access products and services more quickly or/and at a lower cost. This slowly shapes consumer behaviour and expectations, as customers increasingly demand immediacy and personalisation, which these services are able to offer.

In this theme we consider the impacts of remote working, online services, e-commerce and the delivery of goods and services, as well as more speculative impacts driven by 3D printing and drones.

**Key trends**

— Remote working;

— Online services including online education and e-health;

— e-commerce – online shopping, online banking etc;

— Rapid production, delivery and consumption (3D printing, light goods vehicles, drones).

# Evidence



### What is the evidence on these trends

Alternatives to work related travel, either commuting or business related travel include:

- Home working and remote working
- Flexible working and staggered hours
- Video and audio conferencing.

The number of employees who say they usually work from home increased by a fifth (19%) between 2005 and 2015 (TUC analysis of Labour Force Survey data, 2016). The TUC note that there are some notable differences and notable changes between different groups. The biggest growth in regular home working has been among women employees, with 35% more working from home in 2015 than in 2005. However, men still account for the majority of homeworkers. Older employees are more likely to work from home, with 454,000 in their forties and 414,000 in their fifties home-working. The South West has the highest proportion of home workers in the UK (1 in 12) followed by the East of England (1 in 14) and the South East (1 in 16). By contrast, Northern Ireland has the lowest proportion of homeworkers in the UK, with just 1 in 48 employees saying they regularly work at home. The industries with the highest shares of home workers are IT, agriculture and construction.

# Evidence (cont.)

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## What is the evidence on these trends

**Online services and e-commerce** are increasingly demanded, a trend that is particularly strong in the UK. On average, we each spend £4,600 a year online, more than £1,000 more than Americans do. By 2025, we are expected to reach 2.7 billion parcels a year, more than double the 1.3 billion being delivered this year, according to the online-retailers industry body IMRG. This is affecting high street shopping – the latest ONS retail statistics show that December's High Street retail figures slumped to their biggest fall for over four years, while online sales rose 21.3%. Over the last years, big retailers have closed shops, which is attributed to the increase of online shopping. Based on April 2017 data, the Institute for International Finance note that it takes 0.7 employees to generate $1 million in sales per annum for an online retailer, while it takes 3.1 employees at a superstore and 8.4 employees at department stores.

**Education** technology is becoming a global phenomenon, and as distribution and platforms scale internationally, the market is projected to grow at 17% per annum, to $252 billion by 2020. Massive Open Online Courses (MOOCs) have become one of the most high profile aspects of the use of technology in teaching in recent years, with 142 universities providing free courses open to all participants via Coursera and edX alone.

The advancements of digital technologies also have the potential to disrupt the **healthcare** sector, potentially reducing the need to travel. As a result of new digital health applications and gadgets that are able to monitor and help us improve our health (eg. wearables) without the need to go the doctor as well as new online services such as GP consultations through video conferencing, healthcare organisations are able to offer quicker and more cost-effective services. The King's Fund notes that professionals can already hold consultations with, monitor and deliver care to patients at home using home-based remote technologies and video conferencing. This trend is likely to continue. In the future, medical 'apps' for mobile phones will also allow patients to access their medical records, make appointments and seek personalised health information and support.

With regards to **3D printing**, the sales of 3D printers have been rapidly growing, showing a 70% sales growth in 2016, partly as a result of a continuous drop in prices (Wohlers Associates, 2016). These are often used by businesses to produce inexpensive models of new products at a concept design stage. Currently used more heavily in prototyping, the 3D printing industry has a strong potential to grow in the manufacturing of finished products. According to Siemens, compared to 2013 by 2023 3D printing or additive manufacturing is expected to be 400 times faster and 50 times cheaper.

Drones are also quickly penetrating the market, with revenues form drones sales expected to top $12 billion in 2021, up form just over $8 billion last year. Drones have also dramatically gone down in price.

**Figure 19: Average Internet Retail Weekly Sales in UK**

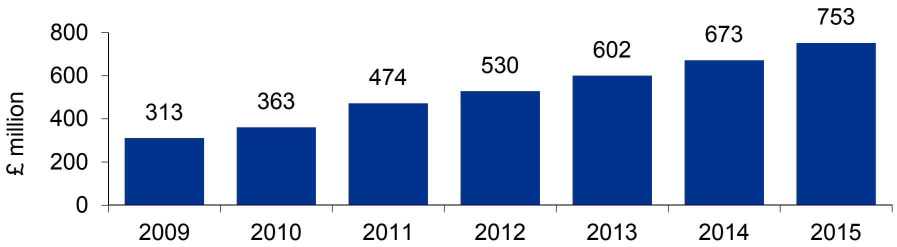
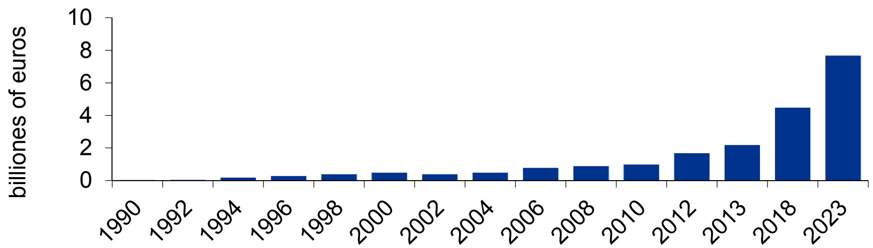



**Figure 20: Global forecast market growth of 3D printing**



# Outlook

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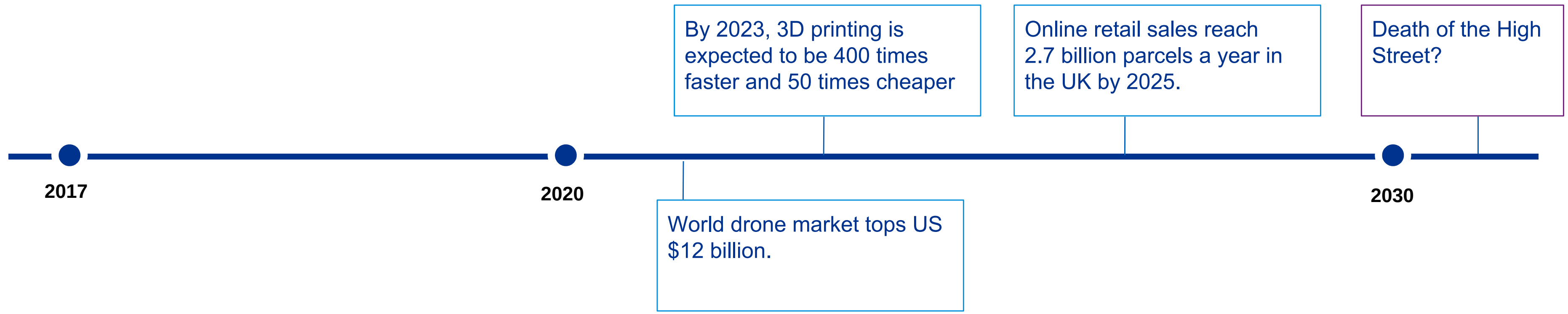
## Impacts over time

Business are increasingly adopting technologies removing the need to travel such as online services, 3D printing and drones are rapidly expanding. Over the next ten years, we can expect industries using these technologies to attract more consumers, which could have a negative impact on travel demand.




## Key uncertainties

It is clear that these industries will continue to grow. However, it is less clear to what extent they will reduce the need to travel to physical shops/services, and to produce or deliver goods.

A big question exist on the future of labour markets with promotion of flexible working as a benefit to the employer as well as the employee. The extent to which trends in remote working will continue is wrapped-up with the future of the labour market more generally and presents both challenges and opportunities to the rail sector. Another big question relates to the future evolution of shopping. The online share of retail trade has grown rapidly causing some organisations to forecast the 'death' of the high street, however other analysts are more optimistic and argue that high streets will simply be transformed providing a more diverse set of goods and services.

# Market segmentation

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## Implications for market segmentation

Segmenting the market to identify different types of consumer behaviour in the context of remote working, online services, e-commerce and the rapid production and delivery of goods is inevitably linked to attitudes to technologies and how these attitudes can be influenced and shaped over time.

Data from the Labour Force Survey shows a strong rate of growth in remote working together with relatively wide variations in the propensity to work remotely across socio-economic groups, industrial sectors and geographical areas. When coupled with the evidence on falling season ticket sales (Figure 8) it is relatively easy to start to build a picture of market dynamics. Further work however is needed to quantify how these trends may evolve and the choices and constraints faced by commuters.

Company travel policy and the use of audio and video-conferencing is an area that needs further investigation. Market segmentation issues are complicated by the fact that travel decisions may involve a combination of employee and employer decision-making. Recent work on the value of time for the Department for Transport may provide a useful starting point to explore variation between geographical locations, business sizes, industry sector, role of travel in production and company travel policy as well as the characteristics of the employee.

Retail sales have historically been quite closely correlated to other measures of economic performance such as employment and GDP, and there are arguments to say that retail trends are captured in rail analysis through their association with other economic metrics. However, given that retail trends are changing, there is a need to understand the who is buying online, what they are buying and are they reducing their use of rail services as a result.

