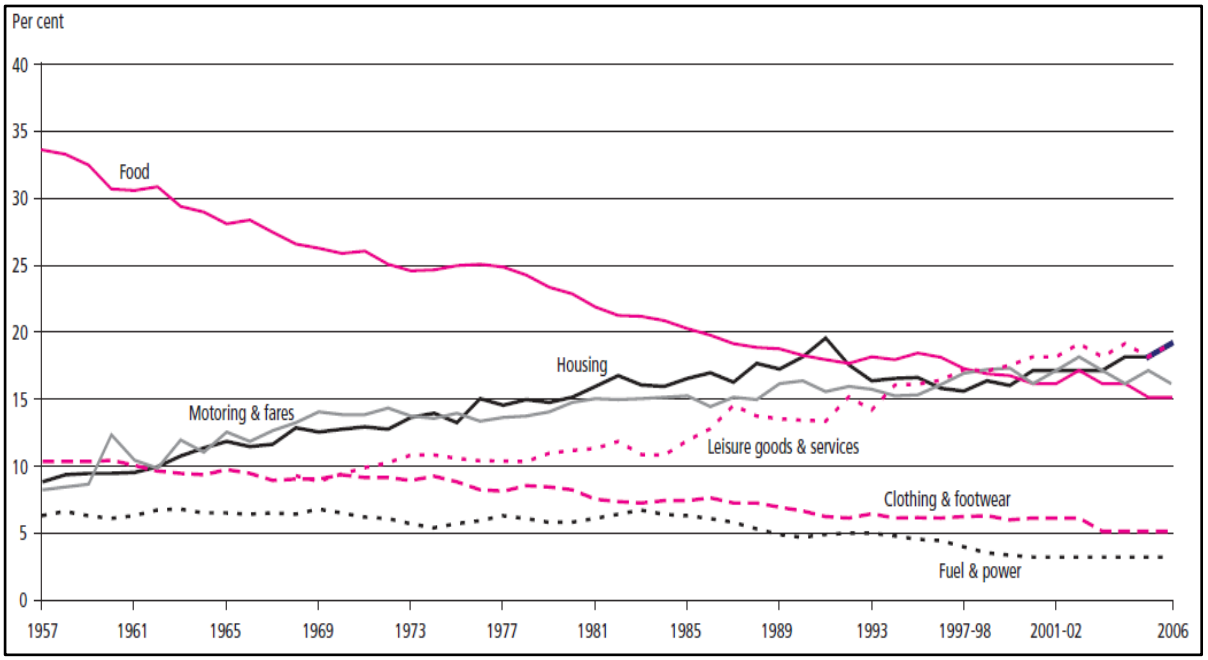
TEG TRANSPORT ECONOMISTS' GROUP

The Transport Economist

The Journal of the Transport Economists' Group



Editor Peter Gordon

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TEG TRANSPORT ECONOMISTS' GROUP

Is transport appraisal failing cycling?

Dr Rachel Aldred, University of Westminster

Arup

23 September 2015

Introduction

Rachel began by saying that she would cover: the benefits of investing in cycling; the need for a "cycling revolution"; transport appraisal at the strategic level and at the route-based level; and ideas for moving forward.

The benefits of investing in cycling

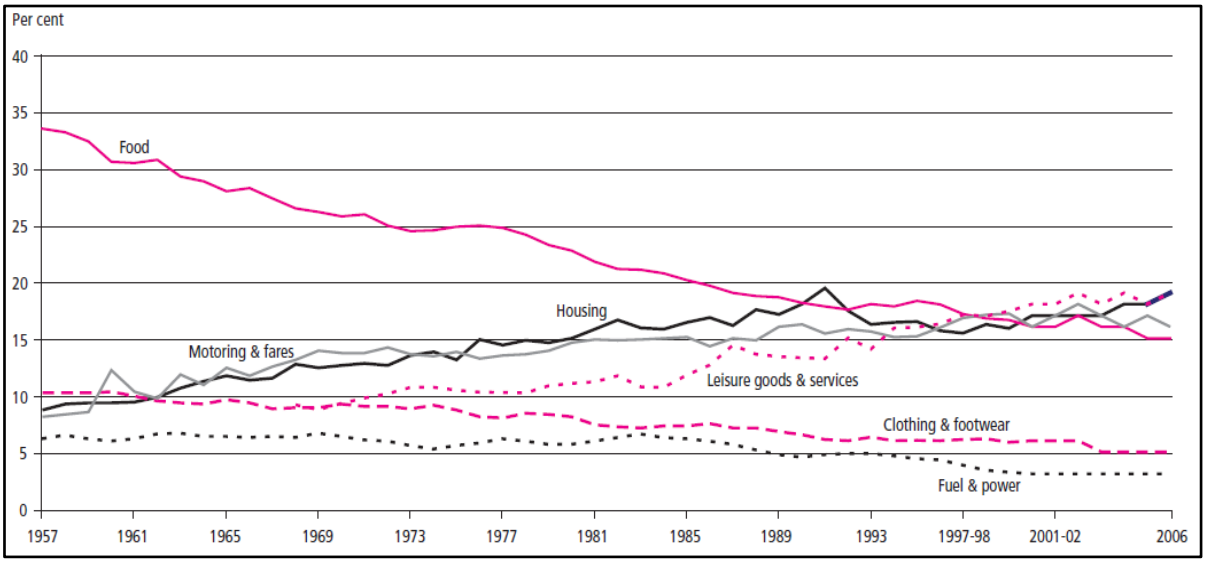
Rachel summarised the benefits of investing in cycling below.

Table 1: the benefits of investing in cycling

Benefit	**Issues**
Physical activity	
Reducing pollution	
Safety: • Reducing risk to others • Impact of improvements	
Emotional well-being	Is cycling a means of transport or a leisure activity?
Access to jobs and services	
All-ages independence	
Liveable cities	
Local economic benefits	
Predictable journey times	Transport for London has shown that congestion has much less effect on cycles than on cars
Network efficiency	A bicycle is equivalent to only 0.2 PCUs (passenger car units)

In addition, transport is a growing proportion of household costs and cycling can contribute reducing that cost.

Figure 1: transport is a growing proportion of household costs



Source: Office of National Statistics (ONS), 2007

In the Netherlands, Fishman et al (2015) noted that cycling is estimated to prevent about 6,500 deaths each year, and extend lives by six months, corresponding to more than 3% of GDP. Investments in bicycle-promoting policies such as improved cycling infrastructure and facilities would probably yield a high cost-benefit ratio in the long term.

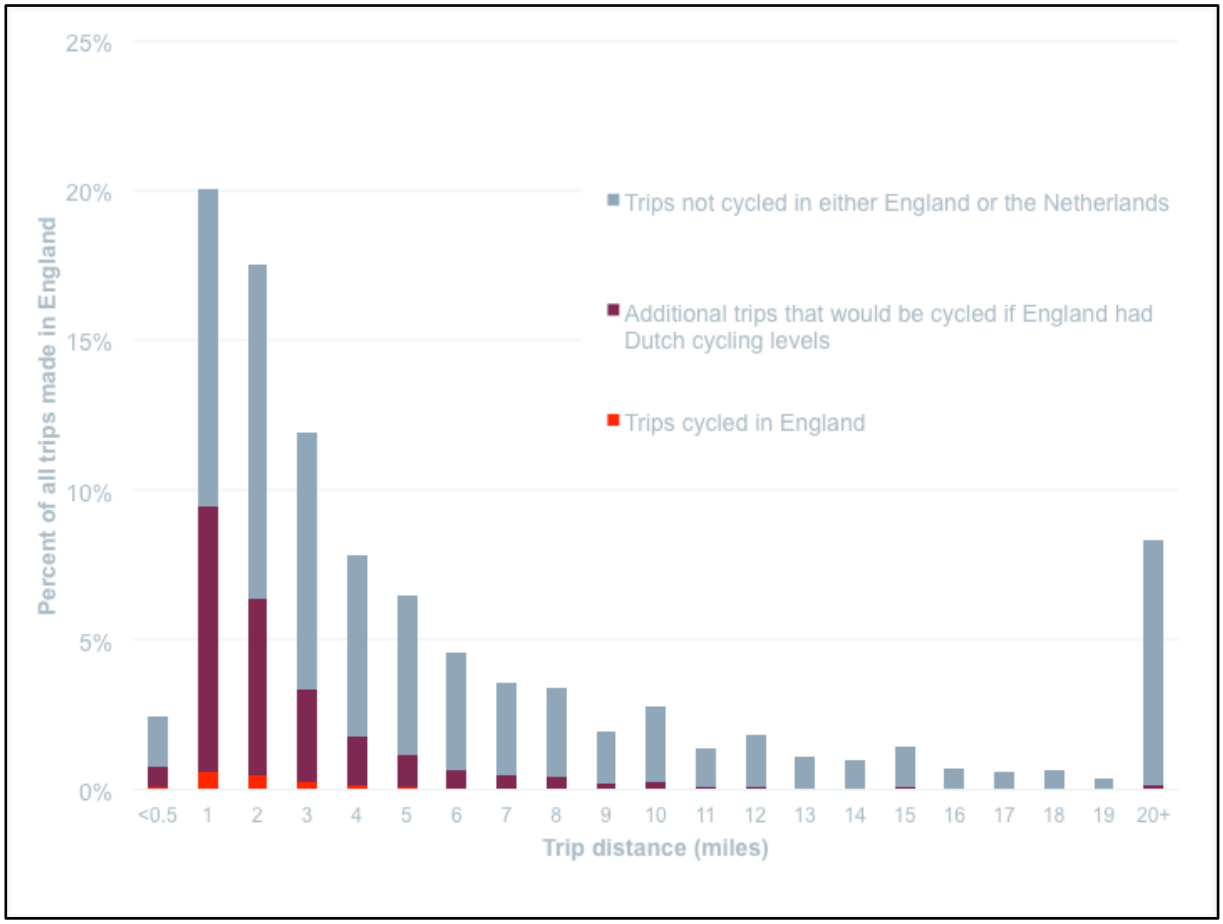
Applying overseas evidence to the UK:

- Netherlands' safety standards could reduce cycling casualties by two thirds
- Danish levels of cycling could save the NHS £17 billion within 20 years and increase the mobility of the poorest families by 20%

However, the distance cycled in the UK fell from around 23 billion kilometres in 1952 to 4 billion kilometres in 1973 and has now recovered to 5 billion kilometres.

Distance is not the key barrier. Most trips in both the UK and the Netherlands are short, and raising cycling on trips of only 1-2 miles would result in a massive increase in cycling in the UK.

Figure 2: scope for increasing cycling to Netherlands' levels



Source: Anna Goodman for NPCT project

What is needed

Stated preference

Stated preference research on cycling infrastructure provides consistent results "a broad academic consensus that most people prefer to cycle away from motor traffic, or in environments with low levels of motor traffic". Recent literature review highlights the need for comprehensive direct cycle networks without gaps, showing the importance of high quality protected infrastructure, in particular for women, older people and children.

Rachel showed a number of photos illustrating the poor condition or design of much of the UK's 14,000 kilometre national network.

Figure 3: example of poor cycle provision

Even the national level guidance reveals low aspirations: the cover of Department for Transport Note 2/08 "Cycle Infrastructure Design" shows a cycle lane adjacent to a goods vehicle, which would be seen as poor in the Netherlands, Denmark or Sweden.

Rachel identified three types of infrastructure identified by stated preference as being "good enough":

- Completely away from motor traffic (such as the Cambridge Busway Cycleway, connecting the community to Addenbrooke's Hospital, in space which would have been required anyway for a service road)
- Physically protected infrastructure on busier roads
- Very lightly trafficked residential streets

However, current mapping and data are poorly suited to identifying such facilities or whether they form usable or contiguous networks.

