

Bus Planning Literature Review - Research and Report by JRC Ltd

Background

1. London Assembly Transport Committee starts hearings into Transport for London's bus services portfolio during spring 2017. JRC Ltd has been commissioned by the committee officers to research and report available information on five urban bus planning topics of urgent interest to the Committee. Each of those topics is listed below, along within subsidiary questions.

Table of contents

Questions answered in JRC review

A1. How does TfL assess and analyse the bus network and how does it make the case for changes in areas, routes and frequencies?	2
The scale of demand	2
Financial policies	3
Strategic implication for bus network planning	3
How TfL undertakes bus route planning – getting the data	4
How TfL undertakes bus route planning – analysis of benefits, choices and consultation	5
Bus corridors paralleling urban railways	6
A2. The British bus planning context, outside regulated London	7
A market-led approach	7
Bus network planning stresses arising with a market-led approach	8
Slow road to integrated ticketing and planning	8
British bus exemplars outside London	9
National legislative opportunities and changes	10
Lessons from other parts of Britain	11
A3. How do London's processes compare to those used by other major world cities?	11
International research and practical implications	11
Comparable world cities	12
Athens	14
Barcelona	14
Berlin	15
Birmingham and Manchester	16
Madrid	17
Moscow	17
Naples	19
Paris	19
Warsaw	20
B1. How well does the bus network allow for journey interchanges with other buses and transport modes? How are these interchanges mapped and strategized by TfL?	20
Ticket integration	20
Interchange between corridor routes	21
A bus interchange strategy	22
Scope for specified interchanges to support promotion of bus corridors	23
Population growth as a stimulus for better interchanges	23
B2. How do interchange opportunities compare in central, inner and outer London?	24
Central London	24
Inner London (Zones 2-3)	25

	Outer London (Zones 4-6)	26
C1.	How is bus stop density analysed?	26
	Bus stop basics	26
	Bus stop density measurement	27
C2.	What role can consideration of bus stop density play in network planning?	28
	Useful stop density depends on land uses	28
	Meridian Water as an exemplar for bus stop planning in a new development	28
	General observations on the relationship between bus stop density and land use	29
D1.	Do local bus routes and infill services achieve a good balance of user benefits and operational costs?	29
	The trend towards more local and infill coverage	29
	Economic issues faced by local and infill services	30
	Current revenue and BCR risks	30
	Other considerations	31
D2.	Do these services successfully supplement major routes to deliver additional capacity / frequency as required?	32
E1.	How can bus services be planned to accommodate existing (and encourage new) jobs and housing?	32
	Generalised demand is the current norm, and under pressure	32
	Prioritising choices	33
E2.	Can different bus networks be planned to suit different areas in London?	34
	What is meant by 'different'?	34
	A simple synopsis	35
	Methodology should be the starting point	36
	Opportunity Areas and Satellite Activity Zones	36
	Emerging Topic: Greater use of 'Rich Data' sources	38
	Real-time tracking for locations beyond stations and bus stops	38
	Benefits for different parties	39
	New types of routes on offer	39
	Accessing 'rich data'	40
	References	41
	Method of engagement	45

A1. How does TfL assess and analyse the bus network and how does it make the case for changes in areas, routes and frequencies?

The scale of demand

- London's scale of bus operations is vast compared with anywhere else in Britain and with cities of equivalent population density anywhere in Western Europe. This is despite provision of one of the most comprehensive urban rail networks. TfL's latest Travel in London report highlights that the private car travel volumes have been overtaken by other modes in the capital.
- In the period from 2000 to 2015, London's population rose by 19.9% but public transport demand grew by 65% (journey stages). Bus demand grew by 60.3%, while the volume of car driver trips fell by 13.9%. By 2015, London had 7,600 buses in peaks, 6.5 million passengers each weekday and 86% customer satisfaction.

4. The problems faced by public transport are therefore one of success and foreseen continuing growth in demand, against a finite road capacity and greater pressure for a better quality street environment. TfL estimates that by 2041 the London population will reach 10½ million, from its present 8.6 million, with continuing growth in travel demand. Financial pressures are greater because of the current Mayoral policy for a fares freeze.
5. TfL policy supports more use of rail where there is foreseeable capacity. The rail industry, and commentators including JRC, have identified that rail and tube capacities will be under considerable crowding pressures despite large scale capital investment by the 2030s. For example, Network Rail's Long Term Market Planning report for London and South-East covering 2013-43, and 'Peak Tube' reportage in 'www.londonreconnections.com'. Such changes in rail demand will place continuing reliance on London's buses for main corridor travel, as well as for local and short distances.
6. The latest DfT analysis of local bus passenger journeys in England shows nearly 2.3 billion London bus journeys in 2015-16 and only 2.2 billion throughout the rest of the country, although London's population is only one-sixth of England's. There has been a 3% fall in bus travel both in London and elsewhere since 2013-14. In London, much of this fall has been attributed to worsening congestion causing less attractive bus journey times and an increase in 'excess waiting time', with the congestion charge's effectiveness under review.

Financial policies

7. TfL's overriding policies are established by the Mayor of London, who has control over London wide policies and priorities including transport and strategic land use planning. The present high level policies are to support economic growth and population increase and to freeze TfL fares for the mayoral term. Meanwhile the government has said there will be no more revenue funding available to London after 2018-19.
8. The new TfL 5-year business plan to 2021/22 was agreed by the Board on 16 December 2016, and this takes account of these twin financial parameters. It fixes the mileage of TfL-contracted bus operations per year at nearly 500 million kilometres, subject to forecast levels of operating revenues and costs, which includes the revenue impact of the new bus hopper fare. The budget represents a 3.7% cut in bus mileage compared to the previous plan, which had projected an increase up to 516m kilometres by 2021/22.
9. Passengers' service satisfaction score is planned to be maintained at 86 points out of 100, and revenue is intended to grow in cash terms from £1,549m in 2016/17 to £1,845m in 2021/22 (about 3½% per annum, so greater than the inflation rate). Net bus operating costs (subsidy) are intended to be held in cash terms for the first four years at about £600m annually, so with a real reduction in unit costs during that period, although costs are forecast to rise for the last two years as a new, greener bus fleet is funded. Net subsidy numbers are between £60m-£100m higher than the previous Business Plan for a lower service volume. Apart from the new buses, the largest single impact is the revenue cost of the hopper fare.

Strategic implication for bus network planning

10. The budget envelope provides a big challenge for all aspects of TfL, including provision of bus services. Extra travel demand is projected, but there will be greater constraints on the affordability and availability of total bus supply, and harder choices on putting the bus

resources where they are going to be of greatest use. TfL has the task to assess options for changes to bus routes, frequencies and capacities.

11. TfL has already stated in its Business Plan [pages 50-53] that “The total number of passenger journeys is expected to rise steadily over the plan. We will re-distribute resources to meet changing demand, maintain network reliability and improve journey times...We plan to get people back on the network by reducing bus delays caused by congestion and investing in modern vehicles, driver training and safety enhancements. We will continue to make the best use of our capacity so that we can boost bus routes in growth areas.”
12. Several specific examples of route changes are given: “We plan to make changes to enable the transformation of Oxford Street, reflecting the opening of the new Elizabeth line, while maintaining connectivity and services in the locality. This will be balanced by improving services in growth areas, such as Barking Riverside.”

How TfL undertakes bus route planning – getting the data

13. Detailed reports on TfL bus planning procedures and options assessment are listed in the reference annex. The main documentation is here.^A This section describes the general processes. The general way in which TfL undertakes the route planning is to understand current and foreseen future demand on the bus corridors and particularly to find out what future causes of demand might be, including new residential and office developments, other changes in local population and other causes of local travel. This involves constant liaison with local authorities, understanding what local housing targets are for additional homes and where those are likely to be located. Also liaison with major sources of demand such as hospitals, schools, further and higher education as well as major shopping and leisure venues.
14. TfL measures passenger waiting and interchange times and uses standard value of time formulae for transport planning use. Research shows that passengers perceive walking and waiting times as 2½ x the actual minutes elapsed. At present TfL uses this 2½ x factor, although as better real time information becomes more widespread it is considering whether there is a case to reduce the weighting to 2 x.
15. A model called WebCAT measures the distance from bus stops and railway stations to existing and new developments. This has just been updated, and is TfL’s online planning tool for showing how well-connected a location is in terms of transport. TfL then converts the time incurred to monetary values.
16. With such information, bus network planning is nowadays a major and sophisticated modelling process. It uses algorithms so that TfL can accurately assess individual and grossed up volumes of passengers based on use of Oyster and other smart cards. Massachusetts Institute of Technology (MIT) was commissioned 10 years ago to undertake algorithm development, and the modelling went live within the last 2-3 years. Two-thirds to three-quarters of bus passenger journeys are known in detail using this system.
17. TfL plans to increase this knowledge through other live data collection methods, as travellers reveal other parts of their journey through mobile devices and Bluetooth. Previous methods

^A [tfl.gov.uk/corporate/publications-and-reports/bus-network-development-papers](http://content.tfl.gov.uk/corporate/publications-and-reports/bus-network-development-papers)
<http://content.tfl.gov.uk/bus-service-planning-guidelines.pdf>

are still maintained at present, including counting staff to check bus patronage, and travel diaries filled by a sample of passengers, with the samples organised across London on a 5-year cyclical basis (BODS – Bus Origin and Destination Survey). This helps to calibrate the automated data.

How TfL undertakes bus route planning – analysis of benefits, choices and consultation

18. Bus planners cannot deal with nor afford all changes at once. They have a 'pending file' of desired and requested changes. There is a regular review cycle which is normally geared to the 5-7 year route contracts, when, by retendering, TfL can use competitive pressure to drive better prices. The key parameters to be measured are route pattern, vehicle capacity, operational reliability, frequency and connectivity.
19. Different options are developed and then valued in terms of benefit to cost ratios for the full range of routes under consideration. The benefit cost ratio could take the form of benefits gained versus net increase in cost, as well as the disbenefits versus net savings if routes were reduced or withdrawn.
20. At present there is a minimum BCR pass mark of 1.6:1 but in practice because money is tight the prevailing BCR is 2:1. Schemes that do not achieve enough benefit or have too great a disbenefit do not get taken forward, but may be still considered in the future as possible inputs to new network proposals.
21. As a simple example of the way in which frequency changes would be assessed, let's look at a desire to increase bus frequency from 6 buses an hour to 8. That gives an average passenger waiting time improvement from 5 to 3¾ minutes, half the interval. The basic valuation is $2\frac{1}{2} \times (5 - 3\frac{3}{4} \text{ minutes}) \times \text{annual passenger numbers} \times \text{value of time}$. This gives the total annual benefits to passengers in Year 1. If the cost of an additional bus per annum is less than half those benefits then the BCR is more than 2. Benefits and costs are assessed only for the first year, as the bulk of immediate change occurs within this period.
22. In reality there are other elements in the calculation. For example a higher frequency may increase journeys and revenues so that it is the net cost which matters. The calculations can become very complicated when entire corridors are being assessed.
23. Consultation is a fundamental, and once the potential options have been devised for new or changed services then TfL will want to explain what the possibilities are and to explain what they see the best value options are using the assessment methodology.
24. Routes are tendered individually and have different dates for renewing even on the same corridor. This is problematic for general corridor planning and route optimisation. Other limiting factors can be the availability of bus turn-round and stand locations, which are in shorter supply as demand and frequencies have risen.
25. TfL does these benefit assessments in detail because the London bus operations are regulated – the Government agreed in 1993 that London, unlike the rest of Britain, should retain regulation of its bus services. Since a Mayor of London has been in post, starting in 2000, and strategic transport, land use, economic growth and environmental plans have been developed, the mayoral requirement is that the bus volume is there for the benefit of Londoners and visitors.

26. The bus network is not there to make a commercial profit, indeed the scale of London bus subsidy is broadly about £600m pa for the next four years, which after 2018/19 has to be funded from operating surpluses in other parts of TfL's budget. As noted above, one of TfL's objectives is to keep the proposed volume of bus operation affordable within that financial headroom.
27. This will increase contractual pressures in future years, tensions for BCR assessments, and potentially some adverse public perception after route revisions if there were significant reductions in service volume, accessibility and connectivity, without sufficient compensatory measures such as improved interchange. Passengers' actual willingness to transfer between buses with the hopper fare has yet to be measured.