Similarly, growth in online education and healthcare services could potentially result in a reduction in transport needs. There is very little published to identify who is taking up these services and the extent that they are supressing demand for rail. Segmentation in this area is likely to involve some combination of observable characteristics such as age together with information on tastes and preferences.

# Data considerations

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## What data is needed

There are two stages to understanding the impact of alternative to travel on rail demand. The first stage involves consideration of the driver of change and the second stage involves understanding the relationship between the driver and rail demand. Whilst there is at least some information on the drivers of change there is much less information on their relationship with rail demand.

### Remote working

The ONS Labour Force Survey contains data on work patterns including information on remote working and some information on the journey to work. This, coupled with travel diary information in the National Travel Survey, should provide data for exploratory analysis.

### E-commerce, online shopping

There are multiple sources of data on online shopping including the ONS Food and Expenditure Survey and e-commerce survey as well as commercial surveys including those by the trade body Interactive Media in Retail Group (IMRG). The challenge is linking this on online shopping with data from travel surveys on trips by journey purpose to identify trip generation and suppression.

### Online services for education and healthcare

Data on the provision and take-up of online healthcare is relatively scarce, in part because the services themselves are relatively new. The NHS New Care Models programme is exploring how telemedicine can be developed. Online education and distance learning is more established although the relationship between online education and travel demand less not well understood.

## Potential data sources

More generally the relationship between online activity and trip generation and suppression is not well understood with extant data only showing part of the behavioural dynamics. More recent samples of NTS data include questions relating to online activity and remote working and trip suppression and this analysis could be included within a programme of work looking at the impact of economic and socio-demographic structure on rail demand. The depth of questioning on online activity and travel suppression in NTS is relatively limited and more targeted social and market research may be needed to specifically explore these relationships in greater detail.

# Section 5.2
# Transport choices

# Introduction

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## Transport choices

In this section we consider three themes relating to transport choices. How attractive rail services are relative to other modes, how well different parts of customers journeys are integrated with each other, and the impact that government policy has on transport choices.

Traditional economic models assume that consumers have perfect information, are rational and make decisions that maximise their wellbeing. However, in reality people base their decisions on all sorts of factors including perceptions and what other people around them do and think. The rail sector has recently invested in developing a better understanding of the customer journey and this understanding needs to broaden to incorporate a better understanding of consumer choice in the context of the changing environment. The travel choices that are available, the integration between modes and the way that the government choses to regulate, invest in and tax alternatives are all expected to change quite radically over the coming period. The impact of autonomous vehicles, mobility as a service and changes to the way we pay for transport services will arguably require new thinking on product take-up incorporating information on customer experience as well as societal attitudes.

Clearly the customer experience is part of the story but there is a need to develop our understanding of consumer behaviour and choice, starting with how customers recognise that they have a need to travel, their search for information on the choices available to satisfy those needs, the purchase decision itself and the post purchase/post consumption evaluation of those choices. This is important for all journeys but it is arguably more important when looking at behaviours relating to discretionary travel. Within this structure, a better understanding of the factors that influence choice include those factors that are in some sense 'internal' to the customer including their motivations, perceptions and experiences, and those that can be considered as 'external' including attitudes and behaviours of reference groups and society more generally. How society could respond to automation could be hugely important to the speed of product take-up.

# Theme 4. Price, quality and availability of transport

# Description

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### What trends are expected on price, quality and availability of modes

Technology is advancing rapidly with the potential to significantly disrupt the transport market. These new technologies, which include connected, autonomous and electric cars, digital railways, high speed rail and possibly even Hyperloop, will affect the competitive position of rail and road by influencing the price quality and availability of modes:

— Automation, alternative business models and greater acceptance of the sharing of assets (thereby increasing their productivity) could dramatically influence the costs of both private and public transport.

— Investment in new infrastructure and improvements in capacity of existing transport networks through digital traffic management could dramatically impact journey times, service frequencies, network performance and reliability. For highway networks, part of this will depend on the role of the state in removing co-ordination failures.

As a result of the disruptions brought by these new technologies, we expect to see changes in transport user behaviour, as they adapt to find the new most convenient mode of transport.

The complexities of travel decisions, together with the introduction of new choices are not well dealt with under the demand forecasting framework currently used in the sector.  Direct demand/elasticity models have many advantages but the also have material limitations. There is a need to develop a much more detailed understanding of the choices that individual customers face, which when joined with data on the observed and unobserved (psychographic) characteristics of the customer can be used to understand how customers are and might respond to changing market conditions. The Rail Delivery Group notes that: ‘Customers must be at the heart of everything we do in the rail industry’. Customers must also be at the heart of demand analysis.

**Key trends**

— Connected, autonomous and electric vehicles;

— Digital railways;

— High Speed Rail;

— Hyperloop;

— Micro mobility;

— Sharing economy

# Evidence



### What is the evidence on these trends

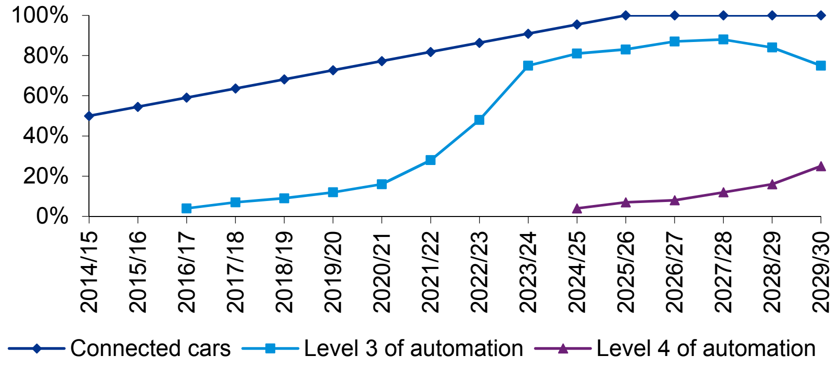
Digital railways, a large transformation programme of the railways involving the implementation of digital technology, will deliver substantial service improvements to accommodate a billion annual rail journeys expected by 2030. Similar improvements have been carried out already in the London Underground which have led to an increased number of trains on the Victoria Line from 28 to 34 trains an hour.

With regards to vehicle technology[4], KPMG estimates in consultation with industry experts that 95% of cars will be connected by 2025 and that 25% of cars on the road will be fully automated by 2030.

Not only will driverless cars allow more people to travel who don't have a driving licence but they will also decrease significantly the cost of taxis, if these also become driverless – having no driver to pay could reduce taxi prices still further.

Finally, currently in testing stage, the first prototypes of Hyperloop are expected by 2020/2021. This new mode of transport is said to be able to reach 700mph, resulting in dramatic time savings (KPMG 2017).  The potential of this mode is certainly exciting but commercial implementation may be some time away.

**Figure 21: Connected and AV technology take up rates**




Source: Connected and Autonomous Vehicles – The UK Economic Opportunity (KPMG, 2015).

[4] The government describes connected and autonomous vehicles as incorporating a range of different technologies, facilitating the safe, efficient movement of people and goods.

Increased connectivity allows vehicles to communicate with their surrounding environment. This provides valuable information to the driver about road, traffic and weather conditions.

Vehicles with increasing levels of automation will use information from on-board sensors and systems to understand their global position and local environment. This enables them to operate with little or no human input (be driverless) for some, or all, of the journey.

# Evidence (cont.)

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New technologies have the potential to transform the way we travel. These include AVs, digital railways, and more speculatively, Hyperloop, as well as other smart mobility initiatives. The provision of both car and rail services is set to improve significantly over the coming decades, either through existing technology such as High Speed Rail or new technologies such as AVs.

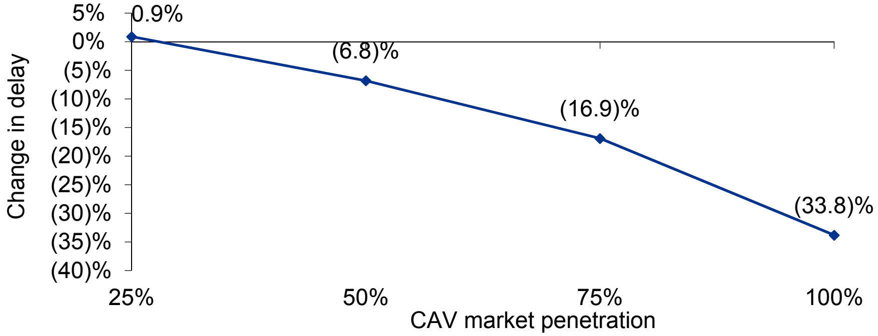
The impact of these technologies on travel will depend to a great extent on new business models making the most of them – this means offering convenient and affordable services to customers. This could for instance include driverless taxi services with facilities which allow people to use their time productively while they are sitting in the car with a user friendly platform for booking trips.

New business models, for instance apps that connect drivers and customers such as Uber, which offer low cost travel, have expanded at an exponential rate and are contributing to changing how people travel. Uber already operates in 603 cities across the world and has been valued at US$69 billion. The combination of these business models with AV technology could considerably increase car travel demand, affecting the rail industry.