Revealed preference

Stated preference reveals what people want but cannot predict levels of uptake. However, there is little revealed preference evidence, for a number of reasons:

- Lack of good interventions connecting into a network
- Lack of good data on what exists (the mapping issue mentioned above)
- Lack of good evaluations: longitudinal studies over several years are best, but expensive, and opportunities to do them have been missed

Thus predictions of demand are often based on cross-sectional studies using a metric such as "length of cycle facilities" which does not reflect any of quality, capacity or contiguity.

However:

- Evaluation methods and interventions are both changing, and the evidence base, for example in the USA, is beginning to improve
- In England, higher quality interventions are being planned and implemented, including the London Cycle Superhighways, mini-Hollands and other schemes
- Evidence is starting to emerge that such high-quality routes along key desire lines can increase cycling uptake

As an example, the Cambridge Busway Cycleway study by the Centre for Diet and Activity research (CEDAR) had found that "proximity to the busway predicted an increased likelihood of a large increase in the share of commuter trips involving any active travel and a large decrease in the share of trips made entirely by car." This is likely to provide substantial health benefits.

However, major problems remain:

- Annual cycling spend per head is at best £4-5 and may fall, compared with £22 per head in the Netherlands on additional infrastructure alone
- The stop-start nature of spend means that expertise and support are lost, and blocks fundamental change

- Established tools, data and techniques are not designed to evaluate, appraise or support cycling

Transport for London had proudly announced ”a new bit of kit to help deliver new smoother segregated cycle tracks along CS2” but this had not prevented parts of CS2 next to dry roads being flooded due to poor drainage.

Summary

Rachel summarised her comments to date:

- There are major benefits from increased cycling levels
- Transformational change is required, with comprehensive infrastructure that is qualitatively different from current provision
- To achieve this, there are political, policy, data and technical challenges

The role of transport appraisal

There has been a drift away from the Department of Transport’s web-based Transport Analysis Guidance (WebTAG), with Transport for London (TfL) using its own approach and the Local Enterprise Partnerships (LEPs) having more flexibility.

There has recently been “great excitement” regarding cycling and cost-benefit analysis (CBA), which Rachel subdivided into:

- Strategic analysis
- Route-based analysis

Strategic, or programme-based, analysis does not harm cycling, but could be more positive and useful, but route-based analysis has clear problems relating to both journey times and cycling uptake.

Strategic analysis

Strategic schemes tend to be based on a medium-term vision, with targets for substantial increases in cycling, and tend to argue that the switch to cycling would generate decongestion benefits. London, however, has a different narrative and approach to modelling, as discussed first.

The Mayor's Vision for Cycling

A key example of strategic analysis was is the London Mayor's Vision for Cycling. On benefits, the Mayor states that "As with other transport investments, it is not possible to monetise all of the direct and wider benefits of investing in cycling, but many can be captured in this way":

- A qualitative discussion of benefits, including many of those listed in Table 1, with quantification of some, basing calculations on the incremental increase in cycle mode share over a baseline.
- Journey time benefits and disbenefits are included and modelled using Saturn, comparing a Do-nothing with population change and other interventions with a Cycling Vision with cycling interventions and increasing cycling mode share.

In summary, the modelling results demonstrate that:

- Planned delivery of TfL's Business Plan, expected population growth, increased traffic and cycle flow, and other "business as usual" activity results in an impact on traffic and buses if not mitigated.
- Achieving a 5% mode share for cycling through the Mayor's Vision will result in further impacts on traffic and buses.
- Delivering the central London Cycling Vision infrastructure schemes mitigates some of these impacts.
- Careful route design, considering the needs of cycling, general traffic and buses, should enable these impacts to be reduced further.

This is the first time that a strategic modelling approach has been used to estimate the high-level impacts of cycling on the road network. The model represents changes in traffic congestion and bus speeds as delays which have been monetised for use in the benefit-cost ratio calculated as 2.9:1.

- £1.1 billion NPV net costs including £913 million for the Cycling Vision Portfolio, additional investment required to sustain growth, and the operating costs of cycle hire.

- £3.1 billion net benefits including journey time, congestion, safety and other social impacts such as health.

Rachel noted a number of points on the London example:

- High level leadership, with the case built from political and policy drivers
- A focus on targets and the medium term
- Qualitative discussion of benefits, as only a few could be quantified and monetised
- A narrative for dealing with journey time disbenefits:
    - "Business as usual" will create congestion
    - A 5% increase in cycling will add to that
    - Infrastructure is a means of mitigating the impact of rising mode share

However, this raised the issues of whether it would work in other areas, and how it could be integrated with broader strategic planning.

Other examples at the strategic level

Analysis of the total benefits for cycling grant showed that physical fitness accounted for 50-60% of the benefits.

Rachel produced a table of the monetised benefits for funded schemes under the City Cycling Ambition Grant. All had high BCRs, ranging from 2:1 to 35.5:1, although unlike TfL they all claimed positive congestion relief, suggesting that they had modelled car users switching to cycling but no reduction in road capacity associated with cycling measures.

Newcastle was unclear about whether cycling would reduce road congestion, but made no reference to reductions in road capacity:

"*There is limited evidence that a change in the mode share away from motorised transport anticipated by these proposals will have a positive impact on the flows of traffic for existing business users improving journey time reliability. A mode shift to cycling for business use will reduce the cost of fuel to business and will increase the reliability of those individual journeys. […] There is evidence to suggest that a change in the*

mode share away from motorised transport anticipated by these proposals will have a positive impact on the flows of traffic for existing commuters improving their journey time reliability. A mode shift to commuter cycling use will reduce the cost of transport for the individual and will increase the reliability of those individual. […] Over 2 million car kilometres are estimated to be replaced each year. This reduction in car trips will provide decongestion benefits for all road users. More specifically drivers who shift to cycle use will reduce impact of time delay as cycling is not subject to being substantially impacted by traffic congestion."

Manchester planned road capacity reductions but assumed that they would be offset by other benefits: "*As the vast majority of the cycle lane improvements are planned to be off-road (i.e. either on low trafficked routes, shared space with pedestrians or on canal towpaths) no disbenefits to road traffic have been allowed for in the economic appraisal. There are a few places where road capacity will be re-allocated away from vehicle traffic towards walking and cycling […]. In these cases, it has been assumed that the highway disbenefits will be netted out by the positive benefits to all users of these busy district centres created by the public realm, ambience and environment elements of the scheme.*"

Summary

Rachel noted that appraisals substantiate the case for going forward with one-off medium-sized schemes. They found large benefits, and the approach could be used for more ambitious, longer-term plans. However while the approach can justify a strategy based on targets, it is poor at comparing and prioritising schemes or options at the detailed level, and is not integrated into the broader planning process for network renewal and Local Growth Fund (LGF) applications.

Route-level appraisal schemes

In contrast, route-level appraisals had two main problems:

- Modelling and valuing journey time savings
- Predicting cycling uptake

Rachel contrasts a cycling and a conventional scheme as shown in Table 2.

Table 2: comparison of cycle and conventional schemes

Conventional	**Cycling**
A120 Bypass (Little Hadham)	**BIG**HERTS**BIG**IDEAS for the A1 corridor
Growth Fund Bid	2015-2016 LSTF bid
Capital cost £24 million	£5 million cost over 6 years
Time savings £236 million	£1.2 million per annum predicted economic benefits: transport, health, absenteeism
"The economic case demonstrates very high value for money with a BCR of 9.1."	
Successful	**Unsuccessful**

The University of the West of England (UWE) (in "Making NATA fit for purpose") had noted that "*On many occasions, scheme promoters cite the Department for Transport's own guidelines in justifying not giving great attention in practice to aspects which are stated as important in principle. […] list of the most important policy objectives and instruments is unfortunately the same as the list of aspects which are poorly treated in NATA, or not at all*".

DfT's WebTAG (A5.1, 2.1.4) states that "*It is of crucial importance to forecast walk and cycle demand as accurately as possible to produce a successful appraisal. Forecasts are the primary indicator of a scheme's effectiveness, along with estimates of the resulting change in use of other modes. Since the cost of walking and cycling schemes is often relatively low and the scale of impact relatively small, the cost-benefit analysis is highly sensitive to the quality of these forecasts.*"

The time savings problem

Completely off-road walking and cycling schemes often have very high BCRs when route-level assessment is carried out. Sustrans often reports BCRs of 20:1 for cycling facilities.

However, the literature agrees that protected space on main roads is key to mass cycling, and travel time changes and (dis-)benefits are likely to be a major item in any appraisal if the scheme affects capacity for motor traffic. One example was TfL's appraisal of extension to Cycle Superhighway 2 (CS2x), which appeared to show negative net overall benefits.

Table 3: appraisal of £14.5 million CS2x for 30-year project life

		NPV £ million
Cycling benefits	**Total**	**+97.6**
	Health	+38.5
	Journey time	+37.6
	Safety	+12.4
	Ambience	+9.1
Journey time disbenefits	**Total**	**-122.4**
	General traffic	-103.0
	Buses	-10.1
	Freight	-5.1
	Taxis	-4.1
Operational costs	**Bus operations**	**-11.1**

The disbenefits are dominated by increased travel times for general traffic, which are always big if road space is reallocated. That said, headlines such as the Evening Standard's September 2014 "*Car journeys to take up to 16 minutes longer because of bike highways*" do not help, especially if the cited time is for a journey (such as along the Crossrail corridor) where car would rarely be the chosen mode.

Working time is valued differently for users of each mode, and tends to be higher for uses of private motorised transport, whereas when mode shift is predicted what is really required is a consistent valuation of the time of the marginal user.

A further, but related, issue, is the poor modelling of the effect of individual schemes, with greater segregation (see below), on accidents and injuries.

Figure 3: road space redesign for cycling

However, other benefits which cannot currently be quantified include environmental benefits, streetscape improvement benefits, economic benefits and reputational and cultural impact. TfL's business case analysis tools are not generally designed to quantify the benefits of cycling projects, whereas countries such as Denmark, Holland and Sweden do not typically use BCR-type appraisal to justify cycling investment.

Predicting uptake

Three approaches are recommended for predicting route-level uptake:

- Comparative study, such as through case studies, which is comparatively easy, but historical data is poor and may provide no good or credible comparators

- Disaggregate mode choice models, but these can result in the estimation of many unverifiable parameters
- Sketch plan methods, which can be based on regression analysis of cycling in different areas, but are often reliant on poor measures of cycling provision, such as the total length of facility.

Summary

Rachel noted the potential for "worst-case" route-based scenarios which ignored:

- Uncertainty and the need for different scenarios
- Medium and longer-term impacts
- Peak-spreading
- Mitigation measures
- Changes in cycle journey routing (TfL does not yet have an assignment model for cycling, so there is no forecast or rerouting to make use of the Cycle Superhighways)

Finally, she noted that:

- At route level, when space is reallocated, pessimistic modelling, and then high valuation, of delays to drivers could result in negative estimated value for money.
- At strategic level, in contrast, ambitious higher-level approaches typically find medium and longer-term area-wide benefits, including decongestion.

The challenge was to square this circle, especially as experts agree that reallocation of road space on main roads is the key to transformation.

Finally, it would be good if appraisal could both compare cycle route network options and integrate this into broader network planning.

Discussion

Peter Gordon (Editor, The Transport Economist), speaking as a pedestrian, asked about conflicts between modes, and whether green waves for motorists fit the speeds at which cyclists travel. **Rachel** noted that more research was needed on conflicts between cyclists and pedestrians.

Robert Cochrane noted that "the entire edifice" of cost-benefit analysis rested on the assumption that the distribution of incomes was fair, but Ken Arrow points out that this is an assumption. In addition, variations in value of time may partly reflect the income distribution, but much suggests that the rich can have low values of time. This is included in the Treasury Green Book, but ignored as "difficult", and treated as a risk.