Bus corridors paralleling urban railways

28. In practice as with any city London has its special features. Where there is an urban railway corridor it is often the case in London that there is a parallel bus, as for example with the number 25 from Ilford to Oxford Circus, even though bus and rail networks are both regulated.
29. This is because the corridor itself has high density suburban housing and many high volume clusters of employment, retail, education and leisure, as well as several major hospitals. These cause busy intermediate travel demand at stops in-between railway stations. The rail service can be near capacity limits during the peak of the peak.
30. Other factors in favour are that London buses are fully accessible for people with reduced mobility, unlike many stations. Also the shorter average journeys made on the buses would be inconvenienced if passengers were forced to incur lengthy access times to distantly spaced stations - a frequent bus will minimise the total origin to destination time. There are passengers who prefer to use a bus for various reasons including cost and dislike of underground travel.
31. In the case of the 25 bus, it is possible that the arrival of Crossrail (the Elizabeth Line) in 2018/19 may divert a proportion of bus users. Some high frequency buses will still be required, servicing the corridor and intermediate stops for the reasons above. TfL has said the route will be reviewed – a 3-year only contract was awarded recently. Currently it is proposed that some current short trips (Ilford – Mile End) transfer to an extended 425 (currently Clapton-Stratford, in future Clapton-Ilford). This plan removes half of the 25 between Stratford and Mile End.
32. Along the Finchley Road corridor, some bus users have been attracted to the greater frequency on the improved Jubilee Line. TfL with its recent consultation about this corridor is proposing to adopt three new high frequency bus services rather than retain the existing four at reduced frequencies. TfL's modelling shows that the three-route option maintains greater benefits at an affordable cost, even though some currently through journeys would then incur interchange. The changes will come into effect in April 2017.
33. We cover in later questions the topic of TfL service planning for lower density areas.

A2. The British bus planning context, outside regulated London

A market-led approach

34. In Britain, outside London the local bus services are in principle market led. This followed the deregulation of local bus services in the Transport Act 1985 (implemented outside London on 26 October 1986), and parallel pressures on local authority-owned operations to be privatised. There is a commercial supply of services on a profitability basis. It is up to the local authorities, including integrated transport authorities (ITAs) for city regions where they exist, to buy in other services where they consider the commercial service doesn't provide an adequate network or frequency.
35. With this regime, benefits to areas are dependent firstly on the commercial market judgment, and then what ever top-up services are affordable. As with other local authority-supported functions, there is vulnerability with revenue support reductions. In general, bus services are more at risk during evenings and at weekends because of the lower passenger numbers. Services will also be more tightly matched to immediate passenger demand, so with greater tapering of frequency and/or splitting of services on route sections which are lighter in demand. There may be less of a constant 'trusted' frequency throughout the day or weekend.
36. Fares will also be market led and it is often difficult to achieve the sort of integrated cross-route and cross-mode tickets that Londoners take for granted, except at higher fares levels where individual operators can take their 'cut'. That is itself a deterrent to their purchase and use, compared to using specific 'operator-only' tickets. Yet such integrated ticketing is recognised as a leading stimulus for higher levels of public transport usage. It also provides a high level of capability to understand passenger journey preferences and plan the network to greatest benefit for the area served - transport is a means to an end, not an end in itself.
37. In terms of use of free travel passes or concessionary fares, there is a proportionately higher reliance on such travel in non-London areas (overall, 30% of all journey stages), compared to London (15%). The National Concessionary bus pass scheme was introduced in 2008, and has boosted ridership, particularly where such a facility did not exist comprehensively before.
38. The risk arising with operators outside London is to see some skewing of planning of bus operations towards that known market base. Policy challenges that might be played down, with less benefit to the wider community, include explicitly challenging car usage which is the main competitor mode and with greatest environmental impact on urban areas. Commercial operators may not be willing to be a modal loss-leader for new development zones in order to ensure higher public transport modal share from the early beginnings of such developments, unless such services are subsidised.
39. In a 2004 Oxford University review authored by John Preston, of bus volumes within and outside London from 1981/2 to 2001/2, the following headlines emerged:
 - Bus mileage outside London rose 21%, inside 35%.
 - Passenger journeys outside London fell by 37%, and rose by 33% within London
 - Subsidy outside London fell 37%, inside London it rose 8%.
 - London bus journeys were subsidised at substantially lower cost per head than elsewhere.
 - The report concluded that 'on the road' market competition can lead to too much service at too high fares, with too low a quality of service.

Bus network planning stresses arising with a market-led approach

40. Local authorities, including ITAs, can undertake levels of co-ordination, and bus-related facilities such as bus stop and bus shelters, and area information and marketing, and service promotion including jointly with other transport modes. However this is mostly revenue funded work. For obvious reasons it is difficult to achieve a comprehensive area wide set of standards, and incurs the risk of budget cuts. Real-time and next bus displays at stops, on buses and on apps are a strong means of generating passenger trust, and are used increasingly, but this too depends on a willing and funded supplier.
41. Data availability and route planning capabilities are often with the commercial bus operators, not the local authorities. With some exceptions when information is shared on a confidential basis, or there are other sources of live travel patterns (eg mass mobile phone tracking), the lack of 'open data' smartcard information across a network also makes comprehensive network planning and optimisation very difficult to achieve reliably at a city region level. It might not be seen by individual operators to be in their commercial interests to divulge such knowledge or to be asked voluntarily to re-allocate resources to operations less immediately profitable.
42. Roadside counts and questionnaire surveys do not provide such a complete or reliable picture, although for operators not using smartcards, these and the farebox showing volumes of travel within fare stages are at least a starting point for bus route planning. Frequent consultation and liaison with users and the wider community provides other information.
43. Such weaknesses in the structure of bus service provision outside London has long been recognised as unhelpful for underpinning longer term economic growth planning, where that is at least partly dependent on a stable or improving supply of local public transport. The service offer is generally weakest in the shires, but major towns and cities can also experience a disparity between urban priorities and strategic forward plans, and the extent to which public transport can underpin and dovetail with those aims and objectives.
44. The consequences are indicated clearly by the gross statistics on bus usage in the recent decades since deregulation. Quite apart from changes in population and economic activity which may have disadvantaged buses in some areas, for example where manufacturing industry has declined, the rate of bus usage is consistently lower in non-regulated areas compared to London. Regulated and benefit-led London remains the primary exemplar for Britain in terms of successful bus operations. However there are actually some striking variations in demand between different locations, so it is not a one-size-fits-all.
45. Because of the commercial forces, routes may duplicate along some profitable corridors while frequencies are generally driven by the revenue expectations and not by the assessment of maximising travel benefits for passengers or communities. The operators will nevertheless want to ensure that the passengers they do carry are satisfied with their service. They may be as good as TfL in anticipating new housing and business developments but the form of their responses to these changes will be focused on the bottom line.

Slow road to integrated ticketing and planning

46. Some twelve years after Oyster began to be rolled out across London, only now are some authorities starting to achieve equivalent levels of ticket integration, with networks not yet aligned on a comparable basis because of the commercial element.

47. It would take half of Transport for the North's entire catchment, either side of the Pennines, to provide a comparable population volume to London. Meanwhile smartcard offers are diffused between smaller city regions. There is no single card with Oyster-like capability with validity across even the main Trans-Pennine corridor between Liverpool, Manchester, Leeds and Sheffield city regions. You would need to be a multiple-card holder, even with the Government-backed ITSO smartcard software.
48. A short comparison of 2015/16 bus passenger volumes (journey stages) vs population is merited, in simplified zones. The statistics below do not include rail, tube or light rail journeys, where London would also be considerably larger in absolute and per head volumes:

	<u>Bus journeys (m)</u>	<u>mid-2014 Pop (m)</u>	<u>Rides per head / year</u>
Greater London	2,293	8.5	269
North West (incl Liverpool, Manchester city regions)			
○ 2 x ITAs	327	4.1	79
○ Rest of area	107	3.0	35
Yorks & Humber, North East (incl Leeds, Sheffield, Newcastle city regions)			
○ 3 x ITAs:	376	4.8	79
○ Rest of area:	134	3.2	42
Midlands (West Midlands, East Midlands)			
○ 1 x ITA:	268	2.8	95
○ Rest of area:	273	7.5	36
Home Counties North (Oxon, Bucks, MK, East of England)			
	245	7.5	33
Home Counties South (Rest of SE)	290	7.4	39
South West	217	5.4	40
Wales	100	3.1	32
Scotland	409	5.3	76

(NB: TfL and ITA areas are not the same as LA population boundaries, so rides per head should be taken as a generalised indicator.)

British bus exemplars outside London

49. Looking for relatively successful bus operations on a county or unitary basis, requires a finer level of detail. If rides per head provides a consistent criterion, then the most successful six non-London operations measured at a county/unitary level (all 2015/16 DfT data) are bus services in Brighton & Hove (160 rides per head), Nottingham 150, Reading 126, Tyne & Wear ITA 104, West Midlands ITA 95 and Bournemouth 92.
50. Some of these feature municipally-owned bus operations (Nottingham, Reading) where there is closer involvement by the local authority shareholders, leading to greater sharing of objectives and more mutuality in how area benefits can be maximising whilst maintaining a profitable operation. While the operations are commercially a stand-alone company, the relationships are generally closer to a social enterprise business model. Another linked-benefit model is seen with Bournemouth, where the council has retained a 10% shareholding in its former municipal 'Yellow Bus' fleet.
51. Although such places are much smaller than London they can demonstrate high levels of bus patronage relative to their population and be more responsive to the local councils' preferences and requirements for the area as a whole. For example, Nottingham has a focus

on corridor planning and marketing including different colours used to denote corridors, even if there are multiple routes on a corridor. This makes route planning easier for passengers than reliance on multiple numbers which may bear no relationship to each other. Nottingham offers a municipal smartcard, which is also valid for other city facilities.

52. In Reading there is a strong emphasis on consultation with the whole community and with bus passengers. There is an extensive website and smart data available. Network developments have been geared to the responses received, along with considerable route marketing and attention to reliability including bus priorities, offering a 'trusted' service. There has also been a sustained year on year investment in new buses featuring high quality facilities to attract and retain passengers. The result is a high passenger satisfaction level with good levels of bus usage.
53. In Brighton & Hove (now primarily a GoAhead operating zone, with a preceding mixed municipal/private sector history) there has been a long history of voluntary revenue pooling between operators, progressive service development, and improved facilities and network information for passenger including area smartcards (the 'Key') now also available on train services. Trent Barton (East Midlands) is also widely regarded in the bus industry as an operator who has explicitly sought to focus on passenger preferences and accepts the slightly higher costs of operations which are more successful in the bus vs car context.

National legislative opportunities and changes

54. There has been a continuing debate within the major cities in Britain and between private operators and the public sector community about the extent to which changes in the law are required to either stimulate or enforce better co-operation and co-ordination on bus services outside London. And how much should be encouraged to happen on a voluntary basis.
55. The Transport Act 2000 already enables Quality Contract Schemes (legally binding), or Quality Partnership Schemes (consensual), in local authority areas. There have been different advocates for each. The former requires a high level of consultation and a valid benefits case being established before legally-binding reregulation could be authorised. Experience shows that the latter can be resisted strongly by private sector operators (eg, in Tyne & Wear, which faced court actions), while the latter can gain traction sooner albeit possibly with few beneficial outcomes, at any rate in the short term (Sheffield being a current example).
56. Cooperative planning between the city region authorities, the ITA and the major bus operators in Sheffield is leading to a voluntary rationalisation of bus operations in ways which add benefits to passengers and the city region. This will provide a more coherent and beneficial network for the half million population in the catchment.
57. In parallel, the government recognises that the commercial-led approach is not giving best outcomes in the context of efficiency and expansion of economic growth. It accepts that a stronger basis is required for bus service planning and development outside the regulated London area, particularly for city regions and combined authorities. There is a Bus Services Bill going through Parliament which, somewhat watered down during its passage, has the following aims and objectives, mostly aimed at England as local buses are a devolved topic for Scotland and Wales: (details below from the official briefing document on the Bill)
 - "The Bus Services Bill provides Local Transport Authorities (LTAs) with a wider set of tools to use to address inefficiencies in their local bus markets and to work with commercial bus operators to

provide better local bus services for passengers. The Government would not mandate which approach is to be taken, encouraging LTAs to pursue the most suitable solution for their area.