The incentives to use AVs versus rail will vary by journey distance and by origin and destination, with long distance travel between cities more likely to be faster by rail as a result of increased investments in High Speed Rail connecting the main cities across the UK. The choice of High Speed Rail versus AVs will depend on people's willingness to trade off journey time certainty with flexibility of travel.

In addition to this, there is a big debate as to whether AV technology will result in such a significant mode shift to cars leading to high levels of congestion. A recent report by Atkins (2016) commissioned by the Department for Transport estimates that congestion could increase by 0.9% in the short-term as a result of connected and autonomous vehicles, but a reduction in congestion as the proportion of these vehicles on the road increases. It is here where public policy could play a big role in influencing travel behaviour through road investments, road pricing, changing speed limits or by limiting the number of cars on the roads. Cities across Europe such as Oslo have the ambition to remove cars completely from city centres.

**Figure 22: Impact of Connected and Autonomous Vehicles on delays (Atkins 2016)**



# Outlook

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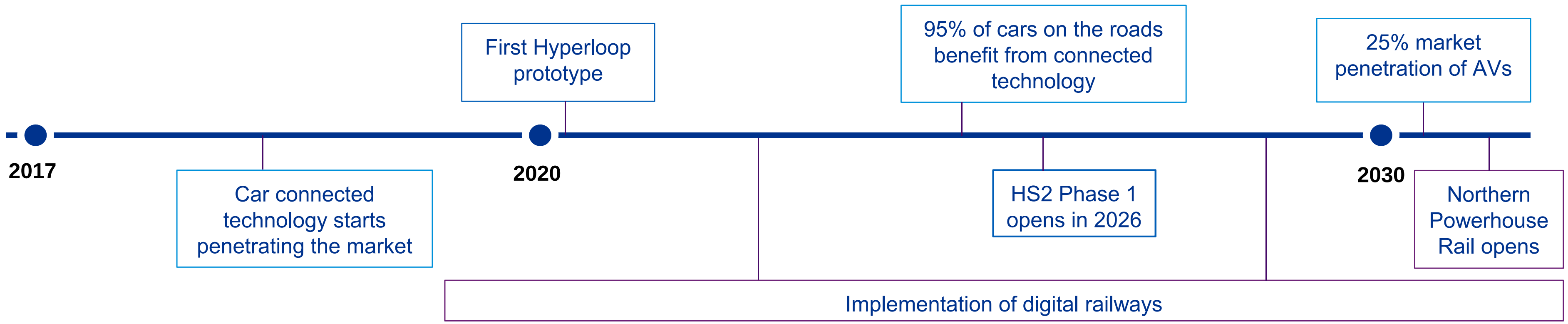
## Impacts over time

The next decades will bring significant changes to the travel market with the largest changes expected in the medium term (from 2025 onwards) as new High Speed Rail lines open, most cars make use of connected technology and a clear picture emerges as to how AVs might change the way we travel.

As the benefits of this technology increase the more people use them through network economies – the more people use connected cars, the more complete the information these cars will receive and the better they will react to it.

In the long term – By 2050 – AVs are expected to be the main form of car on the roads.




## Key uncertainties

Important uncertainties exist with respect to both the implementation and impact of new transport technologies. It is likely that these technologies will require government support in delivering the necessary infrastructure and regulation for these technologies to operate, as well as private sector involvement in developing business models that use these technologies (eg. car sharing using driverless cars).

With regards to the railways, the implementation of digital railways could take a long time. The timing of this will determine the rail industry's competitiveness with respect to advances in road vehicle technology.

# Market segmentation

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## Implications for market segmentation

Similarly to the analysis of alternatives to travel, a key aspect for market segmentation in the analysis of new technological trends in the transport market is attitude to new forms of travel, risk and technology – i.e. how fast do people change their behaviour and will the timing of the introduction of new technologies matter in shaping customer behaviour.

Attitudinal factors are usually correlated with age and education level, and therefore demographic variables may be useful in segmenting the market.

The analysis of socio-demographic trends has shown that younger people are more inclined to use public transport for a number of reasons including the cost of driving. However young people are now often using ride request apps like Uber to travel.

In segmenting the market to analyse the impact of new technologies that disrupt the market and therefore have a more than marginal impact on the provision of transport, different behavioural models may also be useful to forecast demand. These models may group people by their past behaviour as opposed to demographic variables. This is for instance used by companies such as Netflix, which segment customers by their past behaviour and use that to forecast which content they will be most attracted to.

The segmentation of customers by behaviour will be possible as the booking and payment of trips becomes fully digital and operators are able to collect time series of customer data through their digital sales channels.

In short, much more detail of the choices available to customers based on micro, geo-referenced data is required to support a much more detailed analysis of the choices customers make.

# Data considerations

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## What data is needed

As noted in the introduction to this section of the report there is a need to look more closely at the choices customers make and how customers make those choices. Direct demand/elasticity models have many advantages but the also have material limitations. There is a need to develop a much more detailed understanding of the choices that individual customers face, which when joined with data on the observed and unobserved characteristics of the customer can be used to understand how customers are and might respond to changing market conditions. The complexities of travel decisions, together with the introduction of new choices are not well dealt with under the demand forecasting framework currently used in the sector. For example, it is no longer sufficient to develop a relatively crude cross-elasticity of demand for rail with respect to bus fares with reference to very aggregate bus fare indices. We really need to understand the actual trade-offs than people make when making their choices.

There is no single source of data that will be suitable to meet the needs of the sector. Instead, data will need to be assembled from different sources to reflect the different influences on demand. The key here will be in the use of micro-data describing customer characteristics, attitudes and choices. The data will need to be geo-referenced to make sure that it describes local conditions and the actual choices people face.

Customer choices recording individual trips or groups of trips combined to form end-to-end journeys can be observed from travel diaries or passively via mobile location technologies. Publically available data on timetables, fares, road conditions, delays, congestion etc. can be used to reconstruct the travel choices available for specific journeys to examine the sensitivities and trade-offs that are important to customers. If this information can be combined with a better understanding of the customer's needs (i.e. the activities they undertake) and experiences, a clearer and much richer picture of the factors driving demand will be able to be developed. This could be further enhanced by examining how individual tastes and preferences change over time and how they are influenced by reference groups and broader societal trends.

## Potential data sources

The National Travel Survey contains much of the data needed, including information of the household, individual, and travel patterns. The NTS data does however have two material limitations when it comes to understanding customer choices. The first is that it only contains information about the journey undertaken and not the alternatives that were also available to the individual. In the past, analysts have tried to in-fill missing information with estimates based on more aggregate data and assumptions but the availability of online travel planning data means that more accurate data on the actual choices individuals face can be assembled. The second limitation is that the NTS is based on household travel diaries with respondents completing questionnaires from memory. Some of the risks associated with under- or mis- reporting of trips can and are being mitigated against using GIS technologies alongside travel diaries. Another way to mitigate against this risk is to use mobile phone location data to produce a more aggregate view of point-to-point demand.

The use of mobile phone location data to generate is however still in its infancy and whilst progress is being made there are still concerns on its accuracy and limitations in identifying key journey attributes such as mode type and journey purpose and lack of information on the socio-economic characteristics of the traveller.

Finally, it is important not to forget the role of market research in exploring attitudes to changing services and opportunities, potentially with greater innovation and use of mobile devices to present and capture questions and answers.

# Theme 5. Integration between modes

# Description

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### What trends might impact integration between modes

Digitisation is already transforming transport provision enabled by smartphones and new digital platforms. A key aspect of this is constant access to information to scheduled and live service provision.

Digital information is increasingly playing a key role in how we use transport and mitigating existing issues that have traditionally affected travel demand. For example, having to wait for a bus can put people off public transport, however this is increasingly happening less as people are able to check live information on waiting and journey times. Queuing up for a ticket is also becoming a thing of the past, with technology enabling easy purchases and validation through digital platforms.

It is expected that in the near future digital platforms will allow us to book a personalised point-to-point journey using different modes without the need of buying multiple tickets, generally referred to as ‘Mobility as a Service’ (MaaS). Overall, as information becomes more complete and uncertainty is reduced, people are able to travel more efficiently and be more willing to use public transport. Information is highly valued by travellers. Willingness to pay analysis has shown that people value information on live departure times and maps with location of stops.

Finally, in addition to allowing people to make better decisions based on more complete information, digital technologies will also allow for better demand management, for instance during disruptions, improving the travel experience for everybody.

**Key trends**

— Mobility as a Service;

— Real-time, personalised information;

— Account based ticketing;

— Use of digital biometric information;

— Sharing economy.