Tom Worsley (ITS, Leeds) noted the debate on value of time, and that data suggest that the value of time of cycle couriers is less than that of taxi drivers. Standard values of time are used for journey to work and leisure trips, but there are "several types" of cyclist: some want speed – as evidenced by the risks they take to go through red lights – and would no doubt prefer left turn on red, downhill roads, and no wind. Others happily take back routes and don't mind: their mind-set is not that of mechanised road users. Has modelling identified the heterogeneity in cycling? People living near central London probably have reasonable values of time. **Rachel** noted that we have created an indirect and quiet network for the nervous, but many want to use direct and busy Cycle Superhighways, even if they mean reallocating road space. **Robert Cochrane** noted a similar issue with buses in developing countries: governments were loath to reallocate road space used by motor vehicles.

Dick Dunmore (Steer Davies Gleave) observed that he would rather use a flooded facility by a dry road than a dry facility by a flooded road. However, did the cost of good design (and drainage) vary with the cycle of urban renewal, and might cycle provision be better or cheaper at a different time in the cycle? **Rachel** commented that even new provision could be poor, as in Hull and at the Olympic Park.

Nicola asked how LEPs could be persuaded to show an interest in cycling. **Rachel** noted that devolution may not help,

although LEPs might be interested in new trips made possible by cycle facilities and, while only London has major congestion, public health ought always to be a selling point.

Vincent Stops (London TravelWatch) noted that TfL calculated the disbenefits of cycle facilities to bus journey times, but TfGM did not, and the implicit result is that Manchester bus users would face higher fares. He also noted that cost-benefit analysis can be used to compare projects, although London's East-West Cycle Superhighway has £40 million costs and £200 million disbenefits. Could the money better be spent elsewhere?

Tim Chatterton (UWE) asked whether social cohesion should be assessed as a benefit, given a preference for modes where people interact face-to-face. In Berlin, car drivers are very respectful to cyclists. **Rachel** said she agreed that social cohesion affects uptake, and she would like to see it included in the analysis, but the effect had yet to be quantified.

Anne Clarke (Arup) had used WebTAG to appraise a cycle to work scheme and found that changes reported by cyclists, such as removal of the need to spend other time exercising, bore no relationship to those included in the analysis. **Rachel** agreed.

Jim Chisholm had proposed in 1998 that Cambridge hold a no-cycling day, which he thought would result in gridlock and add 15 minutes to the average road trip. Sensitivity of road speeds to the numbers choosing cycling suggests that even a small mode shift to cycle could eliminate road congestion. He also noted that he can set out for the station later on a bicycle than he would need to in a car, yet appraisal is based on the mean journey time by road. Appraisal based on a reliable time would favour cycling, which is less subject to journey time variation. In addition, the Treasury's "City Deals" do not allow the inclusion of health benefits, but no one can tell him why. **Rachel** agreed that these were all important issues.

Ivan Viehoff (CEPA) noted that a Dutch cycling model had perfectly explained cycling in Ipswich with only minor adjustments to reflect local conditions: tools developed in one place can be recalibrated and reused. A further issue was "knowing people who cycle", but many planning authorities have no cyclists. **Rachel** had read of the application of a Dutch model to Ipswich and having to recalibrate some variables.

Ivan said that they had had to recalibrate the model, but this did not imply a "cultural difference".

Dick Dunmore noted that a possible factor in declining driving was that it precluded use of an iPhone or iPad, and wondered whether this also worked to disadvantage cycling. **Rachel** noted that Londoners seemed to be open to a variety of modes, depending on context.

David van Rest (retired academic) noted that COBA values time at average speed, but that this includes some drivers who are speeding, so modelled time savings are based in part on illegal behaviour. Speeding drivers' daily business trips by an extra 4 minutes per day includes law-breaking.

Report by Dick Dunmore

Travel in the twenty-first century: reconsidering appraisal and forecasting methodologies

David Metz, UCL

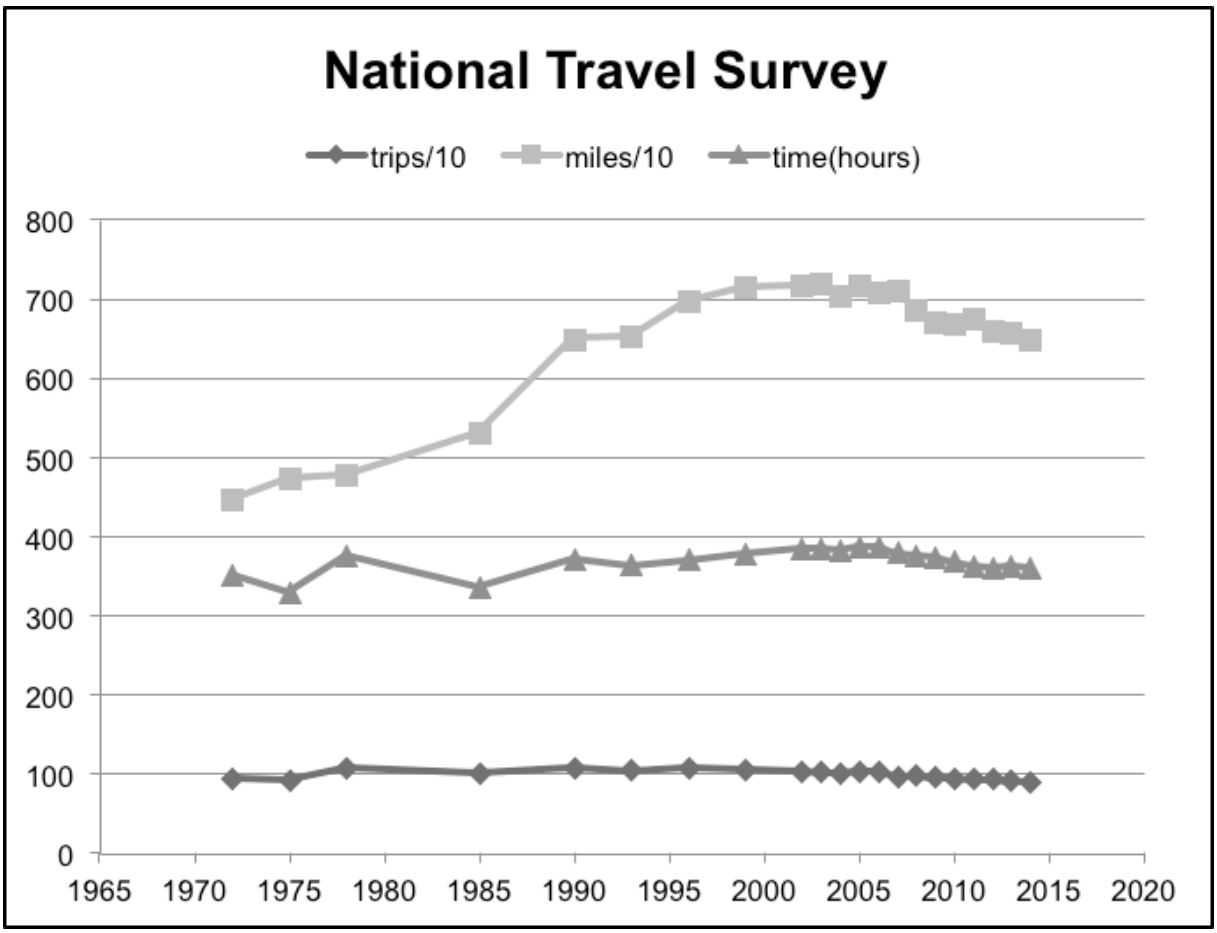
Arup

28 October 2015

Introduction

The speaker began by noting that the National Travel Survey (NTS) has been going for 50 years with full data available for the last 40 years. Two parameters have remained broadly constant over time: people take roughly 1,000 trips per annum and travel for around an hour per day. However, the total distance travelled increased up to 1995, after which there has been no further growth.

Figure 1: National Travel Survey (NTS)



The increase in distance travelled was the result of investment that allowed faster travel, but this growth in per capita travel has now ended, and total travel demand is driven by population growth.

The invariance of average travel time means that there are no travel time savings in the long run, and the long run benefits of transport investment are seen in changed land use. The Docklands Light Railway (DLR) has made brownfield land accessible for development. This demonstrates a causal mechanism for transport benefits arising from a change in land use. The same was true for the USA when the interior was opened up for development in the nineteenth century. There is more of a step change with major rail schemes than with a more incremental change with road improvements.

Congestion arises on the strategic road network near populated areas where local and long distance traffic mix together. The Department for Transport (DfT) approach to appraisal considers relatively small reductions in journey time when analysing major schemes. You can take two views on these savings: that they don't matter; or that they add up. However, a saving of three minutes may be irrelevant to a longer journey but material for a short distance trip. Local users will travel further and this induces traffic, restoring the congestion to what it was, Long distance traffic will not be better off, but the investment will actually improve local access, which may not be the intended result.

Many of the perceived problems of congestion may be due to unreliability in travel time. It is likely that investment will be more effective in digital technologies than in civil engineering. The speaker showed examples from Seattle, where the Washington State Department of Transport had a website predicting 95% reliable travel times, and from Autobahn North Rhine Westphalia, which gave a prognosis for travel time.

The implication from the NTS was that benefits are taken in the long run as access, opportunities and choices but not as time savings. Time savings are short run, observable but not observed – we could use travel diaries to observe time savings but it has never been done. The average distance travelled has

now stabilised. Travel demand is now driven by demographics and not income.

There are problems with basing investment appraisal on travel time savings. Infrastructure investments are long-lived with a discounted cash flow of up to 60 years. Long run time savings are notional and not real. The standard approach disregards land use changes and value enhancements and the spatial and socio-economic distribution of benefits. There are biases against urban rail and in favour of interurban road civil engineering. There is also bias against digital technologies.

We should therefore reconsider the economic appraisal of transport investments using findings based on an open-minded evaluation of completed schemes – what exactly we get for our investment? This should recognise changes in land use and value. The evidence-based approach avoids double counting. We need to rethink the economic framework with a move towards spatial and urban economics. This will help us to align economic and business/financial cases.

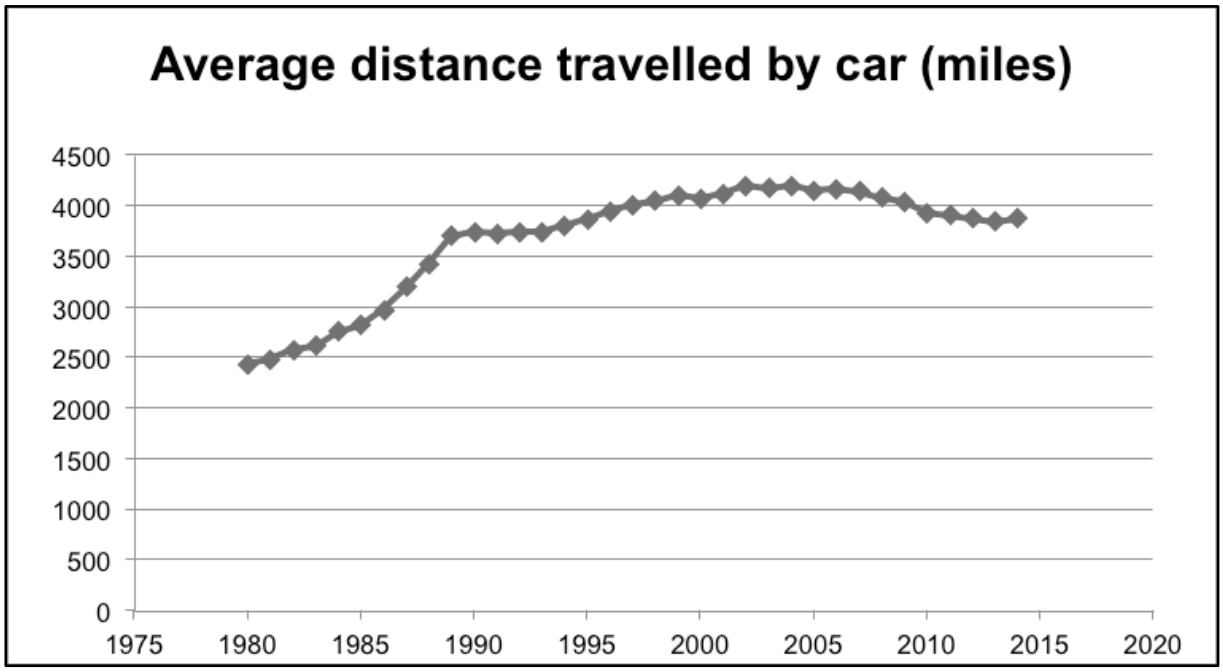
It should be principles-based with less detailed guidance: WebTAG is far too detailed. The policy implication is that it links transport investment to development to capture benefits. Without this linkage, transport investments are speculative. Some such as the DLR have been very successful, others such as the Humber Bridge did not achieved the benefits hoped for. We need to consider what we actually achieved rather than compare the outcome with what we set out to do.