- “The devolution agreements that the Government has already signed with North East, Tees Valley, Liverpool City Region, Sheffield City Region, West Midlands, Greater Manchester, West of England CA, East Anglia CA and Greater Lincolnshire and Cornwall have included a commitment to introduce a simpler route to bus franchising than currently exists in the form of Quality Contract Schemes (QCS) under the Transport Act 2000. This Bill provides the powers for combined authorities with directly elected Mayors to implement bus franchising. *[JRC observation: Devolution is now – January 2017 – not proceeding in some locations, such as the North East.]*
- “Alongside franchising, the Bus Services Bill delivers a variety of partnership options, via strengthening of the current Quality Partnership Schemes in England (which become known as Advanced Quality Partnership Schemes) and the introduction of new Enhanced Partnerships.
- “The Bill also makes it easier for passengers to access information about routes, fares and timetables, and ensure ticketing schemes meet passengers’ needs.”

Lessons from other parts of Britain

58. In conclusion, looking at British comparators, the overriding point remains that London’s bus planning and its ability to take direct account of the wider benefits to passengers is considerably ahead of much of the activity elsewhere in Britain. This is reinforced by the integrated smartcard and contactless ticketing which provides a high level of travel data, and a stimulus for maximising use of public transport by all modes – including (with contactless) less of a barrier to bus use by visitors to London who are used elsewhere to complex ticket rules.
59. Solutions which might be best fit for a town or small city may not be relevant for all or distinct parts of a world-scale metropolis. Equally, because most bus travel is local – simply because most travel *of all types* is local, generally less than 5 miles/8 kilometres in a British context – then it would be unwise to discount ideas and initiatives which though generated in a different locale might be applicable in London. They could ‘raise the game’ with greater volume of benefits for London and for travel quality within the capital city.
60. The key elements of potential interest for use in London, from the examples noted above, are extensive attention to detailed passenger preferences, strong and trusted information including web-based information and apps, and clear marketing to demonstrate easy-to-use convenient services. The use of smartcards is also a fundamental.
61. A more tailored approach to bus service frequency – closer to a wholly commercial approach described above – could result in greater service variability in parts of London at different times of the day or week. Whether the benefits of releasing some mileage to use elsewhere within the same cost envelope, would be sufficient to outweigh the disbenefits of a more variable service offer on existing sections of route, would require assessment.

A3. How do London’s processes compare to those used by other major world cities?

International research and practical implications

62. A large-scale research analysis, published in 2015 in the Transportation Research Journal, is appended to this report as a major international source of literature on bus planning,

operation and control. This report is a compendium of theoretical options and practical operational observations. A specific footnote is below, setting out its provenance.^B

63. The self-evident risk of relying solely on a theoretical approach is that, apart from zones of new development, it may not be easy to achieve different or more optimal operations as there is no 'blank map'. [Comment below] Some or all factors such as subsidy levels, existing network planning practices, routeing priorities, interchange and transfer policies, standards for bus stops, information techniques, operating rules for staff, established passenger travel habits, familiarity with present routes and stakeholder views, and so on, may prevail. Such planning, operational and user preferences may have grown up with the historic development of the system.
64. City region strategic policies may have over-riding parameters influencing bus network planning, such as definition of high capacity corridors and which modes to allocate for those, priorities for serving new land uses, the desired quality of local access and interchanges, new standards fit for travellers, and specifically what rôles are seen for bus routes of different types. These could vary the future functions seen as important for buses.
65. TfL has itself accommodated large-scale changes in planning techniques, in order to introduce benefit values into the network process and trade-offs between options. Outcomes from this have influenced TfL's views on parameters to adopt for route specification. In parallel, the contractual system for routes was developed pragmatically as part of the lengthy sequencing and hard experience of contractorising London bus operations within a regulated framework. Various specifier/contractor models were trialled during the period between 1985 and 2000. For comprehensive details, see Roger Torode's seminal 2015 book '*Privatising London's Buses*'.
66. However more change may be feasible in London, and might possibly be required given the budgetary situation which effectively sets a rationing benchmark for the supply of bus miles in future years. TfL is already anticipating some reallocation of mileage to new development zones.

Comparable world cities

67. For the bulk of this section, JRC has therefore focused on defining those major world cities which are potentially comparable to London, and then describing in summary form some of their planning and operating features that might be relevant for consideration in London's context.

Comment on 'blank maps', made by Lewis Carroll:

"Other maps are such shapes, with their islands and capes!

But we've got our brave Captain to thank

(So the crew would protest) "that he's bought *us* the best—

A perfect and absolute blank!"

From *Hunting of the Snark, Fit the Second*.

^B *Planning, operation, and control of bus transport systems: A literature review*; O.J.Ibarra-Rojas, F. Delgado, R.Giesen, J.C. Muñoz; BRT Centre of Excellence, Department of Transport Engineering & Logistics, Pontificia Universidad Católica de Chile, Santiago; published in *Transportation Research Part B* Vol.77 (2015), pp38-75.

Largest cities in the world ranked by population (1 to 125) and density compared to London (%)						
Cities/regions listed below are within 30% of London's population density.						
Population Rank	City / Urban area	Country	Population	Land area (in sqKm)	Density (people per sqKm)	Density as % of London
20	Paris	France	9,645,000	2,723	3,550	70%
76	Jeddah	Saudi Arabia	2,750,000	777	3,550	70%
111	Campinas	Brazil	1,750,000	492	3,550	70%
55	Riyadh	Saudi Arabia	4,000,000	1,101	3,650	72%
62	Berlin	Germany	3,675,000	984	3,750	74%
86	Birmingham	UK	2,284,000	600	3,800	75%
81	Curitiba	Brazil	2,500,000	648	3,850	75%
94	Baku/Sumgayit	Azerbaijan	2,100,000	544	3,850	75%
99	Taichung	Taiwan	2,000,000	510	3,900	76%
78	Cape Town	South Africa	2,700,000	686	3,950	77%
93	Fukuoka	Japan	2,150,000	544	3,950	77%
89	Manchester	UK	2,245,000	558	4,000	78%
91	Katowice	Poland	2,200,000	544	4,050	79%
83	Naples	Italy	2,400,000	583	4,100	80%
92	Tashkent	Uzbekistan	2,200,000	531	4,150	81%
100	Warsaw	Poland	2,000,000	466	4,300	84%
80	Fortaleza	Brazil	2,650,000	583	4,550	89%
53	Belo Horizonte	Brazil	4,000,000	868	4,600	90%
1	Tokyo/Yokohama	Japan	33,200,000	6,993	4,750	93%
74	Porto Alegre	Brazil	2,800,000	583	4,800	94%
59	Barcelona	Spain	3,900,000	803	4,850	95%
17	Moscow	Russia	10,500,000	2,150	4,900	96%
15	Buenos Aires	Argentina	11,200,000	2,266	4,950	97%
97	Sapporo	Japan	2,075,000	414	5,000	98%
85	Tel Aviv	Israel	2,300,000	453	5,050	99%
25	London	UK	8,278,000	1,623	5,100	100%
45	Madrid	Spain	4,900,000	945	5,200	102%
70	Ankara	Turkey	3,100,000	583	5,300	104%
61	Athens	Greece	3,685,000	684	5,400	106%
65	Guadalajara	Mexico	3,500,000	596	5,900	116%
6	Osaka/Kobe/Kyoto	Japan	16,425,000	2,564	6,400	125%
31	Bangkok	Thailand	6,500,000	1,010	6,450	126%

Sources: City websites, Wikipedia (January 2007). The original table has been adapted by JRC to rank by density

68. The table above assesses which major world cities have similar population characteristics to the London urban area. Out of a long list of 125 world cities, 31 are shown to offer an initial comparability with the London urban area, based on the average population density being in a range of \pm 30% of London's population density. That was 5,100 people per square kilometre in January 2007 (the data baseline), although London is now about 5,300. It is considered that substantially lower or higher densities (beyond a range in 2007 of 3,600 to 6,600 people per sq.km) will not help realistic consideration of general bus planning
69. Two of these city regions, Tokyo and Osaka, although having comparable population density, have such large populations (respectively 33 and 16 million in 2007) that these are excluded.
70. Of the other 29, the better comparators will be those with similar cultures and travel habits. There are 10 such cities, including Birmingham and Manchester. A table similar to the British bus passenger volumes identified above, with population and rides per head, is set below for these cities, based on what information is easily available (which may not be wholly consistent). JRC then discusses relevant highlights of bus provision in these cities.
71. As with the British bus context, there will be other cities of different sizes and densities where applied planning and/or analytical techniques are worth noting, if they have been identified in transport planning literature.

72. The summary data below, set out alphabetically, includes where possible an indication of all main public transport use as well as of buses, as buses may have a radically different share of the total transport matrix, between cities:

City	Population	Year	Bus travel volume (million journeys / journey stages)	Year	Rides / journey stages per head	Note on area defined	All public transport journeys in year (million journeys / journey stages)	Rides / journey stages per head, All public transport	Note on all public transport estimates
Greater London	8,538,689	2015	2,293	2015/16	268	TfL served zone is different from LA zone	4,522	530	This estimate of journey stages includes rail boardings
Birmingham (WMITA)	2,808,356	2014	268	2015/16	95	Including Coventry	330	118	Including all rail stations in WMITA area
Manchester (GMITA)	2,732,854	2014	205	2015/16	75	Greater Manchester	281	103	Including all rail stations and tram entries in GMITA
Athens + Piraeus	4,173,542	2011	380	2004	91	Urban area	874	209	Unreliable figures as over a decade old
Barcelona	1,604,555	2015	155	2015	97	City only, not Metropolitan zone	939	585	
Berlin (City not region)	3,520,031	2015	405	2014	115	Population only within city	1,510	429	Various dates, excluding long distance rail
Madrid	3,141,991	2016	404		129	City area, more relevant for bus system	1,120	356	Population divisor might need to include met. area
Moscow	12,197,596	2015	?		?	Permanent residents within city limits	?	?	Metro alone serves more than 10m passengers daily
Naples	975,260	2015	92	2014	94	City only, not Metropolitan zone	?	?	
Paris (Ile de France)	10,601,122	2013	1,007	2015	95	Ile de France is the planning area	3,255	307	Excludes SNCF volumes
Warsaw	1,748,916	2016	?		?	City only, not Metropolitan zone	960	549	Based on 3m public transport trips a day, x 320 for year
Sources: City websites, Wikipedia									

73. The discussion below follows an alphabetical sequence.

Athens

74. Athens is marked by a very high density old city zone with a constrained and congested street pattern, and significant geographical limitations because of the historic quarters of the city. Simultaneously it is the expanding economic hub for Greece. Piraeus is the largest passenger port in Europe and in the top ten in Europe for container traffic.
75. High capacity public transport is limited to four metro lines and a tram line which is being expanded. There are also commuter rail services. The shortage of high capacity railways means that those which exist are very busy, and by default the bus services remain as an extensive network with about 320 routes and over 2,200 buses, about 1/6th of which are trolleybuses. The slow expansion rate for rail infrastructure, partly a consequence of the Greek economic problems, means that buses will continue to be vital for passenger travel in the city and suburbs for many years to come, despite the scale of road congestion which they face.
76. The other strategic problem, which Athens is tackling, is that of pollution which can reach unhealthy values at times and also directly damages the historic monuments throughout the city. Athens' bus network is being converted to reduce their emissions. It has the largest fleet of natural gas powered buses in Europe. Enforcement measures and powers to limit emissions from car and lorry fleets are also in hand.
77. *Commentary: There are few immediate parallels with London. The Mayor of London's expansion of the Low Emission Zone to the extent of the North and South Circular Roads might merit liaison with Athens about its emission and greener bus policies.*

Barcelona

78. Barcelona is a classic mix of old city centre, expansionary inner suburbs and an expanding metropolitan region. The Catalan authorities determined before the 1992 Olympics that the Barcelona region should be substantially invested in both for economic growth and to strengthen the region vis-a-vis Madrid, with a target of becoming the leading city region in the Western Mediterranean. The direct consequence has been further large-scale investment in

the two commuter rail networks and the metro. Trams have also been introduced since 2000 on two main corridors, and more are planned.