# Evidence

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### What is the evidence on these trends

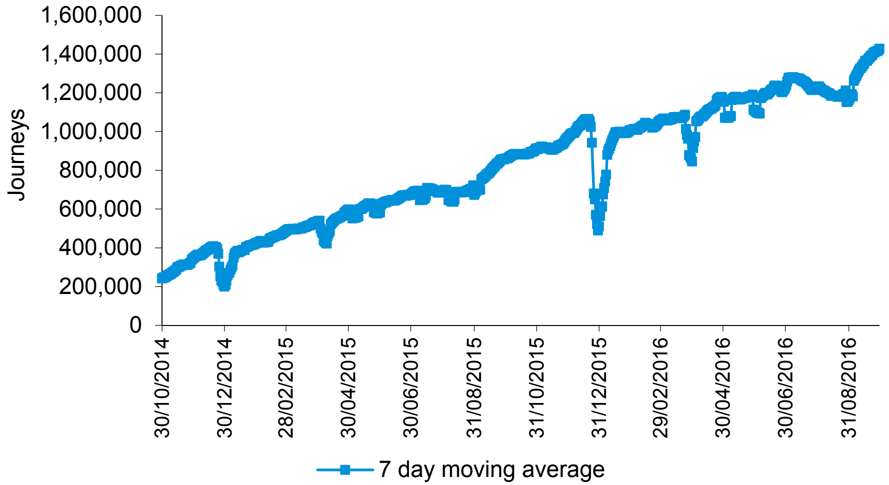
More than 450 travel apps covering all modes of transport are available on the market powered by TfL's free open data, reaching millions of customers. These include the popular and highly ranked apps Google Maps and Citymapper, which provide users with live information on how to get from one location to another using any of the modes available or a combination of them. This brings significant benefits to users in journey time savings – It has been estimated that the economic value of time saved thanks to apps in London is between £18 million and £58 million per year.

With regards to MaaS, the rate of implementation and take up will not only depend on the technology but also on the willingness of operators to work together to integrate services and implement revenue sharing mechanisms.

Complementing the role of digital information are new forms of ticketing. The take up of new ticketing forms has happened quickly, with people rapidly adapting to it. New forms of payment such as contactless allow people to travel without the need for a special ticket with the guarantee that they are paying the lowest price.

Since its introduction in 2014, more than 900 million contactless journeys have already been made in London. In the future, biometric information, already used for contactless payments on mobile phones, may provide options for new forms of ticketing – Already 27% of smartphones include a fingerprint reader. The market intelligence firm Research and Markets forecasts that annual biometrics hardware and software revenue will grow from US $2.4 billion in 2016 to $15 billion worldwide by 2025, representing a compound annual growth rate (CAGR) of 22.9%.

**Figure 23: Number of journeys processed by TfL made using contactless payment.**



# Evidence (cont.)

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## New business models

Enabled by digitisation, new business models are slowly shaping social attitudes and preferences. Through the **sharing economy**, people start to feel less the need to own things (eg. cars and bikes), and adopt a more flexible behaviour based on their immediate needs.

At the same time, an increase in online services, which provide an increasing range of personalised products and services to costumers, is also contributing to changes in consumer behaviour and how people interact.

The UK's sharing economy is expected to expand over the next decade. An increasing prevalence of the sharing economy will further shape preferences towards ownership and consumption.

According to Car Clubs UK, there are over 40 car clubs in the UK, including community car clubs. Based on the latest annual car club survey, over the past five years, there has been sustained growth in car club membership – To over 27,500 members using almost 1,100 vehicles in England & Wales outside London. The reach of car clubs continues to expand, covering an increasing amount of locations. The most frequently cited reason to join a car club is 'my household did not have a car, so I joined a car club to gain additional personal freedom'. The expansion of car clubs has been enabled through technology – Cars are booked online or though apps 91% of the time.

# Outlook

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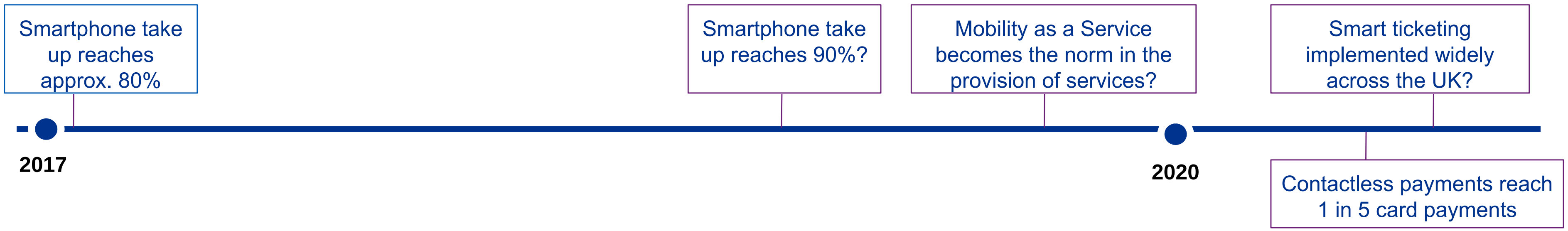
## Impact over time

The impact over time of digitisation is already being felt and therefore the largest impacts are expected in the short term. However, the exact timing of these remain uncertain and will depend on the transport providers working together as well as Government investments.




## Key uncertainties

There is some uncertainty surrounding the implementation of MaaS and mode integration. This is partly because this depend to a large extent on public policy and investment, which is often required to address coordination and provide the right incentives to accelerate the implementation of these services which could greatly benefit customers. A clear example of this is the implementation of smart ticketing in the UK, which is still to be implemented in numerous locations despite the fact that proven technology is available.

# Market segmentation

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## Implications for market segmentation

Similarly to the trends related to the competitive position of rail and road, demographic factors including both observable (age, sector of employment) and unobservable personal characteristics (attitude to technology) are likely to play a key role in people's propensity to use a certain mode of transport that provides this technology. Data sources such as the National Travel Survey or Experian provide useful information for market segmentation based on these factors.

Mobility as a Service will be key for market segmentation, as it will allow for datasets to be created that include which trips people book based on information across modes, thus providing valuable information on mode choice. Through digital multi-modal ticketing platforms, users will be able to choose a trip based on centralised and complete information. The cost of accessing information for each mode of travel will be the same. This also provides valuable information with regard to people's behaviour, including how they trade-off price for journey time and flexibility for journey time certainty, for example.

The latest Car Club Annual Survey Report (2015/16) presents details of the characteristics of car club users based on analysis of members' postcodes and Experian's Mosaic segmentation tool:

— Youngsters renting in vibrant city centre locations (Central Pulse, 11%).

— Prosperous households in accessible inner suburbs (Uptown Elite, 8%).

— Young professionals in their 20s and 30s (Metropolitan High-Flyers, 8%).

— Other Mosaic types include older residents owning inner suburban properties (Ageing Access, 7%) and people in their 20s and 30s progressing in their careers living in commutable properties (Career Builders, 6%).

Factors such as age, location of residence and profession are likely to play a big role in segmentation in the context of mode integration.

# Data considerations

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## What data is needed

Improvements in digital communications can reduce barriers to using transport networks, by providing information to customers to help plan, undertake and pay for the journeys they make. In many instances, this information is already available but it is arguably not as coordinated as it could be. Customers have increasingly high expectations with regard to digital service and innovation. Most people already use the internet on a daily basis, and many access the internet via mobile to help with travel decisions. Advances to account based ticketing have already proved their appeal as demonstrated by the use of contactless payment cards in London.

Developing a better understanding of journey complexity, together with information on the parts of the journey that are most challenging or stressful will help inform the development of systems to make things easier for customers and help improve the management the network as a whole. Rail ticket systems only record information on part of the journey, and even that is sometimes not complete.

Data supplied by mobile phone companies can help provide information on aspects of customer journeys that are not possible simply by looking at ticket sales data. This information can be combined with data from Wi-Fi hotspots, Bluetooth technologies and ticketing systems to develop a better understanding of the travel choices that customers make.

# Theme 6. Policy and regulation

# Description

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### What policy and regulation trends are important

The market impacts of government policy and regulations are far reaching. Government influence on rail demand includes indirect influences such as changes to economic policy and other impact are more direct such as:

— Investment in infrastructure and other capital projects

— Taxes and subsidies, including for example fuel duty and the Network Grant

— Economic regulation of market power and competition, including efficiency targets for Network Rail and policy on moderation of competition on the tracks

— Regulation of safety and operational standards, including cybersecurity

— Environmental standards and controls, including for example the introduction of clan air zones.

Looking further ahead, government policy and regulation will need to guide the introduction and development of new technologies and business models where potential market failures exist. One of the challenges facing transport markets is the introduction of autonomous vehicles for both public and private transport.

At a macro level, government policies on globalisation, international trade and devolution of power to local bodies are also likely to be important influences leading to changes in transport demand and competition and choice between modes.

**Key trends**

— Licensing;

— Regulation;

— Demand management and charging;

— Infrastructure investments;

— Economic policies.

# Evidence

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### What is the evidence on these trends

Infrastructure investments delivered by the public sector also have the potential to greatly influence transport markets and the competitive position of different modes. Motivated by the relatively poor state of UK roads – ranking 29th in the World Economic Forum road quality ranking, behind countries like France and Germany ( in 7th and 13th position respectively), the UK Government is investing large sums of money in the road network over the coming years.