Consider the proposed Northern line extension to Battersea. This will cost around £1 billion with a funding package including contributions from all parties that will benefit. It has a business, financial and economic case. It was the most expensive of the transport options available but was chosen as the developers did not want to rely on buses. A separate WebTAG-compliant transport analysis was based on assumed time savings, but the people working at the development will mostly not be those currently working at Nine Elms, and so there is a great deal of uncertainty as to the outcome. In reality, the scheme is all about land development.

Part 2: peak car

75% of all distance travelled in the UK is by car and so the average distance travelled by car has ceased to grow, consistent with the findings of the NTS. This is also the case in other developed countries, a phenomenon named "Peak Car" by Phil Goodwin, although "plateau car" might be a better term.

Figure 2: "peak car"

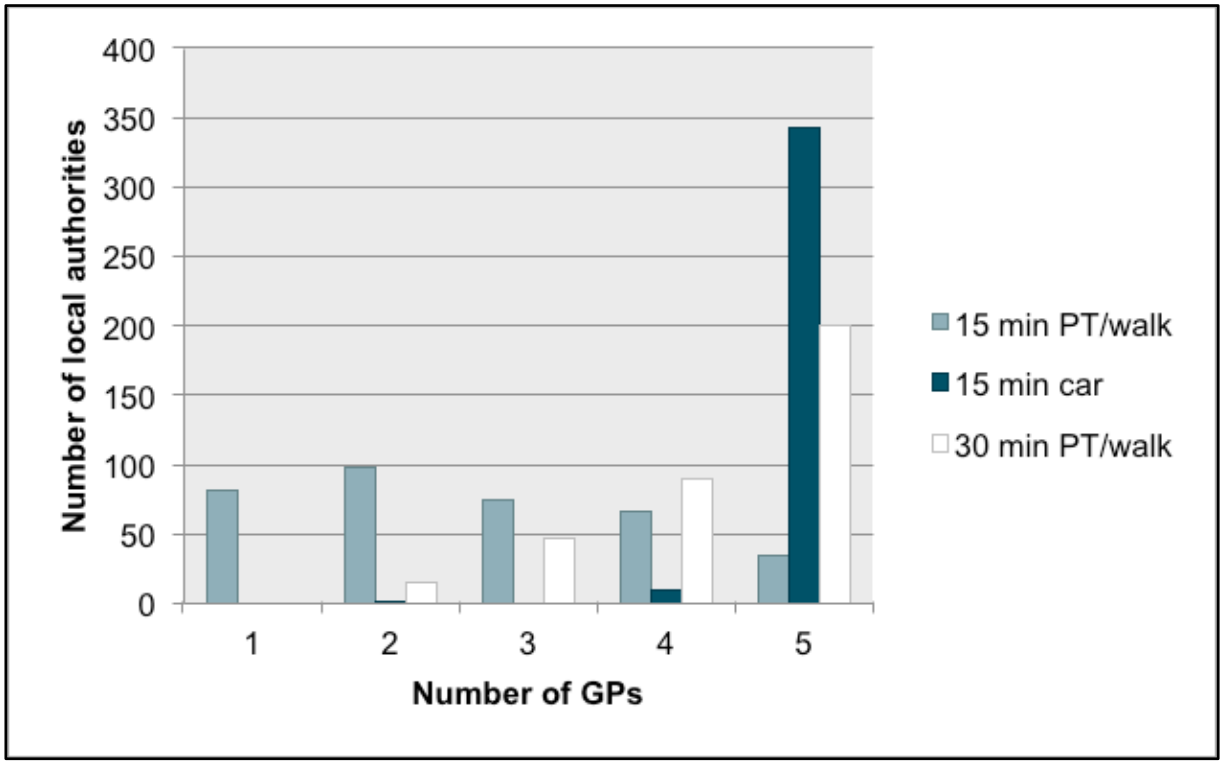


Various factors have been suggested as contributing to the Peak Car phenomenon, such as urbanisation, younger people being less interested in cars, changes in company car taxation (only true for the UK), demand saturation (there is already enough daily travel) and technological constraints.

The Department for Transport has developed a set of accessibility statistics to measure access of the population to regularly-used services such as General Practitioners (GPs).

These statistics can be used to ask how much choice people have. The average travel time to a GP is 15 minutes. Almost everyone has good choice of GPs within this time by car, but fewer do if they walk, particularly in rural areas. Car, or indeed good public transport, gives a greater choice, arguably enough travel to meet peoples' needs.

Figure 3: accessibility of General Practitioners



Access and choice increase with the square of speed of travel, whereas choice is subject to diminishing marginal returns, consistent with a saturation function. Housing is an exception, as the market is not in balance and people will take advantage of faster transport to access affordable housing. The largest increase in prices recently has been seen in areas next to the London Overground. New capacity on the strategic road network is likely to be used by people seeking new housing opportunities.

Prior to 1830 the average speed of travel was 3 mph and people travelled around 1,000 miles per annum. Since then both figures have increased by a factor of around seven giving a 50-fold increase in access to travel. Technological constraints now limit the scope for increasing average speed and the speaker did not expect there to be much of an increase. In consequence, per capita distance travelled is likely to remain unchanged.

The population is growing at a significant rate.

Figure 4: past and forecast UK population

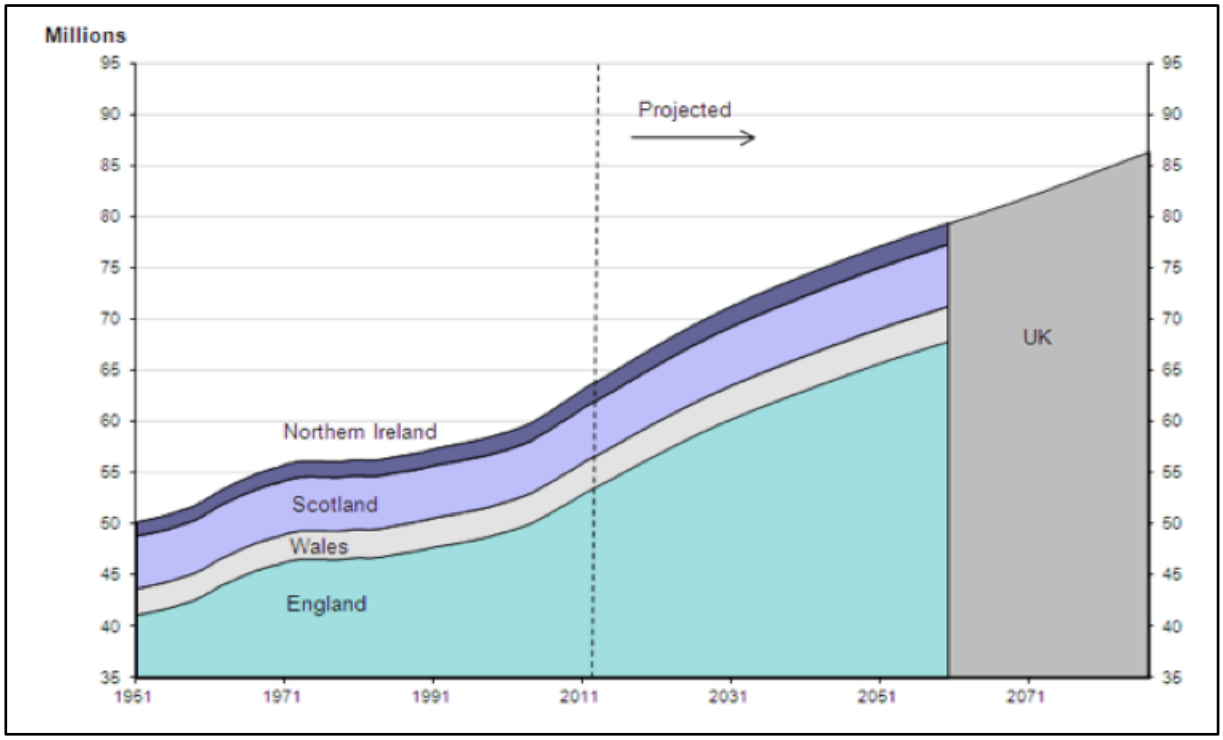
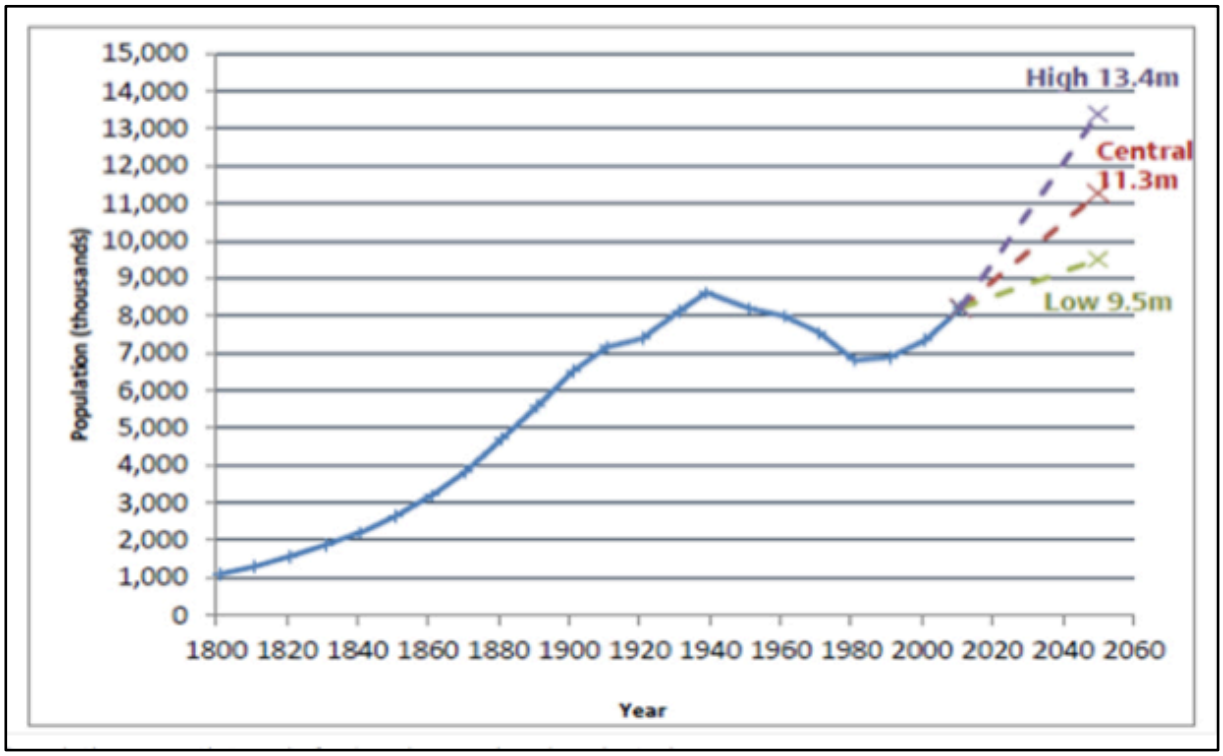