79. Consequently the bus system in Barcelona is gradually being changed from being the principal public transport service along main corridors in parts of the city, to being more localised, and, in the expanding territories, connecting suburbs, town centres and major rail and metro interchanges. This process has particularly been underway since the 1990s. There is also a large scale night bus network. However, ideas for bus rapid transport corridors are being considered, where a better service offer is justified to complement the local bus network. Buses now carry about a quarter of all public transport journeys and this proportion is unlikely to grow substantially, because of the increasingly dominant rail-based capacity.
80. *Commentary: This city illustrates a theme also seen in examples below, that reformation of bus networks around more high capacity rail and new large scale developments, does not deter the case for improved / faster bus services or bus rapid transit (if light rail is not adopted), to give main non-rail corridors a quicker journey between main nodes.*

Berlin

81. Berlin has had a complex history since the Second World War which has substantially influenced its transport development. Since the city was reunited in 1989 it has been able to reconnect and greatly improve its already extensive commuter rail network (S-Bahn), including a new high capacity north-south rail corridor through the centre also shared with InterCity trains. The metro (U-Bahn) has also seen extensions.
82. High capacity surface transport remains divided between an upgraded tram/light rail network in East Berlin (trams were retained there) and the West Berlin bus network (trams were withdrawn there). Those bus lines are largely subsidiary to the U-Bahn, which saw large-scale expansion in West Berlin during its decades of isolation.
83. 17 bus routes run by the city's transport operator BVG provide a special high frequency service, in areas poorly served by the U-Bahn and S-Bahn. There are also 13 express BVG bus routes. A point of interest for comparison with London is that over 400 of Berlin's buses are double-deckers, out of a fleet of over 1,300.
84. Berlin's city development has resumed at a pace since reunification, not only through the former wall zone in the historic heart of Berlin but also in the larger metropolitan region of Berlin-Brandenburg. This now has about 6 million residents where main public transport commuting is done on rail systems; most buses provide a local and feeder service. There are five river bus and ferry services based on Berlin's lakes and the River Spree.
85. Partly because of the extensive damage in WW2, roads were widened afterwards to facilitate uncongested travel. Despite that, Berlin has one of the lowest number of cars per capita in Western Europe, which is a residue of the tight boundaries in West Berlin before reunification, and communist controls in the eastern part. Berlin's bus operations benefit from these historic circumstances. The city also has a highly developed bike lane system carrying over 1½ million daily rides in 2010 (13% of travel). The Berlin Senate wants to increase cycle usage to 18% by 2025. There is an extensive night bus network, including routes running parallel to each U-Bahn line during the night, and limited weekend U-Bahn, S-Bahn and tram services.

86. Berlin's local public transport network is controlled by the regional transit authority named Verkehrsverbund Berlin-Brandenburg (VBB). This is a undertaking shared in ownership between the two federal states of Berlin and Brandenburg, plus the local authorities within Brandenburg. This is equivalent to a joint transport authority for Greater London and the Home Counties. Such Verkehrsverbunden are a normal form of transport administration and planning throughout Germany and Switzerland.
87. VBB is the planning authority for the city region's transport, awards service contracts to private and public companies, and sets fares and charges. For transport lines and networks which do not cross local borders, the locality is responsible. This means that the city-state of Berlin is the sole authority to award service contracts for networks and lines which do not pass outside the city limits, but has to agree with Brandenburg for regional rail and bus transport, including the S-Bahn and longer distance commuter trains.
88. *Commentary: Express and other high capacity bus operations are an interesting feature in Berlin. These are partly facilitated by lower congestion levels than in some European cities. The terms of the joint transport administration between the urban city and the neighbouring counties might be relevant for commuter rail and bus service specification on the borders of the London commuting area.*

Birmingham and Manchester

89. The general policies and pressures facing bus service planning in these city regions has been discussed above. Both Birmingham and Manchester also have seen a historic lack of cross-city buses – most radial buses terminate in the centre. This is a hangover from tram operations which ended post-WW2, and also reflects the lack of many high density destinations in other parts of the urban area. Bus to bus interchange can also be deficient, for cross-city travellers.
90. Both cities are actively defining and investing in new economic development clusters, eg Birmingham Eastside, Manchester/Salford Docklands and Trafford. These will help to breach such invisible transport boundaries. Indirectly, the eventual arrival of HS2 is also expected to stimulate such clusters.
91. The existing regional rail networks in both city regions, and the expanding tram system in Greater Manchester, do not radically change the volume of journey stages per head of population. The rail networks have significant problems, including poor connectivity between service groups in both cities (Moor Street to/from New Street lines in Birmingham, and Victoria (north system) to/from Piccadilly/Deansgate (south system) in Manchester. Greater Manchester is continuing with works to improve matters, eg Salford Crescent line (existing) and Ordsall Chord (under construction). There are similar ideas in Birmingham, to increase city centre access capacity through new rail chords connecting to the Moor Street corridor. Manchester's Metrolink trams already connect the rail systems albeit requiring a cross-city tram ride, and a second cross-city tram line is under construction.
92. The shortfall in the geographical structure of both the bus and rail networks, is a significant deterrent to strong modal use of public transport in each city. Rail network capacities are also under pressure, with large reliance on the existing railways with their station and junction limitations. 'Transport for the North', the 'Midlands Engine' and the regional ITAs have ambitious plans, but long term funding is unclear.

93. Greater Manchester ITA is seeking to stimulate commercial bus operators to share territories as part of city region transport priorities, and the outcome of the Bus Services Bill may assist. Meanwhile a new Leigh guided busway is reportedly delivering positive results on modal split on that western city corridor.
94. *Commentary: The role of new and expanded economic growth clusters, in influencing the future share of the city regions' public transport, is the most germane factor meriting attention by London, along with whatever emerges from the Bus Services Act.*

Madrid

95. Madrid is the heart of the Iberian economy and has some principal travel flows not dissimilar to London. Three quarters of a million people commute into the city to work (London has over 1 million), and another quarter million live in the capital but work outside. This leads to classic high density rail commuting patterns and a busy metro network, to service many parts of the city.
96. There is another parallel with London although simultaneously a difference, in that Madrid has built an extensive radial and ring motorway system which has made the car attractive for many inter-suburb journeys. London did not build most of its Ringways. Despite the motorways, there has been large scale investment in expansion of the metro and commuter rail lines, construction of nearly 30 transport interchanges and a policy of a high level of subsidy for public transport. Improvement in bus networks is part of this policy.
97. The Madrid bus network expanded by 31% in terms of roads served between 2005 and 2013, to nearly 2,700 kilometres, served by 217 routes, over 3,000 buses and 10,000 stops. Almost almost all city population lives within 300m of a bus stop.
98. A 2004 survey in 2004 showed 14½ million journeys per day by all modes, 10m mechanised (road vehicles and public transport). Public transport was used for nearly 70% of journeys within the central area, down to 27% in the outer region. Metro then accounted for 40% of journeys by public transport, commuter rail 10%, city bus 30% and interurban buses 10%. Since then, investment in the rail modes has raised their share to 74%, with buses 26% (2013) of a larger total volume.
99. The inner city relies for public transport mainly on the metro and the city bus service. Meanwhile the metro continues to expand and is now the second largest system in Western Europe (being second to London Underground). About 50% of the city population live within 600m of a metro station. In the outer region, the public transport offer is a combination of commuter rail and buses.
100. *Commentary: Madrid has some types and volumes of passenger flow which are comparable to London. The investment profile is greater in Madrid for high capacity new rail and metro schemes than exists in London. Despite this the Spanish authorities see a strong case for continuing to expand and improve the bus network. Their bus network policies and the attention to dense stop location look interesting to explore further.*

Moscow

101. The Moscow metropolitan area is continuing to expand fast including recent inclusion of outer towns in 2012. The intention is a Greater Moscow of 20 million people, from 12.2 million in

2015. Moscow's place-making to become a leading world city is all part of this strategy, and aligns with the dynamics of Russian national economic expansion.

102. The consequences for transport are a large scale increase in trunk roads and continuous growth of new housing suburbs and new business centres. There are immense expansionary plans for high capacity commuter rail and the metro network, with much under construction, along with upgrading of the remaining tram networks and a continuing requirement for an adequate quality of public transport where rail and metro cannot reach or cannot be justified.
103. The Moscow Metro on its own already serves 10 million passengers daily, equivalent to over 250 rides per head now. There is extensive crowding, at an intensity unfamiliar to Londoners, at the major stations and interchanges. To relieve central area pressures, the Moscow city council has invested jointly with the main line railways in upgrading a former outer ring railway to become a second high frequency orbital metro, the Moscow Central Circle, at a distance from the central area of 3 to 7 miles. This opened in 2016, and is expected to carry about 1 million passengers daily by 2025.
104. A third ring metro, the 'Third Interchange Contour', will open in later years and complement the second orbital, by extending out to 7 miles where the second is closer in, and v.v. This is equivalent to two new high capacity railways circling London at the distance of North/South London Lines and also parallel to the North/South Circular Roads.
105. The bus network is plugging the gaps, between metro stations which are often a long distance apart in the suburbs, 1 mile or more. Because of the extreme depth of some metro stations, over 200 feet underground, the journey time implications of using the metro for short hops are considerable and use of buses, trolleybuses and trams remains popular. Every major street in the city is served by at least one bus route and many roads also have trolleybus services.
106. This is a case of a vast expansionary city region where every mode of transport is being stretched to the limit to accommodate the existing and foreseen passenger numbers. It is unfortunate that the Russian love affair with the car since the end of communism means that city is frequently snarled in many locations and there is currently a lack of priority for surface public transport.
107. *Commentary: The functionality of Moscow bus services is different to London, as a complementary but subsidiary form of transport to metro and rail. London has some expansion parallels with Moscow and other European cities, with its planned growth along corridors such as the Lea Valley and Thames Gateway, and intensification with Opportunity Areas. Moscow has more space to expand in distance rather than density (the built-up area is dense already). London is not urgently providing new large-scale transport capacity on some of the corridors foreseen for growth, eg the Upper Lee Valley, so there may be some investment examples to be considered.*
108. *Moscow's new high capacity ring rail services could provides ideas for greater rail investment within London's Zone 3 ring (roughly the North/South South Circular Roads) in conjunction with higher density development. Such investment might be linked to the Mayoral Low Emission Zone, extending to the North and South Circular, to attract people from inter-suburb car travel. Buses may also have a greater rôle for such journeys if a full rail upgrade were not possible.*

Naples

109. Naples comprises both a high density Italian city where many streets are extremely narrow so that any effective public transport is constrained, and also a much wider metropolitan area beyond the city limits which has diverse types of urban development. The limitations within the main city area mean that in 2014 the total number of boardings on the city transport services were only about 138 million of which 92 million were on bus services.
110. *Commentary: This city is unlikely to provide much guidance in relation to London. Three quarters of its surface transport fleet in 2015 were diesel buses, so environmental issues are not being addressed on a large scale.*

Paris

111. The main driver for public transport network development has been the long-term land use plans for the île de France area with high density housing developments at numerous nodes and various standalone business centres such as La Defense. Cross-Paris regional express rail (RER) and the Metro are the favoured modes for radial travel between the suburbs and central Paris. Current large-scale Metro investment is publicised as the “Grand Paris Express”, for new radial and suburban orbital lines. In the high density inner suburbs there is also a policy of providing new high capacity orbital tram lines to complement radial rail and Metro.
112. There is a top-down policy by STIF (the regional funding body for public transport) that bus network planning will be subordinate to the rail and metro high capacity system, but that services will be maintained and improved. The Paris bus network is subdivided into exclusive central area routes and suburban services. The suburban bus networks are essentially a hub and spoke system connecting town centres with each other and main rail and metro interchanges and along main suburban corridors.
113. Despite improvements, bus service levels in the outer areas remain sparse and are all separately contracted. RATP bus routes do not stretch that far out, causing a distinct split between service qualities in different parts of the île de France. This is in contrast to the relatively generous outer London bus services (eg 4-6 per hour, sometimes more) that TfL typically provides. Any suburban bus routes that reach the central area generally terminate either at the historic city ‘Portes’, or at nearby mainline termini. A separate central Paris bus network is operated.
114. There are nearly 60 bus routes running in central Paris, served by standee vehicles similar to London’s former ‘Red Arrows’. These routes do not parallel the zone 1 Metro lines throughout. Since the early 2000s there has been a specific traffic reduction policy on major arteries which have been thinned to provide priority lanes reserved only for bus and taxi. This is a little easier to achieve on some of the ‘Haussmann’ boulevards. More recently these lanes have been isolated from the rest of the road through low concrete barriers that form ‘couloirs’ and inhibit other traffic from using them. Such hard measures have proved necessary to deter drivers. Paris is in the middle of a large scale consultation process to simplify their very long standing route network in zone 1.
115. Paris’s zonal fare system preceded London’s, and they are similar to each other; there is a large range of integrated tickets and smartcards available. To that extent Paris is comparable with London, but the way in which passengers have been encouraged to interchange on a much more

enforced basis because of the bus route structure, produces very different results for bus usage. Paris has put resources into creating a larger range of bus/tram/metro/rail interchanges, while on-demand fares have also been simplified and have now trended towards the London model.