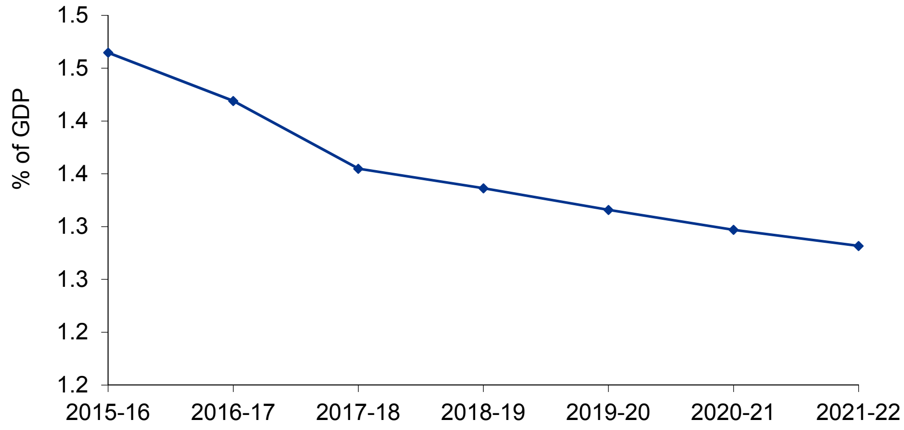
In addition, changing technologies and new business models will require changes to government policy and regulation to mitigate against potential market failures. The change in propulsion technologies may also stimulate a change in the way road transport is taxed and paid for. In the medium term, it is likely we will see changes in how roads are funded. This is because fuel duty is forecast to decrease as more fuel efficient and electric vehicles become more prevalent, which could lead to some forms of road pricing being introduced. Figure 24 shows the reduction of fuel duty as a proportion of GDP.

Other policies that could have a substantial impact on travel behaviour are changes to regulation such as bans on cars in a move to make cities more walkable and free of pollution. Some cities like Oslo intend to have car-free city centres and London is considering pedestrianisation of Oxford Street. The Government could also introduce limits to the number of cars providing rides through new business models such as Uber to avoid further increases in congestion.

Changes to the way local public transport markets work through the Buses Services Act 2017 has the potential to affect the railways. By making it easier to introduce franchising, new bus routes and services may be introduced subject to local funding which could both compete with the railway or favour the use of the railway by providing better access to rail stations.

In addition to transport infrastructure investments, other economic investments and policies will affect which sectors and locations will grow more and therefore what type of travel will increase over the next decades. For instance, policies to rebalance the economy may enable greater growth in the North of England, potentially creating more travel demand.

**Figure 24: Forecast fuel duty receipts as a percentage of GDP (OBR)**



# Outlook

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## Impacts over time

In the short term, we expect changes to bus policy to be investment in transport infrastructure, while in the longer term we could see changes in regulation of car travel as a result of new forms of driving and changes to vehicle technology.


## Key uncertainties

Uncertainties exist in relation to policy and regulation impacts over the long term as a result of political cycles. Each government is likely to change policy and therefore it is very difficult to forecast what policy impacts we might observe in the long term. However, these play a key role as they are closely linked to all of the other themes identified so far.

## Market segmentation and data considerations

Policy and regulation impacts are an important aspect of rail demand and should be considered separately to other demand drivers. As their impact on demand can be largely viewed through the lens of price, quality and availability, market segmentation and data considerations are best dealt with under Themes 4 and 5.

# Section 6. Summary and conclusions

# Our approach

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### Background

Customer behaviour in the transport market has been changing. Increased use of rail, lower number of trips per person and longer distance travelled per trip are key characteristics of these changes. There are concerns within the rail sector that methodologies used to understand and forecast changes in demand in response to internal and external changes have lost some of their ability to produce reliable rail demand projections. Questions have emerged as to whether this trend will continue, especially in the context of the rapid economic and social changes happening across the UK and globally.

Against this background, the purpose of this work is to assess the drivers of transport demand and the competitive position of rail in both the near and longer term, with a view to define priorities for future research and analysis. In assessing these trends, the scope of the work has also included assessing the implications of these trends for customer behaviour and market segmentation, and considering the availability of data sources that might be useful to segment the market and analyse demand for rail travel.

### Our approach

Our approach has been structured around the following four stages:

1. Identify a long list of market trends and disruptors →
2. Assess the impact of market trends and disruptors on travel demand and mode choice →
3. Group key trends into themes for further analysis →
4. Assess implications of themes for market segmentation and data

We have sought to reduce the scope for further research by identifying and grouping the key themes that are worthy of detailed exploration, while also considering the implications for customer behaviour and how this translates into meaningful market segmentation approaches.

# Assessment of trends and disruptors

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### Identifying a long list of trends

We have conducted an extensive desk-based review to identify a long list of trends across eight different dimensions: Political, Economic, Demographic, Social, Environmental, Legal, Technological and Digital. The output of this work is a list of 50 market trends and disruptors. The key trends are shown below:

- **Economic.** Changes to the labour market through automation, the gig economy and flexible working;
- **Demographic.** Growing, older and more urban population living in smaller households;
- **Social.** The sharing economy, remote working, online services, personalisation and immediacy;
- **Political.** Capital investment, globalisation, devolution, regulation and demand management;
- **Legal.** Regulation, cybersecurity;
- **Digital.** Mobility as a service, data and analytics, virtualisation, use of biometric information, blockchain, artificial inteligence;
- **Technological.** Automated vehicles, high speed rail and digital railways, 3D printing, drones;
- **Environmental.** Pressure on resources, clean air, climate change.

### Impact assessment of trends and disruptors

We have reviewed each trends and disruptors in terms of their potential to impact:

- Need to travel. Whether this trend will affect the overall demand for travel and transport across modes
- Competition and choice. Whether a trend will improve the competitiveness of specific modes
- Market segmentation. How the trend is likely to impact more on specific market segments.

This assessment has shown whether the identified trends are expected to have any impact on rail demand and whether this will be positive or negative, as well as what the key uncertainties are.

# Six themes for further investigation

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### Grouping market trends and disruptors into themes

We have grouped trends into six themes based on their impact on transport needs and transport choices.

**Transport needs**

The impact of trends and disruptors on transport needs are likely to be material through their influence on economic and social activity, demographics and alternatives to travel. Important themes include:

- Theme 1. Changes to economic and labour market structures.
- Theme 2. Changes to demographic profiles including household structure, migration, urbanisation and household location, as well as changes in social trends including dispersed personal networks, changes to income distribution, participation in education, changing societal attitudes and expectations.
- Theme 3. Alternatives to travel including remote working, online services and the rapid production and delivery of goods.

**Transport choices**

The impact of trends and disruptors on competition and choice are likely to be material through their impact on quality and price of alternative modes, integration between modes and government policy and legislation. Important themes include:

- Theme 4. Anticipated change in connected and automated vehicles, and propulsion systems, together with changes in the quality of public transport including high speed rail and digital railways.
- Theme 5. Integration between modes through new technology, new business models and personalisation.
- Theme 6. Regulation, licensing and demand management.

A summary assessment of each of the six themes is presented on the next two slides.

# Transport needs - Summary

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| Themes | Description | Short term forecasts | Long term forecasts | Impact on travel | Key uncertainties | Implications for segmentation | Data for segmentation |
|---|---|---|---|---|---|---|---|
| **Changes to the economy structure** | The labour market is expected to change over the coming decades through:<br>— Flexible working;<br>— The Gig Economy;<br>— Automation and robotics;<br>— Changes in productivity. | Trends in flexible working and the Gig Economy will continue in the short-term. | Automation could disrupt numerous industries in the longer term. It has been estimated that 30% of jobs could be at risk by 2030. | There is a trend in increased economic activity rates, which could be a consequence of new flexible forms of employment. This could have a positive impact on travel.<br>On the other hand, job losses as a result of automation and remote working could lead to reduced travel. | The impact of automation on the job market remains a big uncertainty – there is a debate as to whether it will result in a significant decrease in jobs or whether it will create new jobs and forms of employment.<br>Automation could also change the sector mix, which will affect the location of economic activity. | Employers and Employees across different sectors<br>(Changes in automation will have different impact on employees depending on the sector and type of skills) | — Employment data by sector and skills level<br>— Land use changes |
| **Socio-demographic changes** | Over time, population is expected to gradually change and become:<br>— Older;<br>— More urban;<br>— Living in smaller households;<br>— Owning less cars. (depending on automation) | By 2024, London reaches a population of nearly 10 million. | 24% of population is over 65 years old in 2035 | A more urban population is likely to travel less, however increasing dispersion of personal networks may increase travel. | It is unclear how an ageing population will change the travel needs of the population.<br>It is unclear whether we have reached peak demand and how trends in car ownership will evolve. | As population ages, the number of people who are not employed will increase and different groups within this group may emerge. | — Age<br>— Location and type of residence<br>— Attitude to ownership |
| **Alternatives to travel** | Technology is increasingly allowing people to do more things remotely without travelling:<br>— Remote working<br>— Online services<br>— local production through 3D printing<br>— Unmanned delivery of goods | By 2023, 3D printing is expected to be 400 times faster and 50 times cheaper.<br>Online retail sales reach 2.7 billion parcels a year in the UK by 2025. | Death of the High Street? | | There is a debate as to whether an increase in the quality and availability of online services will remove physical shops or service centres and will dramatically reduce travel. | The whole population is likely to be affected by these changes although people with different preferences will respond to these trends differently.<br>Shopping behaviour will determine how people react. | — Remote working<br>— Shopping behaviour |