Figure 5: past and forecast London population

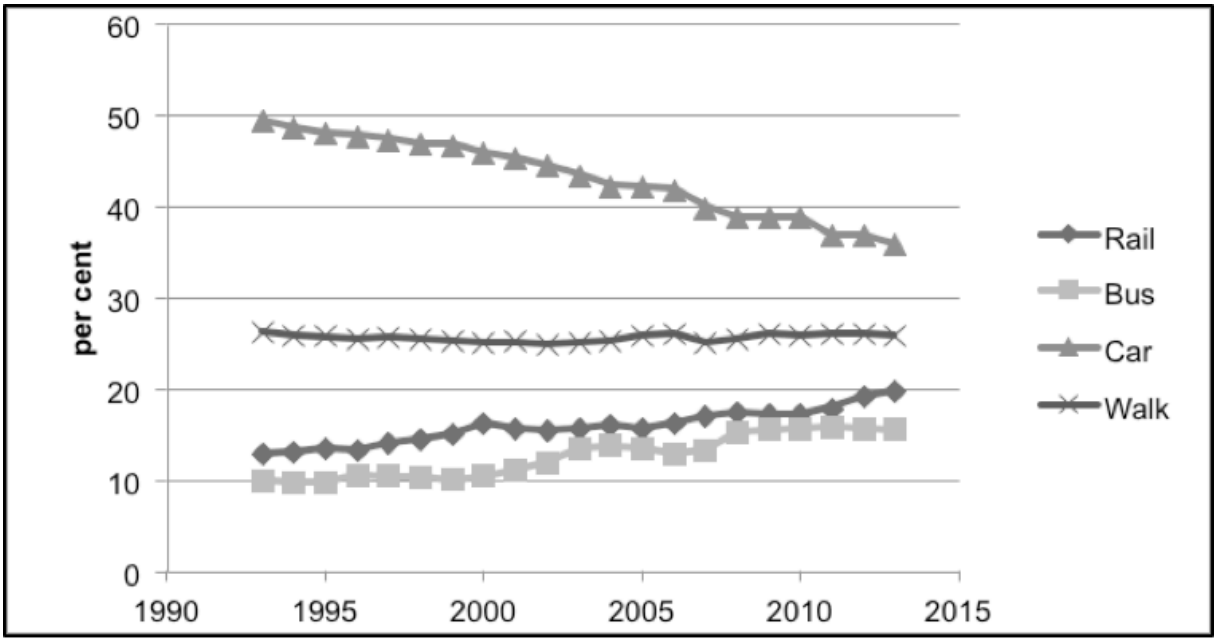


The consequences for future travel demand will depend upon where additional people are housed. If they live in green field sites they will probably want cars, whereas in urban areas public transport will be more important. London has a growing

population following a 50-year decline from 1940 to 1990: the forecast range is 9.5-13.4 million. People are increasingly seeing the attractions of living in cities by 2050.

While population and income are rising, car traffic is static or declining, the result of policy decisions not to increase road capacity. The population did not like new road schemes such as the Westway in London and existing policies are reducing carriageway for cars and constraining parking in inner boroughs. The consequences of static car traffic and a growing population is a declining share of trips by car.

Figure 6: mode share in London

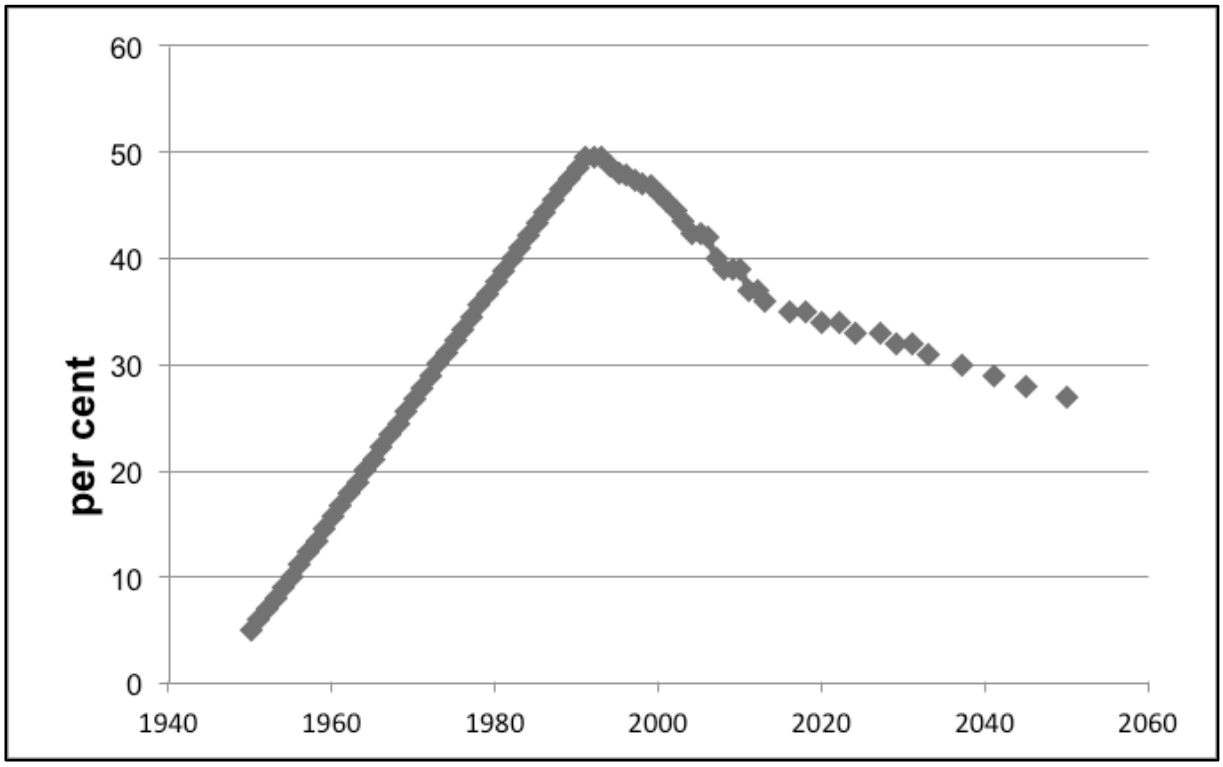


The development of the rail network has been important in achieving public acceptability of declining car use, since rail offers fast and reliable travel for work purposes: there are very few cars in the Canary Wharf area. It is harder relying on buses owing to congestion.

To estimate car use in London over the century 1950-2050, it has been assumed that car use grew in line with national ownership, known from the vehicle registry. The modal share of car peaked at 50% around 1990 and has since declined to 37%. The speaker believed that there was no reason why it might not fall further, to below 30%, if current transportation policies continue and London's population grows in line with projections. A similar effect is seen on other large cities such as Birmingham and Manchester. Big cities attract people and

population density increases. This is very helpful in reducing transport greenhouse gas emissions and could achieve 60% of the 80% reduction if trends continue: not all that is required, but much better than if the peak car phenomenon did not exist.

Figure 7: share of journeys by car in London, 1950-2050



David concluded by noting that in the twentieth century prosperity was associated with increased car use, the reverse was true in cities in the twenty-first century. The reduction is car usage started around 1990. Models extrapolate existing trends but the future will be different from the past. The National Transport Model is based on historic elasticities: modellers are in denial about peak car and indeed forecast an increase in car usage in London and other large cities. This results in a knock-on effect for interurban travel.

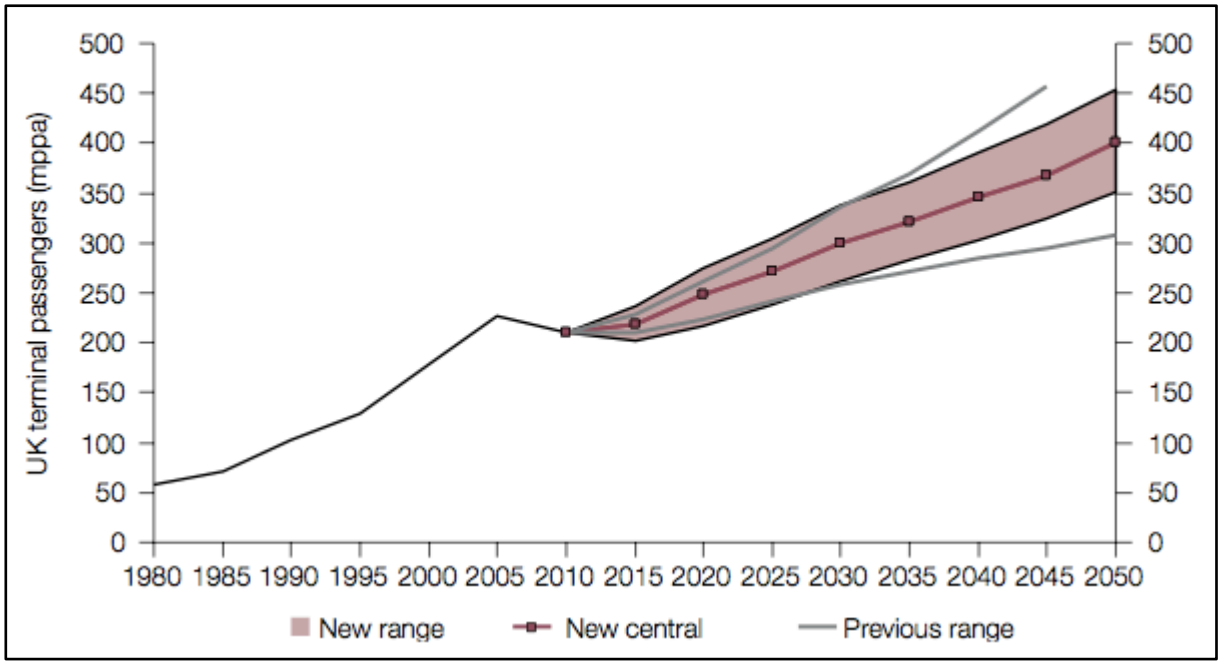
The speaker suggested that travel time be considered as a constant. We need to invest in transport to stimulate economic growth by changing land use, not by saving time.

Part 3: air travel

There has been strong growth in air travel, and the Airports Commission is confident of a doubling in the next 35 years to 2050, a 2% compound growth rate.