116. Paris has invested much more in additional high capacity cross-city railways, including the RER (5 lines), than London has (2 lines: Crossrail 1 and Thameslink). However London Underground caters for cross-city journeys to a greater scale than the Metro.
117. Looking at the rides per head of population by bus compared to total city public transport demand (RER travel is included), Paris bus usage is in a minority even excluding travel by 'Transilien' commuter rail.
118. *Commentary: The Parisian central and suburban bus network planning is a subsidiary to a cross-city rail-based high capacity network. The determined enforcement of bus lanes may have some lessons for London.*

Warsaw

119. Warsaw in common with Berlin suffered immense damage during the Second World War. The city centre has since been rebuilt spectacularly with the original street environment, but the bulk of the suburbs and new development areas have wide multi-lane roads. The most significant problem that Warsaw faces is of difficulty with achieving consistent investment policies.
120. Some major projects have been stalled or make slow progress. For example Warsaw still lacks a complete ring motorway and much through national and international traffic must still drive through the centre. There are only eight road bridges across the main river, the Vistula. Car ownership has soared since the communist era yet there are few parking spaces in the centre and only one line of Warsaw metro has been completed and a short portion of a second one.
121. Public transport remains important with about 60% of travel on the buses, trams and rail. The backbone of the existing public transport is the tram network and the commuter rail network although the low density of stops on both networks leads to a high reliance on buses to serve the intermediate housing developments, in a similar way to Moscow.
122. *Commentary: It is clear from the prevailing situation that public transport in Warsaw is still not in a mature state of development.*

B1. How well does the bus network allow for journey interchanges with other buses and transport modes? How are these interchanges mapped and strategized by TfL?

123. Because the bus network in London is so vast there is no one-size-fits-all, in investing or planning for facilities. Greater London is 606 sq.miles, smaller than the bus network which goes further. There are over a thousand major and minor interchange locations just between buses, never mind the underground, light rail and rail networks. How well does it do this?

Ticket integration

124. Thanks to fare zones, Oyster, PAYG and contactless, flat fare buses, daily travel fare capping, etc, ticket integration within Greater London means that there is no barrier to interchange

between buses and other main transport modes as far as tickets are concerned, subject to the journey being wholly in London. Commercially-provided services such as taxis and river buses do charge separate fares, although there is a discount on most river buses for Oyster-type use.

125. The new hopper bus fare will limit the financial penalty of having to pay twice for two bus journeys. It will be an incentive to consider interchanging even where there might be a through bus, as it might be quicker to get the first bus and change where more buses are available, in a similar way to travel on the tube.
126. While in theory a bus operator should offer an onward free bus ticket where buses have to get turned short of their destination for operational reasons, in practice the process of having to change buses will become much easier with the hopper fare.

Interchange between corridor routes

127. As described earlier, TfL's network planning prefers higher frequency to lower frequency through routes, because of the valuation of net travel benefits. There is an *implied* built-in requirement for bus to bus interchanges to be available as part of any significant route restructuring. However this may not be assessed pro-actively for specific interchange locations, rather than a generalised corridor volume. Some corridor volumes will also be at risk in zone 1, so that clear guidance on good interchanges could become more important.
128. Better, bite-sized information at interchanges will become very important in central London. In recent years bus stops have been moved, or rationalised because of road works or use of larger buses. This has temporarily worsened interchange at places like Tottenham Court Road / New Oxford St. In future with fewer routes and major arteries being denuded, the network will be harder to navigate as buses will no longer reach many well known destinations from key parts of the central area / inner suburbs. Without adequate information, this risks overloading some tube stations and interchanges or simply deterring people.
129. To the extent that route changes follow the same corridor then interchange might simply be alighting and boarding another bus at the same stop. This is the simplest possibility, though a walk to other stops might be required. TfL's assessment may not however guarantee the quality or capacity of waiting facilities at such a stop, nor might an interchange location be specifically recommended by TfL to passengers, unless a more active form of route information for the corridors as a whole were provided as part and parcel of the restructuring. This is quite apart from any case for assessing the merits of other interchange improvements along a high frequency corridor, to and from other bus corridors or other modes, discussed below.
130. At present such interchange publicity is generally only provided at complex interchange areas, with lettered bus stop mapping, summary times and route patterns at bus stops, plus 'spider maps' to show available bus corridors. While you can 'dial in' to apps to preview or pre-load this information, and there are also journey planning apps on TfL's website, many passengers, those unfamiliar with using modern I-Phones etc, and people unfamiliar with London, will simply face the visual information challenge and navigation challenge between stops, when they alight from the first bus.
131. Most buses internally do not show a route diagram in the same way as tube trains. Nor do they show other routes and corridors or what other modes are available at potential interchange locations. It could be considered whether some fixed display on buses or electronically updated

screens showing route sections with interchange scope would work, and/or other information including audible summarised headlines as buses near the next main interchange.

132. This may be an area for the Transport Committee to explore with TfL, if there is future reliance on the hopper fare and interchanges being more an intrinsic part of TfL's network planning and passengers' network knowledge. The tension is that key information is easier to assimilate in one bite-sized piece rather than be provided with more detail than is really necessary.

A bus interchange strategy

133. Is there a specific bus interchange strategy? The empirical evidence is that there isn't a hard-and-fast one.^c TfL does what seems appropriate when each route or group of routes comes up for review, and with latitude for the areas served. There is no evidence on the street that there are overriding interchange standards, e.g. maximum distance between bus stops, and good quality pedestrian links and facilities at each bus stop.
134. In general, the interchange quality between bus to bus, and bus to other modes, both in inner London and elsewhere, is highly dependent on the actual location of stops which vary in distance from critical road intersections and whose location may be more dependent on total road traffic management than bus interchange. Pedestrian facilities between stops may also be suboptimal e.g. subways rather than surface crossings.
135. TfL's place shaping proposals for some inner London main road junctions might assist. The Transport Committee may wish to explore with TfL what bus interchange standards might be appropriate in different parts of London, and how they might be introduced alongside other road junction considerations such as pedestrian crossings and cycle lanes.
136. In practice a greater volume of bus interchange data for existing and new journey patterns should be revealed with the better analysis using smartcard and other data sources. In turn TfL already can and could target where there are sufficiently large interchange flows to justify review of bus stop proximity to other routes at junctions. What potential there is to promote those interchanges locations as part of the ability to get around London by bus and encourage more bus travel even where there is no direct route?

^c see <http://content.tfl.gov.uk/bus-service-planning-guidelines.pdf> Under 'The Comprehensive Network', TfL states that "In residential areas, it is desirable for the bus network to run within about five minutes walk of homes, if this is cost-effective and if roads are suitable. This is about 400 metres at the average walking speed. The 400 metre guideline will be used alongside other indicators of accessibility to the network. These may for example be demographic, such as low car ownership, or physical, such as steep hills, parkland or severance due to main roads. In town centres, passengers should be taken close to the places they want to reach - shopping centres, rail stations, etc. At the same time, however, complicated or indirect service routings should be avoided... Effective interchange is essential to achieving a comprehensive network, as there will not be a direct bus link for every journey. Interchange opportunities will be taken into account in service design. In particular, good interchange facilities in town centres are important given that town centres form the hubs of the bus network."

There has been a specific interchange workstream within TfL. While not *exclusively* focusing on buses, they were captured where multi-modal interchange happens or was envisaged. (See tfl.gov.uk/info-for/urban-planning-and-construction/interchange.)

Scope for specified interchanges to support promotion of bus corridors

137. Londoners have a high level of recognition of their individual bus routes rather than automatically knowing what the other services are along a variety of corridors or on nearby roads. This limits the general attractiveness of buses as a travel option, and in turn limits the scale of wider benefits that a better perceived and understood bus network might generate. Are there ways of aggregating bus service routes with corridor colours to make it easier for the average person to understand – so more like a tube map – and also how to interchange between bus corridors especially where there is no tube or main line? Is the scale of the current information and marketing gap sufficient that initiatives to close the gap that could increase bus usage and bus revenues?
138. A bus corridor planner would not be straightforward if seeking to cover the whole of London, because of the network density of high frequency routes. Such a design might only be feasible on a more localised scale. TfL has frequently produced ‘quadrant’ (ie, NW, SW, etc) and ‘Central London’ bus maps, and the idea recurs in successive decades, in different formats. However all routes are shown in those editions, not selected high frequency corridors and interchanges which might bear the test of ‘passenger trust’ in a similar way to the tube map.
139. To be effective there might be a balance between an underground style journey planner and selected bus corridors, to define core dependable interchange locations, where high frequency corridors meet others with similar standards. The reliability of the timing and frequency of a bus service especially in the suburbs is relevant for passenger trust and willingness to travel by bus. Also good real time signage reassures the passenger that the bus is coming. Emphasis on designing information and marketing services and supportive live data, in ways which ensure greater passenger trust, may be fundamental in increasing passenger usage, especially in the suburbs where car ownership is greater and use is easier.

Population growth as a stimulus for better interchanges

140. The continuing population growth in the suburbs is another material factor which may make the case for new or additional information methods, in order to raise the profile of bus services. There are various forms that this could take. There may be ways of promoting better understanding of the criss-cross of high frequency routes in the suburbs and their interchanges so that the bus can be more used more by existing and future populations, instead of taking to their car on roads without capacity for future population and travel growth.
141. The current substantial rate of growth of dense housing developments in inner London points to the need for bus routes to perform better as a whole network, not just as individual routes, with a corresponding dependency on design and marketing of trusted interchanges. Because of the high service frequencies through inner London and town centres and some interchanges, there are physical space limits on how closely some stops can be located and how many buses can be accommodated per stop, so that double stops are sometimes necessary, which make interchanges more complex.

B2. How do interchange opportunities compare in central, inner and outer London?