# Transport choices - Summary

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| Themes | Description | Short term forecasts | Long term forecasts | Impact on travel | Key uncertainties/Scenarios | Implications for segmentation | Data for segmentation |
|---|---|---|---|---|---|---|---|
| **Price, quality and availability** | The price, quality and availability of modes is expected to be significantly disrupted over the next decades through technology. These include both existing and new technologies:<br>— Connected and autonomous vehicles<br>— Digital railways<br>— High speed rail<br>— Hyperloop | HS2 Phase 1 opens in 2026.<br>Connected cars start penetrating the market and reach 95% market share by 2025.<br>First Hyperloop prototypes expected to be ready by 2020/21 although full delivery is some way off. | By 2030, 25% of cars on the road could be driverless. | Autonomous vehicles are likely to significantly reduce the cost of car travel through better use of cars and by removing the cost of the driver.<br>Digital railways and high speed rail will improve rail travel and increase capacity | The impact of driverless cars has generated a lot of debate as it is unclear how it will impact congestion and car ownership. This will depend on new business models and demand management policies. | We can expect different customer behaviours in response to these trends depending on:<br>— How far people travel;<br>— When and where to they travel;<br>— How flexible they are in their travelling;<br>— Whether they own a car. | — Car ownership<br>— Location of residence<br>— Type of destination<br>— Length of journey<br>— Journey purpose. |
| **Integration between modes** | Although smart ticketing has been around for a long time, new digital technologies combined with new business models for instance through the sharing economy can significantly improve the customer experience when booking journeys and travelling. | Although we expect smart ticketing to continue to be implemented in the short term, it is unclear when Mobility as a Service (MaaS) type business could start operating. | | Better digital information and integration of ticketing could have a positive impact on travel across modes. | The timing of the implementation of Mobility as a Service remains a big question mark. Implementation will require coordination and investment from public and private organisations. | We can expect 'early technology adopters' to be more likely to increase their travel as a result of these technologies. | — Data on internet use and smartphone use<br>— Age<br>— Access mode to rail station<br>— Car club membership |
| **Policy and regulation** | New regulation and policies has an impact on people's incentives and ultimately their behaviour. | It is unclear how governments will respond to new technologies and introduce new regulation or demand management policies. By changing incentives, these policies can great influence travel behaviour. | | | | An appropriate market segmentation will depend on which policies or regulations are introduced. | |

# Timeline of trends and disruptors

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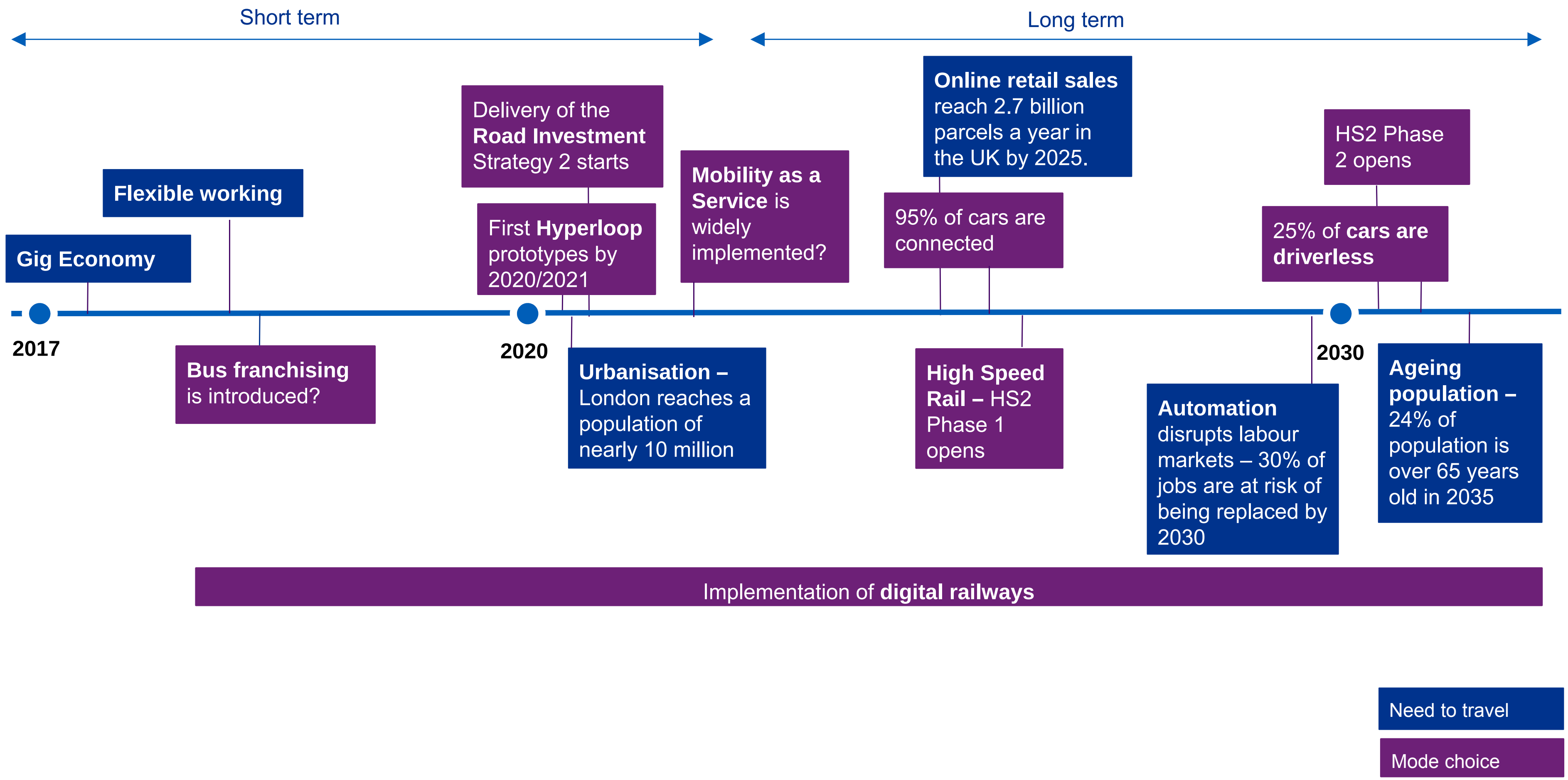
The timeline below summarises the forecasts around the key trends identified. These are highlighted based on their expected impact – need to travel or travel mode choice.



# Market segmentation considerations

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**Market segmentation**

Traditional analysis of rail revenue employs relatively crude segmentation by ticket type (full, season, reduced) mapped to journey purpose (business, commute, other). This has advantages in terms of its simplicity but the mapping is relatively crude and the segmentation lacks the flexibility to explore behavioural motivations and product innovation.

In reality, the railways serve a diverse customer base, travelling between diverse origins and destinations for diverse reasons at different times. This picture is complicated by the fact that individual customers often belong to multiple market segments with different transport requirements for different journeys and that the sector is characterised by significant levels of market churn as customers enter and exit the market.

The relative lack of sophistication in market segmentation constrains the sector's ability to accurately forecast trends. Improved market segmentation, taking account of changing customer tastes and preferences, offers the potential to avoid some of the systematic biases that are inevitably introduced with sub-optimal approaches to segmentation. It should be noted however that:

— Segmentation fit for one purpose may not be equally fit for another purpose. Clarity on the purpose of segmentation will be important.

— Segmentation needs to evolve as new segments emerge (eg. part-time commuters) and other fade (eg. young people with access to cars). Segmentation is therefore dynamic rather than static.

— Segmentation brings added complexity to the forecasting process, especially in the longer term which may require additional forecasting how segments will evolve. Segmentation has costs as well as benefits.

Whilst it is possible to think about segmentation in abstract in terms of geography, socio-demographics, journey purpose, journey type, lifestyles and behaviours, for example, the practicalities and statistical rigour associated with data analysis will determine what is achievable.

The impact of trends and disruptors on the propensity to travel by rail by different market segments has always been diverse and varied, but recent socio-economic trends such as flexible working and increased digitalisation are contributing further to the emergence of new travel behaviours.

Our review of available evidence has shown that economic characteristics such as employment status and sector as well as demographic factors such as age are associated with different patterns of travel behaviour. When developing a picture of demand it is therefore likely that we will need:

— More segmentation to reflect different needs and choices between people and personas (individuals with different behaviours at different times).

— More geographical detail to reflect local differences and the increased availability in geo-referenced data.

Important dimensions for segmentation are likely to include:

— Structure and location of economic activity and employment, including sectors and skills.

— Structure and location of households, including demographics, income distribution, life-stage and life-style.

— Flexibility to adopt alternatives to travel, including ability to work remotely.

— Attitudes to and take-up rates for new technology and business models.

— Attitudes to sharing / owning cars and other assets.