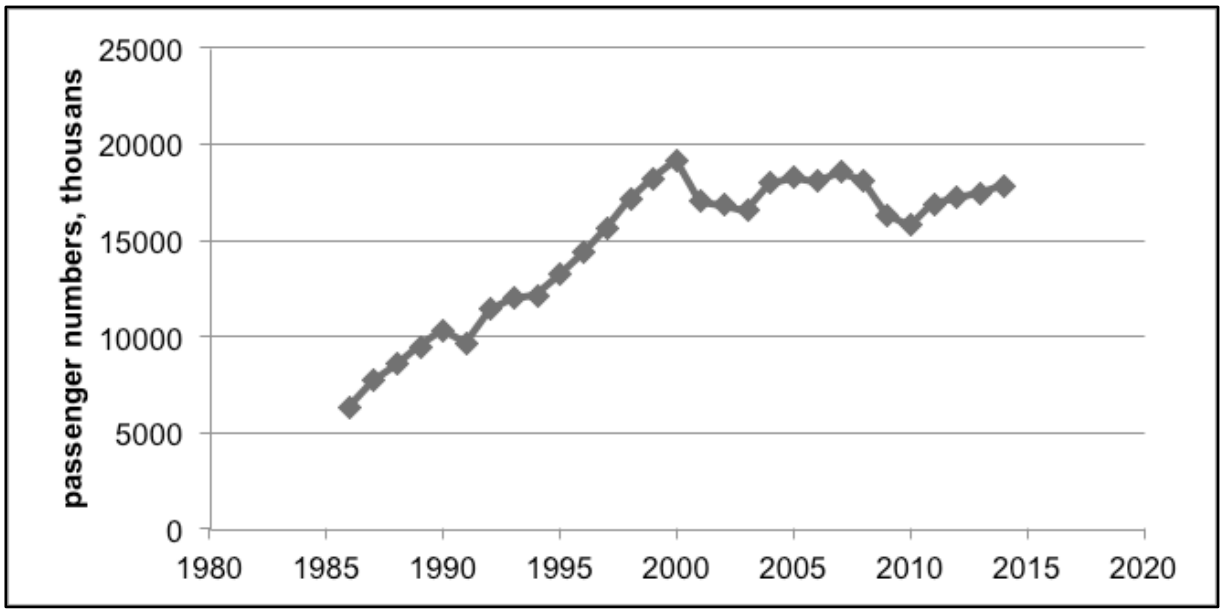
The new central forecast is 400 million passengers per annum, against old low and high forecasts of 310 and 500 million. Growth will vary by market.

Figure 8: new and previous DfT aviation forecasts



However, the UK-US market grew steadily to 2000 but has since stagnated, as shown in Figure 9, suggesting more than a transitional effect caused by 9/11.

Figure 9: UK-US travel



Travel to and from Japan has declined the most of any developed market. Figure 10 shows CAA passenger data that might have been affected by traffic hubbing via the Middle East.

Figure 10: UK-Japan travel

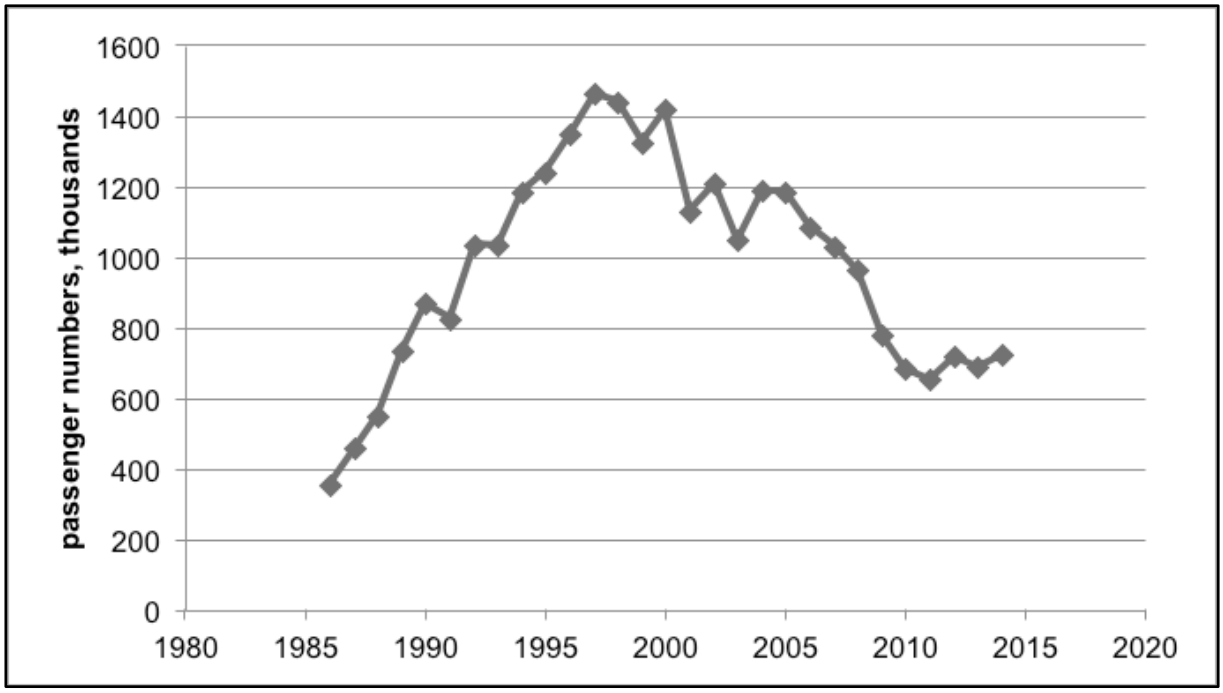
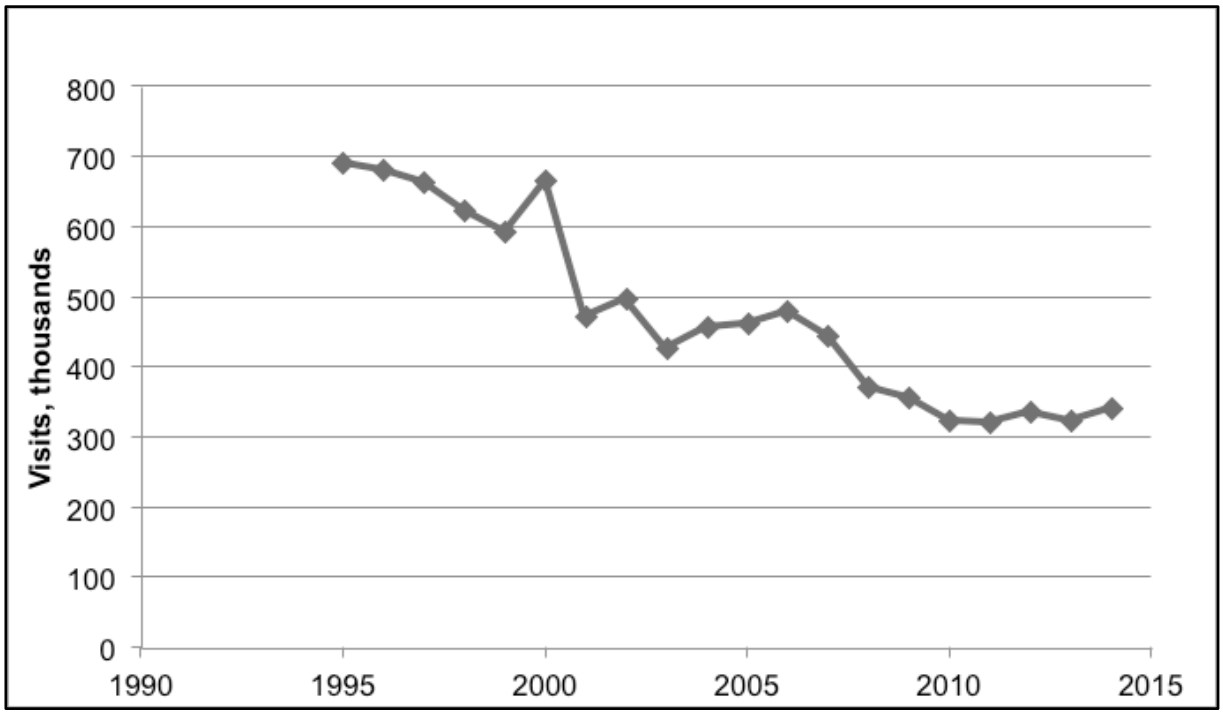


Figure 11 shows the International Passenger Survey (IPS) data for visits to and from Japan. These have more than halved from the peak in 1995, confirming the passenger data.

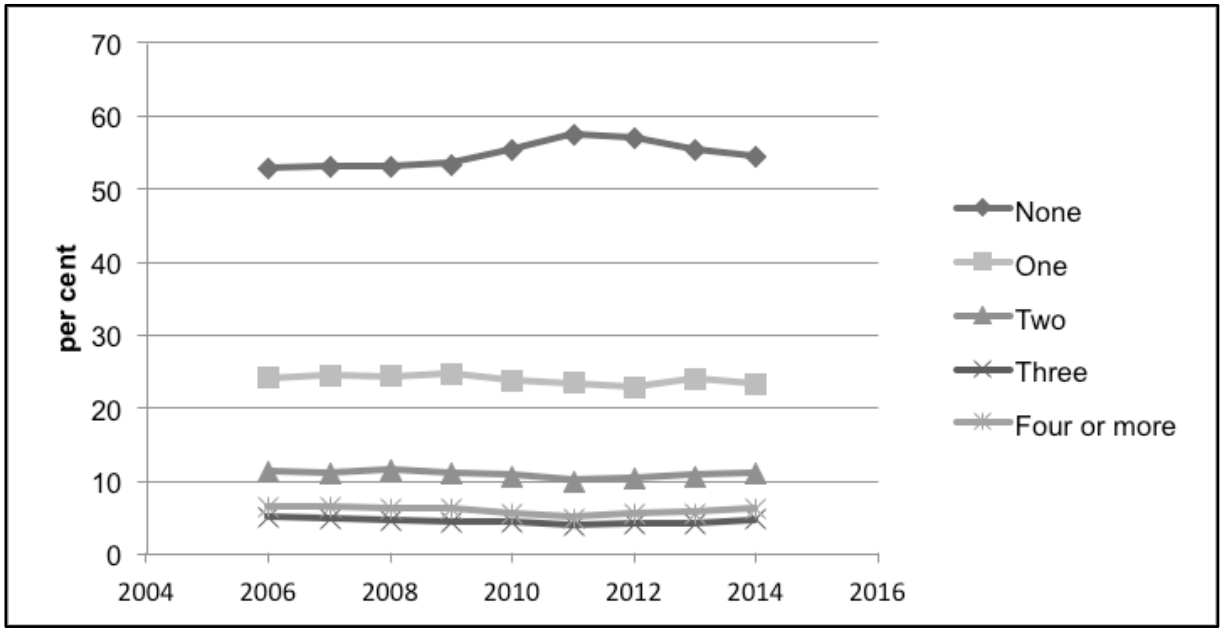
Figure 11: visits to and from Japan



The USA and Japan are not typical – most markets show some growth – but may illustrate market maturity which may be applicable in other markets in time. We have seen as example of this with the rise and decline of English coastal resorts.

A significant factor limiting air travel may be time constraints, both for business and vacation time, but the number of trips depends on how individuals use their time away from home.

Figure 12: percentage flying abroad in the last year



Over 50% of individuals have not flown in the last year and the pattern has been fairly stable, as seen in NTS data.

Table 1: propensity to fly increases as income increases

Income quintile	**1**	**2**	**3**	**4**	**5**
Infrequent flyers	72%	66%	58%	48%	30%

A recent CAA Household Survey asked infrequent flyers about barriers to flying.

Income was the most important factor. Incomes must therefore rise faster than the cost of travel for growth to occur on the part of the infrequent flyers. However, reductions in prices due to the low cost carriers may have run their course.

Table 2: reported barriers to flying

Rationale	
Budget constraints	47%
Flying not an option	28%
Health issues	19%
Prefer other modes	13%
Family changes	11%
Air travel concerns	8%
Access difficulties	6%
Environmental concerns	4%
Poor experience	2%
Other	9%

The speaker concluded that there was evidence of a demand plateau in travel to/from the USA and peak to/from Japan. Is this an initial indication of market maturity? Time constraints are likely to operate, but these are not understood, although they are researchable. Infrequent flyers may be a reservoir of demand. Low cost carriers provided a one-off boost to demand which has run its course. There is therefore more uncertainty about future demand than is generally supposed, and existing models need to be reconsidered.

General conclusions

For daily travel, the NTS suggests that there are no time savings in the long run and there has been no increase in travel per capita since the mid-1990s. The analytical framework of conventional appraisal and forecasting is inconsistent with the NTS and Peak Car evidence, and we should reconsider the framework. Investment strategies are questionable, with too little being spent on urban rail and too much on interurban road civil engineering: we cannot build our way out of congestion. There is also too little investment in digital technologies and this would be suitable for a national strategy.