Central London

142. In central London there are so many routes and stops that the interchange possibilities are widespread, with over 70 significant locations. There are also many 'round the corner' routes although with some *prima facie* surprising omissions, for example the Euston-Kingsway corridor round towards Fleet Street.
143. In headline, there are great frequencies and multiple route choices, and yet interchange can be poor because of bus and passenger volume, pavement widths and general traffic flow. Buses cross each other at major junctions at potentially high frequency. The problem is that the location of the stops for your desired interchange could be a long way apart, and with awkward pedestrian crossings at road intersections. Navigation between stops may be assimilated by regular users, but not by infrequent travellers.
144. Optimum interchanges between journey pairs using bus-only travel can sometimes involve totally different roads and buses in opposite directions, in order to minimise access complications between each pair of interchange stops. Rail and tube stations have varying standards of accessibility, some with one entrance, others with multiple access. These too can influence interchange choice with buses, while interchange standards may vary between directions of travel.
145. There is no room for large bus stations. Even where they do exist, eg at some main termini, there is not enough space for all bus routes. More bus stand space per route is needed with recent increases in higher frequencies, plus passenger waiting and boarding space, so there is a necessity to use adjoining main roads as an intrinsic part of each interchange.
146. For example, outline plans for rebuilding (part of) Euston to accommodate HS2 faces tensions with the Euston Area Plan and with the desire to get buses from all directions as close to the high-speed and main line and tube station entrances as practicable, all this at the nexus of the arterial Euston Road and a principal north-south cross-London bus corridor once designated for the CrossRiver Tram.
147. There are many such conflicts to be faced throughout central London, along with the risk of continuing pressure on available bus stand capacity if routes terminate. At Euston, the present bus station might not survive – detailed planning is not sufficiently advanced to know. A working party on various main line termini interchanges might be merited.
148. It has been suggested to JRC that there remains untapped potential in central London – if the right information and marketing were offered – for improved general interchange between routes which parallel each other for several stops before diverging to different corridors and destinations. This could be achieved by promoting intermediate stops *between major junctions* as being the least complicated place to hop off a bus and get on another one.
149. For example, Royal Courts of Justice or Fleet Street if you want to interchange westbound between Waterloo and Strand routes, or eastbound to Liverpool Street and NE London, or East London. Similarly at stops between Marylebone Road and Marble Arch along Edgware Road, if you wanted to transfer between different bus groups heading to Oxford Street and Victoria bus groups. Trying to change between buses at Marble Arch itself could involve very

long walks from one stop to another, which will be a point of tension in seeking to define passenger-friendly solutions to the proposed Oxford Street pedestrianisation.

150. Could TfL consider if it ought to prioritise locations for interchange in central London which present the easiest interchange distances for passengers? And how could those be defined, designed and promoted? If you don't do that, passengers may overall fail to achieve a satisfactory interchange?

Inner London (Zones 2-3)

151. Inner London has by definition rather fewer opportunities for interchange per square mile, as the buses are less frequent and cross less often. However inner London as far as the North Circular and South Circular is about seven times larger than that of central London. Cumulatively there are more bus-rail and high frequency bus-bus interchange locations, over 160 on a pessimistic count, and more if counting low frequency interchanges.
152. There are many railway corridors, but few are just two bus catchments' distance apart and so able to displace high frequency buses. Often in town centres there are similar constraints on bus stop location as in Central London, plus greater risk of servicing traffic such as van deliveries. Road congestion can be considerable, while standards for bus accessibility may be as much down to local authorities rather than TfL, if they are not TfL-managed roads.
153. Major inner centres poorly served by rail but on arterial roads, such as Holloway, can have a dysfunctional series of bus stops inconvenient for changing between different directions of travel. This is particularly the case if large-scale one-way systems also separate bus flows widely, as at Holloway and Wandsworth, or gyratory systems were overlaid on a former cross-roads, as at Clapton Pond. Going forwards, this requires a major programme of place making, with bus accessibility and interchange in the forefront of planning criteria.
154. More successful exemplars are locations such as Hammersmith, Stratford and Lewisham bus stations, although bus frequency and density can require some routes to use adjoining main roads. Brixton has a linear series of bus stops which serve as a practical interchange between bus routes and with tube and railway, even if passenger densities are very high. There are some other long-standing examples such as Golders Green.
155. In summary, inner London is possibly the most important single area for buses to be able to function better as a comprehensive network, including interchange. This is because of the scale of operational bus resources already committed and which could offer a more 'trusted' network while simultaneously using bus resources more efficiently. It is also because of the density of passenger travel which is likely to grow considerably in the next decades, as population density and jobs increase, and as spare capacity on tube lines becomes harder to find.
156. The Transport Committee may wish to consider what analysis would be beneficial, to define the extent of variations in bus-to-bus interchange and bus-other modes interchange in inner London, and what benefits would arise from measures (at different scales of investment) to raise the quality of interchanges (to a range of standards to be defined as options).
157. Such interchange benefit assessment might be measured over a much longer timescale than the standard bus network planning timescale which measures the first year only. This is because population and jobs growth and the scale of benefits could continue over a 20-30 year timescale,

towards 2050. It would then be on a more consistent footing with London railway planning, where 15-30 year timescales (and longer) are normal for forecasting. Interchange benefits might be measured over a similarly long period, although as discussed elsewhere a shorter timescale might apply for bus route contracts because they are themselves shorter in duration.

Outer London (Zones 4-6)

158. While there are many town centre bus interchanges in outer London, there is a lower density of such interchanges. There are also more poorer interchanges, between one lower frequency outer route crossing another. The arguably easier interchange in distance between pairs of stops is offset by lower service frequencies in general, although the historic tendency to undertake road junction improvements in outer London for the benefit of vehicle flow can also cause inconvenience to interchanging bus passengers.
159. The foreseen high rate of population growth in outer London set out in the London 2050 Infrastructure Plan has been discussed already. The committee may wish to probe TfL on how it considers making progress in terms of raising the profile and quality of interchanges, in order to make the bus network more relevant and effective to existing and new populations. In general, there will be a tendency to move towards an inner London scale of issues to be resolved, particularly on corridors where higher bus frequencies will be required, and where new high density developments also require good links with strategic radial and orbital public transport services.

C1. How is bus stop density analysed?

Bus stop basics

160. Bus stops never existed originally on a mass volume basis, except at termini, depots, fare stages, and for special reasons (eg, a mandatory stop at the top of a hill to check the brakes, as with trams at the top of the 1 in 10 Dog Kennel Hill in Dulwich). Generally, people used to hail at the kerb side but they tended to cluster, so when stopping arrangements were rationalised the formal stops were mostly sited where the most popular locations were.
161. Then and now, road kerbside has heavy usage by delivery vehicles, parking, pedestrians, crossings, cyclists etc. These days there is greater sensitivity on impact on frontages if a bus stop and shelter are located outside your front door. Traffic flows and junction design have also militated in recent decades against stops being located very close to significant junctions, even though junctions are often the best access points from the bus catchment hinterland.
162. Consequently, seeking to vary stop location and density is not straightforward, even if change were desired. One proposition in favour of little alteration to stops, at whatever density prevails, is that roads and roadsides are congested, so better to stick with what one's got. Another is that high frequency bus corridors may need multiple stops in the same direction for multiple routes, which limits the flexibility for further stops. If one stop is moved it may be closer to another one so minimal marginal gains are made, unless it is possible to achieve a large-scale reshuffle.
163. However some planning processes do appear to work. The world city analysis shows that there are examples of very high density stopping patterns on a planned basis – Madrid is the exemplar above, while hail and ride – the original bus concept – can be valid in specific localities and is

used in London. JRC considers that changing the type of service volume on selected corridors to have limited stop services could be another option. There are few examples of such services in London, because roads are so congested that it makes minimal difference to the journey time. However a stronger emphasis on bus priorities might permit more limited-stop operation, which in turn might enable a review of stop frequency for all-stop services. The caution is that the constraints above will still apply.

Bus stop density measurement

164. The main method used by TfL in analysing different stop densities and their benefits, is an indirect process using the WebCAT accessibility tool. This correlates the location of stops and the frequency of bus services there, with the distance to nearby and more distant parts of the catchments. It is subject to a maximum walking distance of 640 metres which is a time distance of a maximum 8 minutes from each stop, based on an average walking speed of 80 metres per minute.
165. The WebCAT tool has been updated on several occasions with the latest change published during January 2017.^D The system is now able to define the quality of accessibility measured as an index for existing and proposed new land uses, and the populations at those locations now and in future years. The bus stop location is therefore regarded primarily as a means of accessing catchments. The accessibility index (AI) varies with the distance from the stop and the number and frequency of services.
166. The method remains a little crude because the measured values are based on catchment squares of 100 metres. It isn't therefore precise about each stop location nor about each development and land use. As will be appreciated, this does mean that there could be 100 metres error or more between stop and land use. In addition there is no allowance for walking routes to and from the stops – it is assumed you can walk in a straight line between the two points. This may not be the case on frequent occasions.
167. The AI could be identified just for individual bus routes by removing the data for all the other buses, although this can cause a technical complication, as the process weights more favourably the bus route with the best accessibility. The most common way that the value is used is in combination for all bus services within the 640 metre limit, and also the accessibility values for nearby rail and tube stations where the frequency of rail services is also taken into account using a different weighting. The stations have an upper catchment limit of 960-1000 metres i.e. 12 minutes catchment walk.
168. The primary purpose of the WebCAT tool is to estimate the basis for authorising lower or higher density developments within the accessible catchments. The accessibility values are summed and a score of over 15 is required in order to justify authorisation of higher density developments. The scores are summarised in bands. A score of from 15.01 to 20.00 equates to a Public Transport Accessibility Level (PTAL) of 4 at which point the GLA is more favourable to higher density development.

^D tfl.gov.uk/webcat

C2. What role can consideration of bus stop density play in network planning?

169. Bus stop density is not analysed for its own sake, while there are few occasions when bus operators would seek to withdraw stops, particularly for high frequency routes where passenger use is by definition high overall. There is a TfL aspiration for stops to be about 400m or less from each other [see also the bus planning link referenced in C], however this varies in reality.

Useful stop density depends on land uses

170. Historically there is evidence that past tram and trolleybus roads have somewhat higher density of stops than those originally served only by motor buses. There were two related reasons for this. The electric vehicles were capable of fast acceleration and braking so could stop more often while maintaining competitive journey times. Also, in the built up areas which they served, there was a tendency for more high density housing for the working classes who benefited from workmen's fares on those routes, so more frequent stops were also justifiable.
171. These days higher housing densities are returning to both inner and parts of outer London as well as denser clusters of large scale office and business developments. While there is a tendency for stop location to be ossified on existing routes, new opportunities for different stopping densities may be available in the Satellite Activity Zones and Opportunity Areas, where new roads and developments are specifically requiring high quality bus access. In those cases there may be merit in more frequent stops in order to achieve high PTAL.
172. An example of the lack of flexibility along a route is the stopping pattern of the 207/427/607 corridor between Southall and Uxbridge (analysed by this author in the early 1970s).
- The stops are based on where the passing loops were on the original route 7 single-track tram service which opened in 1906, so are geared to that era's service frequency. There was only one exception in Hayes End – a long single track section had a depot so a stop was there as well.
 - The area started to be developed and people became used to where trams stopped. The stops were retained when the service converted to trolleybus in 1936, and when most of the road was made into dual carriageway in the 1930s-60s. Urban development has coalesced around the stops, which have remained except for changes caused by factors such as major road works.
173. So bus stop density is not a necessary criterion without the population and jobs to justify it. There is no point in having a stop to serve a cow in the adjoining field. In an already built-up area, what matters is the location of converging roads and footpaths to achieve good accessibility. In theory the density of those developments can influence stop and bus frequency. Stop frequency will impact on efficient bus operations, as greater distances between stops could speed up the service and require fewer buses for a given frequency, but at the risk of missing out local populations or at least causing some to have a longer walk to the nearest stop.

Meridian Water as an exemplar for bus stop planning in a new development

174. An example of the importance of bus stop location and its relationship to bus frequency and PTAL levels is demonstrated by the 2015 JRC analysis for the Meridian Water development within the London Borough of Enfield. It is part of the strategic economic growth and land use changes planned for the Upper Lee Valley Opportunity Area.
175. The report shows that, to achieve a high availability of PTAL 4 to support high density development, major land uses should be within 160-210 metres of stops served by a high

frequency of buses as well as the primary provision of a minimum 4 trains per hour rail service at a station (Angel Road) which is to be relocated closer to the centre of Meridian Water.