Importantly, market segmentation needs to account for differences between local environment reflecting quality and availability of services and also broader societal attitudes.  It is simply not sufficient just to consider how many people might be affected by a change, we also need to know who will be affected, where the are located and how they will be affected. This will require analysis of activities and choices at a very disaggregate level, arguably with hundreds if not thousands of segments and potentially at the level of individual customers.

# Market segmentation considerations (cont.)

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## Segmentation in other industries

There are lessons to learn from elsewhere. Desktop research and consultation with KPMG experts identifies substantial variations in the approach to market segmentation across sectors, including:

- Financial services and airlines are amongst the industries with the most sophisticated models of customer analysis and segmentation.
- Pharmaceutical companies and food retailers also undertake detailed customer analysis include. Socio-demographics and the sensitivity to marketing campaigns are key factors considered in these sectors.
- New tech companies such as Netflix and Airbnb are also highly skilful at analysing their customers and targeting them with personalised offerings, for example:
  - Airbnb predicts hosts' preferences for accommodation requests based on their past behaviour;
  - Netflix groups customers by common taste as opposed to demographic factors such as age.

Models of customer segmentation have evolved as more data has become available. Typical approaches include:

- Survey approaches: traditional approach to customer analysis consisting of surveying existing customers to identify their opinion on the customer experience.
- Big data approaches: merging different and extensive data sets containing information across multiple dimensions related to the customers and their preferences to model consumer behaviour.

## Examples approaches to customer segmentation

### Experian Customer Segmentation

Experian holds data on customers across industries in the UK. Using this data, they have developed different sets of market segmentation for specific industries, described on their dedicated segmentation website. Examples across different industries include the Public Sector and the Financial Sector:

- Mosaic Public Sector: 15 segments (eg. 'rental hub')
- Financial Strategy Segments: 15 segments (eg. 'small scale saver')

### Personicx Eye

The Personicx Eye is an interactive tool which visualises the unique segments that make up the UK market place. It is a consumer segmentation with 55 clusters, driven by behaviour combining life stage, affluence, digital activity and age. Information on where they live, the type of assets they own, where they buy, lifestyle choices and their level of digital engagement is provided for each cluster.

### KPMG Case study – UK University

KPMG has undertaken extensive customer analytics. In this project, KPMG data analytics team identified the segment of students most likely to drop out of a UK university.

To do this, the team collected large data sets from different sources and developed a model to identify the characteristics of students that made them more likely to drop out.

Living with their parents, taking certain modes of transport and not joining university societies were key characteristics of students at risk of dropping out.

# Market segmentation considerations (cont.)

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## Segmentation within the transport sector

Market segmentation is frequently used in transport analysis to show differences in customers' propensity to travel and their sensitivities to changes in the things that drive travel demand. These include for example:

- Characteristics of the customer, including 'observable' characteristics (eg. age, income) and 'unobservable' characteristics (eg. psychographic/ personality features such as 'attitude to spending' or 'brand loyalty');
- Characteristics of origin and destination catchment areas;
- Journey purpose (eg. business, commute and leisure);
- Journey type (eg. long distance), service type (eg. regional) and product type (eg. first class advance purchase);
- Time of day and day of week, seasonal and non-seasonal;
- Frequency of travel (eg. regular customer or inexperienced traveller);
- Travelling in a group, travelling with luggage;
- Captive and discretionary, car owning and non-car owning;
- Concessionary and non-concessionary, railcard and non-railcard.

Much of the segmentation concerns the journey itself rather than the individual or the individual's underlying transport needs. That said, that is not always the case and at times segments are based on multiple dimensions which together combine to define groups with similar behavioural traits.

An example of this features in the Dutch rail market where six different segments were identified based on customer needs:

- The explorer. Cares about flexibility and independence;
- The individualist. Cares about status and exclusivity;
- The functional planner. Cares about speed, control and efficiency;
- The certainty seeker. Cares about certainty, safety and protection;
- The socializer. Cares about sociability;
- The convenience seeker. Cares about convenience and uncomplicated, carefree journeys.

While these groups may be better at grouping people by behaviour and needs, understanding the customer dimensions that they capture may not be straightforward and could decrease transparency in demand forecasting, especially longer term forecasting.

# Market segmentation considerations (cont.)

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### Possible segmentation related to economics and labour markets

The increasing differences in ways of working and employment across sectors requires greater granularity in the analysis of business and commuting trips. Specifically, an analysis by sector and occupation is likely to bring additional insights into the patterns of travel that these trends are influencing, as shown in the recent DfT study on rail demand forecasting (ITS *et al*, 2016) which found that those working in manufacturing, wholesale business, construction and health/social care sectors are less likely to travel by rail, whereas those involved in the finance sector (for commuting and other travel) and real estate (for business) are more likely to travel by rail. In analysing these trends, it is important that we understand personal behaviour in additional to adoption a macro view of the population. This means looking at trends in trip rates and the propensity to travel by segment, including: employment by industrial sector, employment group, and hours worked, flexibility of employment, retirement age, location of residence and employment, and income.

### Possible segmentation  relating to socio-demographics

With regards to socio-demographics, current rail demand forecasting methodologies take population growth and car ownership into account. But travel statistics show that additional demographic factors may help explain different behaviours in terms of travel, especially at a local level.

As with the analysis of changing structure of the economy and labour markets there is a need to consider: how many people will be affected, who will be affected, where those people live and work and how they are likely to be affected by trends and disruptors.  Getting a better handle on the structure of the population at a local level will be an increasingly important part of understanding trends in rail demand. This will need to take account of differences in age, gender, personal income, migration, car ownership, and geographical location as well as this factors relating to employment status. Within each of these dimensions there is a need to look more carefully at behavioural patterns to identify sub-groups, for example by groups identified by stage of retirement, participation in higher and further education, household structure, healthcare related activities and dispersal of personal networks.

Some of the differences in travel behaviour between individuals may not be able to be explained with reference to the observed characteristics of the individual and may need to be linked to past behaviour and/or spatial correlations reflecting local attitudes and behaviours. The identification of latent segments may be helpful in this regard. It is also important to note that travel behaviour even within relatively well defined market segments is not stable over time. Recent work by Transport for London notes the 'often considerable dynamism of travel behaviour change and underlines the importance of looking below aggregate-level trends in seeking to understand, explain and influence the causative factors underlying them'.

### Possible segmentation related to technology uptake

In light of the rapid technological changes that are happening or are expected to occur and important aspect of market segmentation includes customers propensity to adopt alternatives to travel, attitudes to and take-up rates for new technology and business models and attitudes to sharing / owning cars and other assets.

Attitudinal factors are sometimes but not always correlated with age and education level and therefore demographic variables may be useful in segmenting the market. It may also be helpful to consider the past behaviour and the speed of take-up of other technologies in predicting how an individual could react to changes in transport markets. This approach is for instance used by companies such as Netflix, which segment customers by their past behaviour as opposed to demographic variables to forecast which content they will be attracted to.

# Data considerations

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There is no single source of data that will be suitable to meet the needs of the sector. Instead, data will need to be assembled from different sources to reflect the different influences on demand. The key here will be in the use of micro-data describing customer characteristics, attitudes and choices. The data will need to be geo-referenced to make sure that it describes local conditions and the actual choices people face.

Customer choices recording individual trips or groups of trips combined to form end-to-end journeys can be observed from travel diaries or passively via mobile location technologies. Publically available data on timetables, fares, road conditions, delays, congestion etc. can be used to reconstruct the travel choices available for specific journeys to examine the sensitivities and trade-offs that are important to customers.

If this information can be combined with a better understanding of the customer's needs (i.e. the activities they undertake) and experiences, a clearer and much richer picture of the factors driving demand will be able to be developed. This could be further enhanced by examining how individual tastes and preferences change over time and how they are influenced by reference groups and broader societal trends.

Our review of available evidence has shown that economic characteristics such as employment status and sector as well as demographic factors are likely to be important determinants of travel behaviour.

An opportunity exists to make better use of the National Travel Survey data that includes details of individuals and households socioeconomic characteristics, location and travel activity. This needs to be examined in greater detail that it has been to date, combining it with more detailed objective evidence on travel times, costs and availabilities of all of the transport choices facing individuals. In addition, data from mobile phone location services could be used to provide additional validity to the data. Whilst the use of new data sources, such as mobile phone location data, however have limitations when it comes to identifying journey purpose, modes used and the socio-economic characteristics of the customer. They are complementary rather than a substitute for survey based data.

**Case study – Amazon**

Amazon, the pioneer of ecommerce in many ways, was the first to implement a personalised recommendation system. They built this system using big data that was gathered from its millions of customer transactions. Every time a user logs into her Amazon account and makes purchases or browses various products on the site, Amazon collects this data and the next time the customer returns, Amazon offers the user products based on his previous purchase and browsing history. This not only helps Amazon deliver intelligent personalised advertising, but also helps Amazon identify trends amongst people who make similar purchases. By segmenting customers based on their interests and purchase patterns, Amazon provides customers with more choices.