The current long term trend is of an invariant daily average travel time. The new trends are of no growth in distance

travelled, no increase in speed, and demand saturation for many daily needs. As a result, population growth rather than income growth is the main driver of demand. We are seeing Peak Car in big cities which is helpful in reducing greenhouse gas emissions. In short, travel in the twenty-first century will be unlike that in the twentieth century.

For more details visit the author's website **www.peakcar.org**.

Discussion

David Starkie (Case Associates) said that he was concerned that the speaker was using the administrative definition of London. Is this appropriate given that the city draws its labour force from a much wider area? Wouldn't it be better to use a spatially wider definition? **David** replied that you could do this but that he was using the data available, which was that published by Transport for London. No data were readily available for the wider area. The broad conclusion would be similar. Transport was about moving people through spaces but we did not use spatial economics.

Alistair Baldwin (Herts CC) wondered if the speaker would have been able to reach his conclusions if the NTS did not exist. **David** replied that the results are similar abroad, but that having the NTS is a huge advantage and that all credit should be given to the Statistics Directorate of DfT.

Peter White (University of Westminster) noted that, if travel per head was constant, any increase would be due to higher population. Investment was required for this pro rata increase in transport capacity. Is this oversimplifying things? **David** said that this was broadly right. Fortunately London is good at transport governance, with its "Infrastructure 2050" plan, which is being used to development the case for Crossrail 2 and other major schemes.

Robin Morphet (UCL) commented that the dip between the two peaks in London has been filling up, for example with inter-firm business. Has the speaker considered "white van man"? **David** replied that he would like to think about this but that the data were limited: it would be very useful if more were available. **Robin** also suggested that the spheres of spatial and

welfare economics overlap. **David** said that appraisals should be based on the economic framework most fit for purpose and agreed that it would be good if we could reconcile spatial economics with welfare economics.

Doug Rose (Arup) asked if the value of time and land should be treated differently across various regions: the benefits will bias towards London with higher values, which raises an ethical question. **David** replied that to examine enhanced land values it is necessary to use local values. This approach would also work for the Northern Powerhouse. We can rank transport investment by increases in property values.

Gregory Marchant (Retired SRA) said that not much had been said about peak and off-peak. How does this affect the conclusions? **David** replied that congestion was self-limiting: crowding deters people from travelling during the peak. It is a measure of stress and makes the case for investment.

Jeremy Drew commented on air travel. 9/11 was certainly a factor. Japan hadn't grown since the late 1980s, before which it was like China is now. Were the two countries relevant? Eurostar considers travel in Europe as a whole. It would be better to look at aggregate air demand. **David** replied that he was specifically looking for the exceptions. Japan's economy stopped growing rather than collapsed. Do economic models cover enough factors? The advantage of examining Japan and the USA was that they are not affected by Eurostar. There was work to do in this area as no one else was investigating it.

Robin Whittaker said that the model of refraction was useful for spatial economics and might explain much of the HGV traffic on the M25. Ships have an "L"-shaped cost curve which may explain why some routes in the North Sea had been withdrawn. **David** replied that it is hard to understand the freight sector. Consolidation of sea routes may increase road transport.

John Austin (Transport Systems Catapult) agreed that the current appraisal models are biased against digital investment. Is this because the models do not pick up the journey modes which are most beneficial to digital technology? **David** replied that Google is pushing ahead and we are seeing a "Countdown" culture develop. The Highways Agency was definitely biased towards civil engineering: this may be changing with Highways

England, but the £15 billion road strategy is geared towards civil engineering schemes. We need a methodology to value investment in digital technologies. There are two types of drivers on the roads: those whose time is critical (commuting); and those who are more flexible (shopping). The latter can use predictive journey time information to avoid the peak, while the former can use this to decide when best to set out.

David Simmonds said that the speaker had raised a lot of interesting material, but was concerned about constraining the model to limit total journey time. Forcing it in this way may be dangerous. Transport investment resulted in a tremendous increase in land values. Could we capture these to finance the investment? **David** replied that a model to show enhanced land values is a pragmatic way forward: it would show who benefits. The DLR extension to Lewisham resulted in windfall gains for existing property owners. Was it good value for money? We need fuller information about who gains to make good investment decisions.

Report by Peter Gordon

Total Appraisal in practice: the story of the Airports Commission and the Lower Thames Crossing

Daniel Hanson, Jonathan Gillham and Joel Strange, PwC

Arup

25 November 2015

Disclaimer

The speakers emphasised that their presentation did not in any way represent formal advice, analysis or conclusions from PwC, The Airports Commission or any other organisation. They were speaking in their personal capacities and from their own experiences.

Need for a new approach

Appraisal of transport projects in the UK is mostly undertaken using the WebTAG framework. This methodology has been in existence for some 30 years and is well-proven for analysing the impacts of "incremental" projects that are relatively modest in nature and which are not thought to have the potential to alter the economic geography of the country. It focuses mainly on the welfare benefits from journey time savings, but does attempt to take into account certain wider economic benefits.

More recently many working in the field of transport project appraisal have recognised that the WebTAG approach has limitations when applied to very large and/or potentially transformational projects. For example, such projects can cause businesses and individuals to relocate, whereas WebTAG assumes land use as a given (at least as a "central" scenario). In addition, some stakeholders focus on the impact of projects on variables such as GVA rather than welfare. In consequence, DfT has produced a series of papers on *Understanding and Valuing the Impacts of Transport Investment* (UVITI) and made available a report for them by Tony Venables, James Laird and Henry Overman on *Transport Investment & Economic Performance* (TIEP).

The work by the PwC Economics & Policy team reported in this presentation represents an evolution of current thinking, albeit a substantial one, rather than a revolutionary new methodological approach. When appraising major projects or strategic initiatives DfT, HM Treasury and other Government departments apply some other approaches. The PwC *Total Appraisal* approach attempts to fuse together a number of different visions for project or policy appraisal, allowing them to be viewed through different but complementary "lenses". The speakers presented it in the context of their recent work in advising the Airports Commission and in appraising options for a Lower Thames Crossing.

Total Appraisal

For the analysis of projects and packages, the *Total Appraisal* approach represents a methodology which captures:

- The overall impact on the UK economy, including knock-on effects
- Whether a project truly provides additional facilities and opportunities or how far it may result in displacement from existing activities
- The impact on both national and local GDP and the welfare benefits of the project
- Effects on spatial distribution for businesses and people
- Impacts over time
- The transmission mechanisms for these effects

It is essential that any such methodology is recognised as robust, clear and transparent, is credible, and is accepted both academically and by others working in the field.

The *Total Appraisal* approach is consistent with, but builds on, the issues and concepts set out by Tony Venables et al in their TIEP Report. It begins by assessing the user benefits using the conventional Generalised Cost approach, with the addition of an analysis of agglomeration effects.

To this assessment is added analysis of the agglomeration effects brought about by changes in location, together with a rigorous analysis of imperfect competition in markets for goods

and services and of how the labour market functions (by, for example, varying the extent to which people will work additional hours in response to higher wages, rather than assuming that these are fixed).

Included in the *Total Appraisal* approach, but missing from TIEP, is modelling of:

- The impacts brought about by the project's construction and how it is financed. Standard practice is to assume away these factors, but this is likely to be misleading, given that markets do not always function perfectly.
- How the changes identified in the analysis feed through the economy in a "general equilibrium" context. For example, cost reductions experienced by firms whose staff are able to travel faster and/or are more productive than they were, due to being located closer to other firms, will feed through into their decisions about what to produce and their prices, which in turn will affect their competitive positions and their recruitment decisions.

While a raft of techniques have been developed to look at the various benefits of projects and packages individually, or in relatively simple combinations and in a "static" way, the aim was to develop an integrated appraisal approach which brought together all the analyses and examined how the benefits flowed through to the wider economy.

Results of transport models, econometric analysis, construction and funding models, and corporate finance and sector knowledge are brought together in a Computable General Equilibrium (CGE) model. The four main outputs of the CGE model are the impacts on GDP, welfare (conventionally measured as cost-benefit), taxation, and employment, but these can be flexed according to what is required.

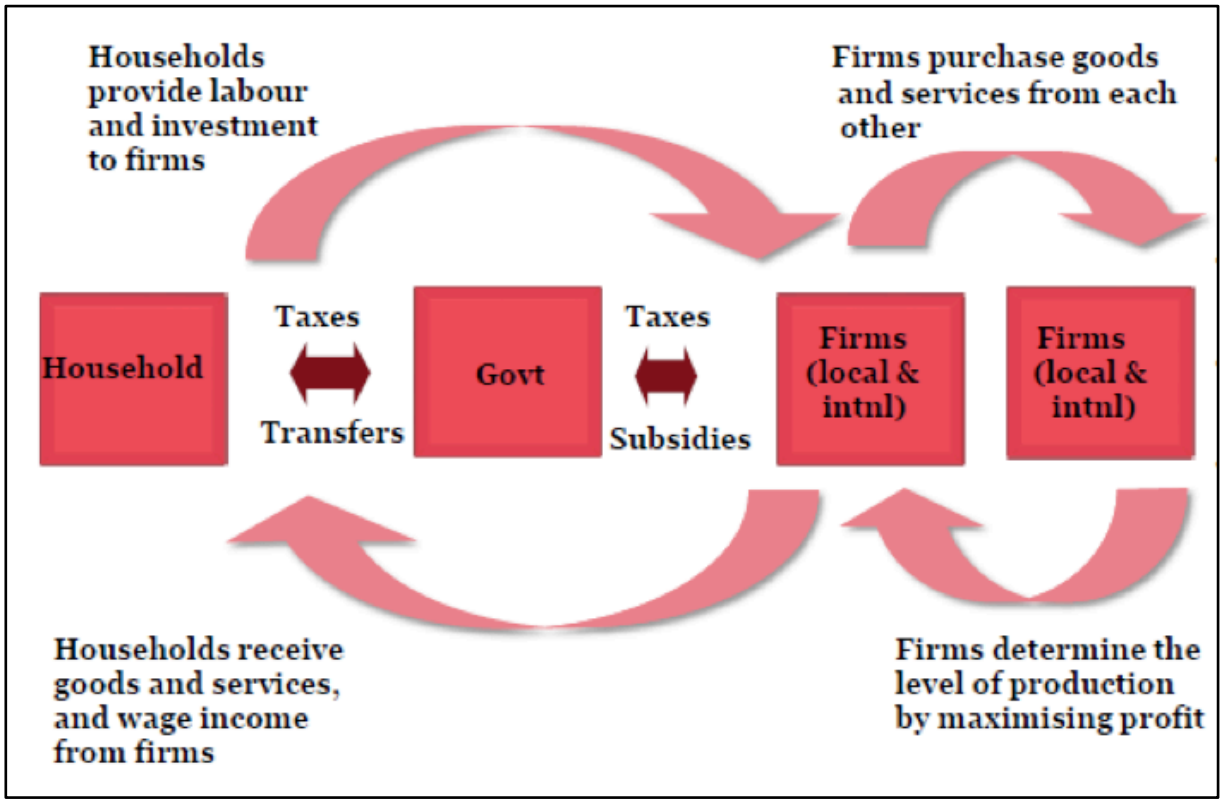
CGE models

CGE modelling is used in the UK for assessing the impacts of public financial policy packages but, until recently, had not been employed for the appraisal of transport projects. Some other countries, such as the Netherlands and Australia, have used the technique to appraise transport projects. Despite

WebTAG being a widely recognised benchmark in appraisal techniques, the UK could therefore be argued to be behind one aspect of international best practice.