176. The report also points to the requirement to reroute the existing bus services on the North Circular Road through Meridian Water, if PTAL 4 is to be achieved without a significant number of additional buses being required.^E

General observations on the relationship between bus stop density and land use

177. This leads to broader consideration of bus access to new development. In theory you should be able to vary the placing of bus stops along existing roads, as well as potentially having more flexibility for new bus stop locations in new development areas. Higher density development might or not require more stops, depending on their present distribution. There is a parallel option, to vary the transport accessibility test set by the GLA to justify high land use densities. GLA has the power to vary this, although any change would need to be evidence-based rather than just an administrative convenience.
178. PTAL 4 is a high pass mark if you have to rely substantially on buses rather than high frequency rail and tube lines, as shown with Meridian Water. In consequence this benchmark puts a prioritisation pressure on allocation of available bus miles, particularly for Opportunity Areas and other major developments around London, if high density is to be achieved and there is no available high frequency railway station. Established parts of London risk losing bus mileage in favour of new high density areas, so that the PTAL 4 criterion can be fulfilled for intended population and jobs growth.
179. Public Transport Accessibility Levels could be turned into a more productive and constructive process. One interviewee saw a TfL tendency to try to define the minimum bus mileage necessary to achieve an adequate local PTAL level, regardless of whether the resulting route structure delivers services to where passengers really want to go.
180. Conversations with housing developers indicate that their marketing priority isn't PTAL 4, but rather an adequate rail service of at least 4-6 trains per hour as a baseline. These at best give a PTAL of 2, as shown by JRC's analysis of WebCAT outcomes in [jrc.org.uk/theoretical-ptal-values-for-combinations-of-local-rail-and-bus-services.html]. Is there a need for the Transport Committee to instigate a discussion on the balance between planners' perceived requirements for high accessibility levels and land use permitted densities, when the supply market is saying that it is the mode – rail by preference – which matters most, even if the PTAL is then lower unless substantial bus resources are put into a rail-deficient area?

D1. Do local bus routes and infill services achieve a good balance of user benefits and operational costs?

The trend towards more local and infill coverage

181. There has been a large increase in local and infill bus services since the mid-1960s. Up to then, high frequency bus services tended to concentrate on main roads and there were few infill

^E Meridian Water – guidance for PTAL and bus accessibility planning, JRC for LB Enfield, May 2015 (Report released for public information with approval from the London Borough of Enfield)

routes to serve local estates. Old bus maps illustrate this. With low car ownership, there was a view that passengers would walk to get the bus regardless of distance. Bicycles were also used widely for local journeys. Changes in the public's modal travel preferences, and the increasing pressures to centralise health provision and change school locations makes a denser network ever more important.

182. The 1966 London bus reshaping plan and most initiatives since then have put greater reliance on direct provision of infill and estate services, as feeders organised as part of 'hub and spoke' systems within the suburbs. The economics of those routes was greatly improved with one person bus operation, although at the cost of longer dwell time at bus stops when people had to pay on boarding. Further measures to speed up bus times and make the network more convenient have come about with Oyster and other smartcards, as well as better information about bus networks as discussed above.

Economic issues faced by local and infill services

183. On the revenue side, such local routes have been of most use for short distance or feeder travel to interchanges, therefore the introduction of a flat fare in the late 1970s/early 1980s didn't significantly alter the revenue-to-cost ratio on these routes. Having a separate fare for those routes being paid by a proportion of passengers gave some revenue/cost advantage. Each freedom pass journey stage also represented separate income. The operating economics changed further with internal London Regional Transport cost centres for groupings of buses, from 1985 to the mid-1990s.
184. This was followed by the sale of ownership of bus assets to private sector operating groups, who would in future bid to work for LRT and then TfL specified contracts. This is the tendered operation of buses which is now in place. Overall this has driven down the per mile costs of bus operations, but factors such as congestion generally worsen operating efficiencies. Segregated local and infill routes might be more immune to some of the congestion in town centres and on main corridors.
185. Nowadays all routes including local and infill services will be validated by TfL on its standard BCR methodology discussed above, so that they have equal merit with other routes in TfL's assessment. Of necessity this BCR passmark will define a balance between user benefits and operational costs, though it may depend on the specific mix of services being assessed whether users and local authorities feel that an adequate local or infill proposition has been specified in the options that are then evaluated. This is a task for TfL to explain the reasoning behind its compilation of different options. Some enhancements have occurred because of direct political lobbying, eg, enhancements in North Peckham to relieve the 343 bus.

Current revenue and BCR risks

186. The current introduction of the hopper fare may have the effect of reducing income attributed to local or infill routes if a proportion of passengers now find it convenient or attractive to use that fare. This is because the fare attributed to each service with two journeys starting within an hour, will be reduced and therefore the route's BCR. Taking the local service in isolation risks showing a lower income therefore worse value for money, if benefits are broadly the same (they *might* increase in terms of transfer convenience, subject to that element being measured and weighted). So a lower revenue, attributed to individual routes or to the assembled group of services, might risk a reduction of bus mileage in order to achieve a satisfactory BCR.

187. It is unknown at this point how TfL will address this issue in terms of future network planning. To be competitive with car ownership and use in the suburbs, and growing suburban population and density expected for several decades to come, it is now necessary to plan for a significant volume of local and infill services in order to ensure the accessibility of public transport within estates.
188. The ability to reduce car use in the suburbs, particularly with population growth where roads may not accommodate much extra car travel, may need greater weighting within the benefit calculations undertaken by TfL. As noted above, TfL's use of just one year benefit calculations may sit uncomfortably with population growth, where benefits of specific bus route options might vary over a 5-7 year period, which is the normal length of a bus contract in London.

Other considerations

189. Several features also stand out:
- TfL prefers using large capacity vehicles even in infill areas, wherever this is possible, in order to accommodate very peaky flows e.g. school demands, without the expense of extra vehicles and drivers, and possibly extra costs if vehicles are specialist in design. The general adoption of large capacity vehicles may influence which local roads can be served.
 - TfL's policy tends to be less supportive of hail and ride sections of route because of expectations that all bus stops should be accessible, when pavement height might be inadequate at some locations. However TfL also recognises that hail and ride can offer good local access. Consultation to abolish hail and ride on route K1 has dragged on for nearly a year with the topic also subject to a council consultation. Many planned stop locations have been changed and shelters have not been provided due to pressure from residents. Route R2 is also going through the same process.
190. TfL is aware that new initiatives will be required in lower density areas, to improve accessibility further for different types of passengers and to improve the economics of such services. Possibilities include using apps to call for buses as with a taxi bus service. Some areas may merit services running on a no fixed route basis although laws about bus accessibility (recently reinforced in the 'Paulley ruling' in the Supreme Court), could necessitate buses having different design ramps to accommodate widely variable pavement heights. A scheme of no fixed routes would be reliant on apps. Meanwhile TfL is also keeping an eye on automation of vehicles and whether a driverless bus might be feasible in such circumstances, on local roads and bus lanes.
191. While some European cities have midi- or mini-buses to penetrate the narrowest of local roads (eg Rome), the generality is that you can have a mini-bus but it is difficult for a large scale transport undertaking to see good economics if there are narrow estate roads, without large general subsidy or other specific subsidy, because of staff pay levels and the limited volume of passenger benefits from small passenger numbers. That service tier would often be a function of voluntary and part-time drivers, eg through operations such as community transport. This point is expanded below in the section on 'rich data' and new initiatives. Future greater population density in some estates would also point towards economics starting to favour larger buses, with less route flexibility, in order to address peaks of demand.
192. Barcelona, among London's comparators, offers a bike-and-rail service at over 400 stations across the city, where a smartcard gives travellers access to a bicycle rank where cycles can be used and left elsewhere – similar to the London cycle hire scheme. Cycle ranks in estates, associated also with cycle ranks at stations and bus interchanges, might offer another level of

transport utility and accessibility for local residents and businesses and so address some of the potential gaps in public transport convenience.

D2. Do these services successfully supplement major routes to deliver additional capacity / frequency as required?

193. The answer depends on the parameters defining the operational priorities. Many infill routes are by definition lowish frequency and, as a use of constrained bus mileage in London, might need to be localised rather than travel significant distances on main bus corridors. Their primary purpose is not to supplement major routes.
194. A different offer for infill is possible, and often used by market-led operators. This is to adapt routes on a high frequency corridor so that for example a service due to terminate at a transport node might have its route projected for a short distance into an infill area, or for part of a high frequency service to be rerouted through such an area and then re-join the main road, for a marginal cost of additional journey time and mileage, and lacking high frequency on part of the main corridor. A judgement is required about the gross effect on the attractiveness on the main bus corridor as a whole, commercially if a net revenue-maximising bottom line, or a combination of net revenue and utility if building in area benefits.
195. In low density suburbs like Orpington, TfL deliberately overlaps lowish frequency services on some corridors to provide a reasonably attractive service where there is greater potential demand, and then thins routes out as they serve rural hinterland or local estates. TfL could include such options elsewhere if they appeared valid within its network planning process.
196. It is however TfL's usual policy to focus on justified core frequencies of the main routes, rather than adopt a different operational stance which weakens the main corridor frequency. The reasons for this have been explained. This is an area where better knowledge through data from smartcards and other sources will be increasingly important, in order to test and validate existing services if revenues reduce because of the hopper fare, and to define best value in a more transparent way when routes are being re-planned.

E1. How can bus services be planned to accommodate existing (and encourage new) jobs and housing?

Generalised demand is the current norm, and under pressure

197. In planning bus services TfL considers the generalised demand along corridors or routes including numerous factors such as jobs and housing, along with demand for shopping, schools, further education, leisure and health facilities.
198. Whether the outcome is less or more effective in supporting jobs and housing depends on the total demand matrix and the BCR result. We have explained earlier that TfL consults in detail with local authorities, developers and others. This information is built in to the forward route and network planning so adding to the total demand matrix. It is rare for there to be a solo cause for a significant route change. TfL cannot justify all the changes that it and Londoners would like to happen.

199. It already runs a 'pending' system for bus route changes. For example, requests for a better bus network to serve more of the Northwick Park Hospital catchment (itself a low intensity demand on each access corridor) perforce waited until there was a business case to split route 83 (formerly Ealing Hospital-Golders Green). A route 483 was then devised to overlap between Ealing Hospital and Harrow via Northwick Park – also creating a direct town centre to centre Ealing-Harrow bus which added benefits – while the 83 now runs Alperton-Golders Green.

Prioritising choices

200. If TfL had more flexible funding for the supply of bus services then they could be more accommodating to existing jobs and housing while simultaneously supporting additional benefit with other bus miles underpinning new jobs and housing. Given we are now in bus mileage rationing, the potential for more amendments risks ending up with bigger pending files and facing difficult choices about what to prioritise.
201. The current overlay of bus service rationing by costs raises a fundamental question whether, at the marginal mile, one is seeking specifically to focus on servicing high density, location-sensitive new jobs and housing, or the wider uplift in demand across London. It might of course be that the second marginal mile was then justified in being allocated in the other direction.
202. The availability of additional bus mileage to support specific extra jobs and housing can only be found from six sources – any one or combination of these may be useful.
- By **negotiating lower operating costs** for bus services to enable more bus miles within a fixed budget.
 - **Revising TfL's existing service volume policy** where the entire service may be scheduled from end to end even though demand may fluctuate along the route.
 - Alternatively **achieving more efficient bus operations** with less congestion enabling more actual miles to be operated for the same costs.
 - Another option is to **impose a higher pass mark of BCR** for the service volume and changes that are justifiable to operate in this system of rationing.
 - TfL could also deliberately adopt a **less generous specification** for any additional mileage. It could tolerate more overcrowding over more hours of the day and/or encourage retention of older, depreciated vehicles.
 - It could also see if there was some better way of **sharing risk and reward** with operators to make running more service volume viable.
203. The success of negotiation is a question of market supply and the attractiveness of the package of routes to prospective operators. Comments from operators suggest that there is only a limited margin left for cost reductions, although different bundling of routes might yet yield more efficiencies – this would need modelling to define value gains.
204. Is TfL's emphasis on high frequency on all main routes scheduled throughout that route actually the best use of allocated mileage? Depending on the corridors and their human geography there can be a tendency for the outer reaches of any route (unless it is another town centre or major railhead) to be lighter in demand overall as a consequence of population and job density. That is how many other UK urban bus operations are organised, with more of a route splitting process, and short route operations on the main corridors. TfL has set out its positioning on that.