Amazon also uses customer big data for Supply Chain Optimisation. It has real-time links with manufacturers, which allows them to track the inventory demand based on the data to provide same day or next day delivery options to its customers. Amazon uses big data systems to select data warehouses based on the proximity of vendors balanced against the proximity of customers to cut down on the distribution costs. Data analytics helps Amazon predict the number of data warehouses needed and the capacity each warehouse should have.

# Data considerations (cont.)

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### The uses of digital consumer data

Consumer data obtained through digital sales channels online or mobile shopping and browsing of businesses' products is now widely used by companies for different purposes. This data offers:

- Data on both customers and potential customers
- Personal socio-demographic data: where they live, age, gender;
- Live consumer behaviour data;
- Data on consumer behaviour over time.

This data can be used for a number of purposes:

**Customer Sentiment Analysis** – Companies can understand and analyse what customers think about their products and services to increase customer satisfaction. Big data and social media channels together help in analysing customer sentiments which gives organisations a clear picture on what they need to do to outperform their competitors. Airline companies use sentiment analysis to analyse flyer tracking experience. Large companies like Delta, monitors tweets to find out how their customers feel about delays, upgrades, in-flight entertainment, and more.

**Behavioral Analytics** – Companies use big data to unlock meaningful insights from customer behavior data which they can use to improve the customer offer. Part of this is customer segmentation as customer profile and behavior information allows businesses to identify common tastes across segments, which they can use to suggest new purchases. Many banking companies rewards its customers through various rewards programs like cashback offers by analysing their previous credit and debit card purchase histories.

Time Warner, the giant media company operates in 15 different markets and has close to 14 million customers of which 7.9 million are its subscribing customers. It collects approximately 0.6 TB of data every data and leverages big data analytics to create personalised advertising campaigns.

**Predictive Analytics** – Companies use customer data to develop predictive models to look into the future to boost revenues. For example, Volkswagen uses big data to support predictive marketing that helps Volkswagen build brand loyalty by boosting its aftermarket service revenues.

**Fraud Detection** – The Big data analytics helps organisations detect, prevent and eliminate any kind of internal and external fraud. Algorithms can detect when a debit or credit card has been stolen by someone by identifying unusual behaviour patterns on the card transactions. This helps banks to temporarily hold any further transactions on the card while they contact owner of the card.

# Data considerations (cont.)

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We have identified potential data sources with valuable demographic data to produce a market segmentation. These include both a mix of public and private data. Below we list potential sources that could be exploited for the purpose of identifying groups of customers with similar travel behaviour and preferences:

| Possible data sources for market segmentation | | |
|---|---|---|
| **Data set** | **Description** | **Availability** |
| **National Travel Survey (NTS)** | The NTS contains data on travel patterns by journey purpose and different socio-economic data including age, employment status and location of residence. This data was recently used in a study to demonstrate the relevance of demographics in market segmentation in the context of rail demand forecasting. | Publicly available |
| **Business Register and Employment Survey (BRES)** | BRES collects employment data by a detailed sector breakdown and is available at a detailed geographical level. | Available at a detailed geographical level upon request for free |
| **Transport Focus customer satisfaction data** | Transport Focus has collected a vast amount of data over the last 17 years on the drivers of rail customer satisfaction which they are happy to share. This also includes information on both demographic factors and travel patterns. | Available upon request |
| **Detailed employment forecasts by industry – UK Labour market projections** | UK Labour market projections up to 2022. Working Futures is the most detailed and comprehensive model of the UK labour market available. The main focus is on the future demand for skills as measured by occupation and qualification and a detailed analysis of prospects by industry and geographical area is presented. Data is available at a LEP level. | Access to the data portal is only available to analysts who hold a Chancellor of the Exchequer's Notice |
| **Oxford Economics UK employment forecasts** | Forecast future employment and economic growth at detailed geographical level. | Private dataset – Available to purchase |
| **Cambridge Econometrics UK employment forecasts** | Forecast future employment and economic growth at detailed geographical level. | Private dataset – Available to purchase |
| **Experian Mosaic data/tool** | Experian collects large amounts of consumer data used for market segmentation – 850 million pieces of information across 450 different data points are condensed using the latest analytical techniques to identify 15 summary groups and 66 detailed types that are easy to interpret and understand | Private dataset – Available to purchase |
| **Retail sales** | Expenditure and food survey and Retail Sales Index provide information of shopping trends | Available upon request |
| **Digital sales information** | Through the increased use of digital channels to purchase transport tickets, operators are able to collect richer datasets that can be used to model customer behaviours. | Commercial data available from operators |

# Recommendations for further work



### Recommendations for further work

We have identified six themes for further analysis. The themes involve developing a better understanding of the need to travel and a better understanding of customer choices. The themes can be initially considered individually but will ultimately need to be considered together to examine the relative importance of each to rail demand. Recommendations for each theme are as follows, first looking at needs and then at choices. It is important to note that our recommendations focus on ‘what is needed’ and ‘why it is needed’ rather than the specifics on ‘how future work should be done’.

Changes to the structure of the **economy and labour markets** in particular will have implications for transport needs - driven not simply by the number of people in employment but the need for employees to travel to a fixed location on a regular basis. This will be influenced by the type of work and the role that the individual has within their employment. There are two aspects to understanding changes in rail demand in response to structural changes to the economy. Firstly, developing an economic activity-based appreciation of transport demand by industry sector and job type over time, and secondly, developing an understanding of how the structure of the economy could evolve under alternative future scenarios.

Changes to **socio-demographics** and societal trends are also like to have strong impacts on rail demand. It is no longer sufficient to simply consider the impact of population numbers on rail demand as we know that trip rates vary significantly between market segment and with market segment over time. Within the demographic theme, there are relatively well researched differences between older and younger people, those with high disposable incomes and those without them, those who live in build-up areas and those who don’t, as well as lifestyle and life-stage issues such the propensity to have a family, own a house and own a car.

As with the analysis of the economy and labour markets there are two aspects to understanding the impact of changing socio-demographics on rail demand. The first is to explore the relationship observed (eg. age, location) and unobserved (eg. attitudes and preferences) characteristics of individuals, their economic and social activities and their travel behaviour over time, and the second is to understand how demographic and social trends could evolve under alternative future scenarios.

**Alternatives to travel** are increasing, with greater acceptance of the benefits of remote working, virtualisation, the provision of online heath and education services, e-commerce in the form of online shopping and banking, as well as the rapid production and delivery of goods through 3D printing and efficient home delivery. Whilst data for some of the headline changes under this theme are available, the evidence on the relationship between specific demand drivers and rail demand is less well established. Increased acceptance and propensity to work remotely should arguably be considered as part of the review of economy and labour market structure. Other impacts such as the substitution of trips with online activities will likely need new market research to improve our understanding of the trade-offs that consumers consider although it is important to note that the NTS includes useful data in this regard.

Given the interplay between work and non-work activities, and the ability of households to substitute activities that involve personal travel for activities that do not involve personal travel there are advantages to taking a more holistic approach to assessing transport needs with reference to existing ONS data sets. New data will also likely be needed to help unpick the complexities associated with provision and take-up of online services and the efficient home/ remote delivery of goods.

# Recommendations for further work (cont.)

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There is scope to look more carefully at the actual travel choices that individuals face. Whilst there is a relatively well established body of evidence here, it is often partial in terms of its coverage and/ or based on anecdote or proxy data.

Instead we need to really understand the choices that individuals face. In the past this has relied on making use of travel diary or survey data for which data on travel alternatives is either (partially) self reported by the survey respondent or infilled by the analyst often using relatively crude assumptions.

With technology companies becoming increasingly sophisticated in providing detailed end-to-end journey times and costs by mode, this information could be combined with data on observed travel choices to build a better picture of the trade-offs that customers make.

There is an opportunity to take advantage of digitised travel information to reconstruct the transport choices that individuals face for specific end-to-end journeys at specific times that have either been recorded as part of travel surveys or are passively collected by mobile location technologies.

The travel survey approach (such as use of the National Travel Survey) has advantages in that it also includes information about the individual (needed for market segmentation) and information on activities (needed to help understand travel flexibility). The mobile data approach has advantages in terms of scale.

Both approaches have clear advantages in looking at end-to-end journeys so that we can develop a better understanding of the impact that **journey complexity** has on choice, and both have advantages in the use of 'revealed preference' data for which the available choices can be enumerated and accurately described.

Given the relative strengths of each approach, there may be benefits to combining both under the same analytical framework. It is important to note however that the impact of emerging technologies, including the development of connected and autonomous vehicles, on rail demand clearly can not be observed and therefore market research methodologies will need to be used to further our understanding here.

The impact that changes to government **policy and regulations** could have on choices can be assessed via their impact on supply and largely viewed through the lens of price, quality and availability.

Given the interplay between modes, interactions between modes and government policy and regulation there is scope to look at these issues together by building a more holistic analysis of individuals transport choices over time. This analysis needs to be based on observed choices, in the context a detailed and accurate description of the travel alternatives that individuals face. This analysis should be structured to reflect the fact that individuals tastes and preferences vary over time and by location.

Ultimately the analysis of transport needs and transport choices should be considered together as part of wider consideration of household constraints and decision-making.

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