In essence, such models are designed to replicate the flows of monetary value through the economy. As a consequence they tend to be large and, even with current computing power, impose limitations on the degree of regional and/or sectoral granularity which can be adopted. A CGE model can be represented schematically as shown below.

Figure 1: a Computable General Equilibrium model (CGE) model



Such models can be used to appraise the sectoral and regional effects of projects, and to analyse regional trade flows and tax effects. They have the advantage of aligning micro-foundations with a "realistic" view of the economy through, for example, taking into account the capital costs of consequential adjustments in the economy and allowing for the presence of imperfect competition.

Some consider that CGE models have large multiplier effects which lead to inflated results, but this is a misconception: in work for the Airports Commission, the "multipliers" (ratios of model outputs to the inputs) are often less than one.

Total Appraisal in practice: some examples

Additionality and displacement

For any major project, construction demand will lead to an increase in outputs or Gross Value Added (GVA) directly arising from the activities of the contractor. Contractors demand for inputs from suppliers will, in turn, result in an increase in outputs across the supply chain, an indirect effect of the project. The subsequent demands from these primary suppliers will cause similar indirect effects lower down the supply chain, causing further effects. Overall there will be an induced demand for labour leading to effects on wages and corporate profits, that is diffusion effects. The role of the CGE model is to capture the totality of these effects.

Agglomeration: analysing static clustering

Was distance or journey time a better measure of agglomeration when appraising the Lower Thames Crossing? Was it appropriate to use the standard national elasticity agglomeration coefficient or might this vary between regions? By running an econometric model using a full range of statistical specifications, together with a more recent data set and GI software, it was possible to test these hypotheses. The model outputs showed that using journey time gave a much more nuanced result. The outputs were also able to suggest that there could be variations in the agglomeration coefficient.

Integrated approach for the Airports Commission

Inputs into the CGE model were grouped into two categories:

- The Operational Phase of a new runway
- The Construction Phase of the runway(s)

For the Operational Phase, key inputs were the Airport Commission's forecasts of passenger flows, information on expenditure per passenger, econometric analysis of the impact of increased passenger flows on trade (and, in turn, productivity), frequency benefits, and changes in transport economic efficiency (changes in consumer and producer surplus brought about by increased capacity).

For the Construction Phase the main model inputs were the costs of the works directly associated with the additional runway(s) and of any enhanced surface access.

For the purposes of the model the UK was divided into separate regions of London and South East, Rest of England, Scotland and Wales. The limitation on computing power noted above was one of the reasons why the analysis was not carried out at a finer regional gradation. Since the outputs from any "Black Box" model can be called into question, an important aim of the team has been to explain the methodology as fully as possible.

Key features of the model are:

- Labour market:
    - Each region has its own employment rate. Workers can enter or exit the market.
    - Real wage and out of work income are key determinants of labour supplied to the market. Regions with high unemployment are more likely to have spare capacity.
- Capital market:
    - Each sector has its own rate for return and risk premia (estimated from long-run stock market βs). Construction and business services have the highest rates of return.
    - There are quadratic capital adjustment costs. It costs money to move capital between sectors: the more capital that moves the higher the costs.
- Imperfect competition and increasing returns to scale: firms have a perceived elasticity of demand and charge mark-ups based on it. Firms enter or exit the market if mark-ups rise or fall, and may enter into price wars to keep competitors out of the market if it is thought to be more profitable. This may lead to multiple equilibria.
- Consumption function: households supply labour and capital to the market. Earnings are spent on consumption or saved. Households have minimum requirements in consumption: there is a major loss in utility if incomes fall and they cannot consume their minimum requirements.

Lower income regions are closer to the minimum requirements.

- Regional trade: the model captures trade between regions and internationally. Regions with major trade deficits will buy-in goods and services from across the UK, affecting the regional distribution of the economic impact.

The challenge in building and running any such model is always to avoid double-counting. Inputs into the model arising from financial and econometric assessments of the factors described above might give rise to similar but increased effects as outputs from the model. However, it is notable that for this model the outputs were generally smaller than inputs, as shown below.

Table 1: drivers and multipliers

Driver	**Multiplier range**
Construction and surface access	0.44 to 0.62
Passenger flows	-0.26 to +0.85
Productivity	0.49 to 0.75
Frequency benefits	1.67 to 1.93
Transport Economic Efficiency: consumer surplus	0.50 to 0.59
Transport Economic Efficiency: producer surplus	0.07 to 0.15
TOTAL	**0.64 to 0.84**

The model formulated the economic impacts from both the Operational and the Construction Phases. Reported results from the model at both national and regional level include:

- GDP
- household consumption;
- investment;
- government consumption;
- net trade;
- employment and wages; and
- welfare.

Bridging between welfare and GDP assessments

In addition to assessing the total impact on variables such as Gross Domestic Product (GDP) or Gross Value Added (GVA), the approach enables us to "build a bridge" between welfare and GDP assessments, which can be particularly important in enabling a project to be viewed holistically and coherently. In work on the Lower Thames Crossing, the following impacts were analysed:

- Stage 1. Partial Equilibrium Assessment of Welfare Impacts
    - Sum of Total User Benefits
    - ◄ *Minus* User Benefits for leisure travel and commuting
    - ► *Plus* Agglomeration Benefits calculated using updated agglomeration elasticities
- Stage 2. General Equilibrium Analysis: GDP Impacts
    - Inputs from Partial Equilibrium Assessment of Welfare Impacts (From Stage 1) are run through the CGE model, which produces a General Equilibrium GDP impact. The impacts of various different assumptions are then explored, the most notable of which are the impacts of:
    - ► An open rather than a closed labour market
    - ► Increasing (rather than constant) returns to scale
    - ► Imperfect (rather than perfect) competition
    - ◄ Capital adjustment costs of any adjustments
    - ◄ Costs of input substitution friction
- Stage 3. General Equilibrium assessment: Welfare Impact
    - Input from General Equilibrium Analysis of GDP Impacts (From Stage 2)
    - ► *Plus* User Benefits for leisure travel and commuting – added back
    - ◄ *Minus* Disutility of Working
    - = **General Equilibrium Welfare Impact**

One of the key questions in project appraisal, the answer to which will vary between different projects, is the relative scale of General Equilibrium Welfare and GDP impacts relative to each other and relative to the partial equilibrium welfare effects produced by WebTAG.

Issues and challenges

A number of challenges have been addressed, and will be faced, in developing and applying *Total Appraisal*. For example:

- Availability of sufficiently disaggregated data. Historically this has made the application of CGE techniques to transport project appraisal very difficult, but significant advances have recently been made.
- The level at which the analysis should be pitched, whether national, regional or local, inevitably involves trade-offs between the size of the model (and computing power required) and the desired degree of granularity.
- The rigour of the modelling inputs can vary significantly.
- It is necessary to consider synergies and interactions, since transport infrastructure projects are rarely planned in isolation.
- Care needs to be exercised in the detailed optimisation of the schemes being appraised, rather than simply comparing one major option with another.
- Rigour and transparency is vital if the "Black Box" is to be unpacked in a way that people can understand and if debates are to be informative and facilitate the coalescence rather than fragmentation of opinions.
- The results somehow need to be benchmarked, although it is difficult to make meaningful comparisons.

Questions and discussion

Gabi Cordero (Jacobs) was interested in agglomeration. She noted the speakers had used journey times rather than distance in their model, and wished to know how they had calculated these and how reliable they considered their figures. Also, how did this fit with assessments of Value of Time (VoT)

and Generalised Cost used in conventional models? **The speakers** explained that their journey time data had come from GIS and journey planning software. They felt that the values obtained were valid, given how quickly agglomeration benefits decay with distance. On the second point, the speakers felt that the work they had done has helped to narrow significantly the gap between WebTAG and the econometric evidence reported in the literature, but more work was required to reconcile VoT and Economic effects in models such as WebTAG.

David Metz (UCL) wanted to know whether in either of the examples presented the team had proposed a "Do Minimum" case. David wondered whether, if no additional runway capacity was provided, business travel at premium fares would continue to grow, but at the expense of lower fare leisure travel. **The speakers** confirmed there was a "Do Minimum" against which the schemes were assessed and explained that modelling both the Do-Minimum and scheme options rigorously is the very essence of doing this work well. They also confirmed that having completely full airports in the South East was seen as a constraint on UK economic growth.

Austin Smyth (Hertfordshire County Council) recalled that the speakers had described WebTAG as being internationally recognised as a "best-in-class" appraisal technique, but had also opined that the UK was 20 years behind in applying CGE to transport appraisal. There appeared to be an anomaly here. **The speakers** made clear that they considered WebTAG very good for assessing incremental changes. CGE was appropriate for projects or packages with a genuinely transformational effect: that was the difference.

Ivan Viehoff (Cambridge Economic Policy Associates) felt that in the real world the economic effects of a whole variety of investments are always acting at the same time. How was it possible to identify reliably the effects from just one project? He was sanguine about the transformational effects of projects. HS1 had been predicted to have a major regeneration effect on the area around Ebbsfleet station, but this had not yet happened. **The speakers** agreed that there were always joint effects going on from multiple projects. This affected all

modelling, not just CGE. CGE is designed to capture the wider effects of major projects through their net effect on GDP. Even very large projects will only have a relatively small effect on the economy as a whole.

Dominic Walley (Connected Economics) raised two issues. Firstly, where did the threshold lie between incremental and transformative projects? Secondly, how was the balance to be struck between the degree of spatial specificity and data quality? The distribution of benefits to winners and losers from HS2 had become a major issue. **The speakers** could only give broad guidance in response to the first point. As a rule of thumb it was worth applying CGE only to projects costing £0.5 billion plus. The key issue was whether the project would cause businesses and people to relocate. On the second point the speakers acknowledged that as one attempted analysis at more local levels, the data was less reliable: hence the need for a trade-off. One way of coping with this issue was through sensitivity testing.

Robin Morphet (UCL) considered that the effects of imperfect competition were already allowed for in WebTAG. Was there then not a possibility of double-counting? **The speakers** felt that the value of CGE was that it evaluated different markets individually rather than taking the broad brush approach adopted for WebTAG. The major effects on imperfect competition came from the changes in the levels of productivity.

David Spurling (Learning Through Co-operation Ltd) felt that very major effects from increases in road and air transport arose through the health problems caused by increasing pollution. This could have significant economic impacts but never appeared in models, so what was their purpose? **The speakers** were of the view that, while all models were imperfect, they were an aid to decision making. Other issues could then be taken into account in a qualitative manner.

Report by Gregory Marchant

TEG Committee 2015-2016

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TEG TRANSPORT ECONOMISTS' GROUP

The Transport Economists' Group, formed in 1973, provides a forum for people involved in transport economics to meet regularly and discuss matters of mutual interest. Membership is open to economists working in transport and others whose work is connected with transport economics.

The aim of the Group is to improve the quality of transport management, planning and decision-making by promoting lectures, discussions and publications related to the economics of transport and of the environment within which the industry functions.

Meetings, held at Arup's Central London HQ at 13 Fitzroy Street from September to June (except December), consist of short papers presented by speakers, drawn from both within the Group's membership and elsewhere, followed by discussion.

The Group's Journal, "The Transport Economist", is published three times a year reporting on meetings and other activities of the Group. It reviews recent publications of interest and contains papers or short articles from members. The Editor welcomes contributions for inclusion in the journal, and can be contacted at **petersgordon@blueyonder.co.uk**.

The current membership of over 150 covers a wide range of transport modes and types of organisation. Members are drawn from transport operators, consultants, universities, local and central government and manufacturing industry. All members are provided with a full membership list, updated annually, which serves as a useful source of contacts within the profession. Applications from people in all sectors are welcome.

Applications for membership should be made on a form which can be downloaded from the Group's website at **www.transecongroup.org**.

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Details of meetings are provided on our website at

http://www.transecongroup.org/meetings.htm

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