205. In practice TfL itself faces partial distance operations of busy routes, particularly because of congestion causing buses to be turned short of their destination. It could be argued that TfL even in such circumstances is at least ensuring that a reasonable supply of buses will serve the ends of the routes. That would be in contrast to a route already scheduled to be slimmer in frequency at the ends, which with congestion or other causes could result in an even lower service frequency in practice – in turn making services less attractive.
206. Regardless of whether a shortfall in availability of rationed mileage is arising from congestion or from a fixed frequency, these days there can be bus miles lost to congestion even on low demand sections. Ironically TfL benefits from this because it doesn't have to pay operators bonuses and can, instead, levy abatements for poor performance. The Transport Committee has suggested recently that the congestion charge has ceased to have a strong impact on vehicle volume, and that other traffic constraint measures may be required. Unreliability gives a definite operational challenge to be addressed. Greener Journeys has remarked that "traffic congestion is a disease which if left unchecked will destroy the bus sector".
207. So changes to bus services planned in the context of rationing may need to give different weightings to different service elements or structures. It could also be that investment in means to achieve greater reliability, could achieve strong net benefits for the same scale of financial input as some bus network reorganisation. Leon Daniels, the TfL Surface Transport MD, recently responded to the London Assembly Transport Committee that 'Excess Waiting Time' was becoming a less sensible measure of passenger disbenefit because so many people are using real time info via phones to minimise their wait times at stops. He said traffic congestion levels were a better proxy for impacts on passengers.

E2. Can different bus networks be planned to suit different areas in London?

What is meant by 'different'?

208. There are different travel dimensions – radial inwards, orbital, radial outwards. Local and infill vs main corridor. Hub and spoke vs through operations. What bus services of any sort are best at in London, compared to other modes, and what those other modes are best at. In the London area, we have seen that the combined capacity limits of rail and tube are being expanded but simultaneously stretched and filled over the next decades. London's rail systems still suffer from past decades of under-investing, and new investment is not on the scale that has been seen, and continues, in Paris, Madrid, Moscow etc.
209. London faces a paradox of high demand radial inner corridors, where rail and tube, busy or full now, are increasingly forecast to be full in future years even with additional capacity. It appears that the London bus will still have a fundamental high capacity rôle on many corridors, the more so in the absence of intermediate capacity options such as light rail which currently is limited to Docklands and parts of outer south London.
210. With London's human geography, there are the established built-up areas, themselves growing in population these days. These can be generalised as zones, these days tending to be defined by fares zones – central, inner, outer – as well as different points of the compass. Then there are the high density overlays for new population origins – and overlays for new 'attractor' destinations, including jobs clusters and also major leisure and retail developments – with many but not all of these in Opportunity Areas and Satellite Activity Zones. These

localities are in many parts of London, but have some tendency towards inner London and the NE and Riverside locations. More precise types of catchments could also be defined.

211. This is a complex matrix for transport options and land uses, in a large area of over 600 square miles. Several entire treatises could be written on the subject of what to do and how to do it. So in trying to answer this question, it is felt best to be brief and draw attention to the commentaries and context-setting in the preceding sections, which bring together many of these strands of transport and land use.

A simple synopsis

212. Overall, this report has endeavoured to paint a backcloth to illustrate the constraints, practicalities and a variety of options for how to prioritise hard choices. These have to be made now and in coming years, to deliver the best possible combination of services for a dynamic, growing city region, within a rationed budget which limits what is affordable. Above all, bus network planning has to take a view on people's preferences for types of travel, and achieve overall benefits in ways which maintain most existing connectivity or improve it, while facilitating desired growth. For example, better bus-to-bus interchange facilities might counter-balance the disadvantages of potential reductions in the volume of through corridor routes.
213. Taking central London first, there is a danger in comparing apples with pears. London is not Paris for transport planning, where a dense metro system in the core of the central area means that bus routes have historically been foreshortened relatively easily. London's tubes are sparser, even though London's central area is smaller than zone 1 of Paris, which may surprise (imagine Hammersmith to Wapping, and Holloway to Stockwell).
214. Central London itself is regenerating with much additional population. The centre has many divergent clusters of intense activity, and a history of direct travel from adjoining inner suburbs, and from further afield, to and sometimes across the centre. Within the area the choices for travel arising locally depend on comparisons of time costs and convenience options between bus, tube and cross-city regional rail. Access times to deep tubes and tube/rail interchanges can militate against its use for short journeys, and for non-rail-corridor and round-the-corner flows. However, to be more effective, the bus must find some solutions to congestion. The same applies at critical inner London junctions.
215. In inner London, the reality is that the bus still has a fundamental rôle as the main transport service from much of this territory to the Central Activity Zone, as well as orbitally and along poorly served rail corridors to some outer centres. Buses will continue to provide strong coverage of these, with adequate capacity and access particularly in the inner London zone which has rail and tube capacity issues.
216. London Overground has shown a fast increase in usage for orbital travel in inner London, which might point to suppressed demand for better public transport. More and improved bus interchanges should enable a better spread of coverage and connectivity within acceptable journey times. Decongestion of routes may be one option, leading to the potential of express bus corridors, as discussed above. Some through routes from outer London follow corridors poorly served by rail or tube, and they might benefit from acceleration.
217. There may be a greater variety of travel possibilities in outer London, including better interchanges and strengthening of orbital routes to offer more choice for journeys now made by

car. There are BCR issues which arise from lower density demand. TfL says that outer orbital X26, half-hourly and serving Heathrow and outer centres, is as frequent as is affordable with the BCR outcome. The fares charged are perhaps low for this long orbital, so also affect BCR. However there is an expectation that most of outer London will see significant population growth in succeeding decades, so that the case for more and more frequent routes should improve.

218. These will have to make their case for more resources, against a backcloth in 2016-20 of a rationed supply of bus mileage. TfL judges that there would need to be a residual case for a strong all-stops service frequency, eg 12 buses per hour, which would retain local travel benefits, in order to justify planning for a new express route as an overlay. A road allowing express buses an efficient run would also be desirable. The route 140 corridor (Heathrow-Hayes-Harrow) has been suggested by TfL as one such possibility.

Methodology should be the starting point

219. This points back to the start of this report, which is how TfL assesses its bus network options. The benefit valuation process is vital, as that is the way that the city region can be sure of gaining from changes to bus service provision, and minimising any losses. However the budget tensions in future years may require changes to the weighting of elements in the value calculations, as discussed above.
220. JRC also notes that a one year benefit vs cost assessment could lead to conclusions which might point differently if a longer term passenger volume estimate were made, given that there is strong population and jobs growth in the city region. A railway tendency to look to 15 to 30 years for estimating project benefits vs cost, is geared to the long term nature of providing railway assets and achieving payback on these. That might not be too helpful for bus assessment, but as London bus contracts are currently running at 5-7 years length, looking at least that distance ahead might help provide bus network solutions which provide greater stability for future decades.
221. Different contractual options might focus on **corridor-scale awards** (possibly allied to simultaneous or preceding corridor route priority measures), or by **depot** (which could address operator overheads and help bus economics), or by routes **radiating from main interchanges** so that an area network was reassessed as a whole (which might assist planning for nearby major development zones). Key Performance Indicators might vary between different strategies for awards, for example a focus on an interchange-centred award could set targets on managing interchange facilities, information, accessibility and cleanliness as well as scores for bus operations.

Opportunity Areas and Satellite Activity Zones

222. Finally, JRC comments on the bus planning challenges that have to be faced in the new development priority zones – Opportunity Areas and Satellite Activity Zones.
223. There are 38 **Opportunity Areas** (OAs) in London of which Meridian Water is one, discussed earlier. There are also 7 Intensification Areas. The total area of OAs is 18,484 hectares. Foreseen jobs in central London and its fringes amount to over 200,000, with nearly double, 372,000, in suburban locations. Proportions for minimum housing numbers (there could be more) show over 53,000 homes in central London, so over 100,000 new residents, and nearly 250,000 homes in the suburban sites with around 600,000 new residents (depending on population density).

224. These could require significantly more bus mileage locally, particularly in the suburbs, on a 'standalone' basis. (Some areas are located on the Elizabeth Line.) When there is a fixed volume afforded within TfL's budget, the extra bus supply will have to be found from redistribution of existing mileage within London. This situation also points to a requirement for careful modification to existing mileage operated within and adjoining the Opportunity Areas, to minimise the need for extra miles. The existing route network should in any event incur changes so that new passengers can easily reach major nearby destinations.
225. London's three large scale **Satellite Activity Zones (SAZ)** will each face such pressures to different degrees. **Canary Wharf and the wider Isle of Dogs Opportunity Area** have already adopted a policy of primary reliance on light rail and tube capacity. Crossrail (Elizabeth Line) will be the next high capacity arrival in 2018, in turn enabling a higher jobs volume heading towards a quarter million working population.
226. Planning for the SAZ is also considering greater housing volumes than the 10,000 postulated. A further rail extension may be required in due course – the Bakerloo Line has been mooted, or, referenced by the National Infrastructure Commission, a new north-south main line connecting the Lea Valley, Stratford, Canary and towards the Brighton Main Line. Because of the rail capacities, the scale of additional bus requirement could depend mostly on the extent of retail and leisure functions, and travel to and from nearby destinations including schools, further education and hospitals. Recent service changes have increased the volume of Isle of Dogs routes run with double deckers, and also diverted double deck routes to corridors formerly served only with single deckers. So capacity increases, without necessarily increasing mileage.
227. **Stratford SAZ** (part of the **Lower Lea Valley Opportunity Area**) is already served by a combination of multiple rail, tube and light rail services, and by an established bus network. The Elizabeth Line arrives in 2019, along with STAR train services from the Lea Valley. Additional bus volume will be a function of the foreseen extra journeys generated which cannot conveniently be carried by rail modes. It is worth noting that Crossrail, STAR, Jubilee Line Extension and Docklands Light Rail will offer step-free access at every station, so that the rail mode provides travel capability in much of East London for people with reduced mobility.
228. As with a number of European examples noted earlier, once rail is the capacity leader, then buses have a subsidiary but complementary function. Stratford additionally has a large bus catchment based on historical corridors, and there is Westfield. Similar bus travel demand might emerge in future as at Canary, if there is continuing large-scale housing development. The former Olympics site is intended to have five new neighbourhoods.
229. The **Old Oak Common** and **Park Royal Opportunity Areas** together make a SAZ (OPDC). They will become densely served by new railway stations in the Old Oak Common area, and have better links to existing stations on its periphery. The stations will themselves merit better bus access as there will be city region and national interchange as well as dense development.
230. There will be the opportunity for a more coherent road network through what is currently a poorly connected area. This can be a stimulus to new and improved bus network planning throughout the OPDC catchment, which will extend at least five miles distance based on present travel patterns. It will require an appropriately dense bus stop pattern. That will also be required in the Park Royal area where no new stations are currently foreseen, and which is on the margins of public transport-focused inner London and car-reliant outer London.

Emerging Topic: Greater use of 'Rich Data' sources

231. There are frequent references in the main text to emerging techniques which effectively amount to using 'rich data' sources. These are able to resolve in finer detail, including more discrete travel segments, the fundamental preferences of passengers into geography and periods of the day, mode of travel, efficiency of functioning networks and individual vehicles. Such data can analyse as well the human dimensions of customers – in the full sense, not just the physical element of travel – so appraising different levels of social mobility and purchasing priorities, which can influence travel choices just as much as the actual availability of services.
232. 'Rich data' is a two-way tool. It can be used to influence travel as well as assess it, by being both cause and consequence of widespread user interfaces, apps on i-Phones and laptops. It creates a society which is rich in travel options close to the point and time of demand as well as information during a journey.
233. As a simple example, consider the psychology of a group of friends out for an evening – physical availability of a night bus or tube may be within their knowledge, possibly via an app, but how much is trusted or easy to use? What about the convenience of just jumping into a cab (taxi or über), with several touches of a screen and/or one phone call? The rise of über-type transport options are dependent on such real-time capabilities. How can a public transport operator then reinforce the potential of still using the bus or tube – another app? In planning and contractual dimensions, how can a bus planner establish a network, information and marketing which is more resilient to quick changes in travel choice, and how can bus contract managers define the right commercial agreement which might need to incentivise flexibility with appropriate rewards?

Real-time tracking for locations beyond stations and bus stops

234. In practice real-time information creates a better knowledge base about the individual and mass demands of multiple lifestyles, and in turn enable public transport to be more relevant to a complex 24/7 society. As part of that process it add benefits to the city region, and makes the transport supply more relevant, targeted and responsive to the travel and purchasing desires. It can also present opportunities for additional travel sales, and for more repeat travel purchases, benefitting the operators' bottom line. Of course it opens up choices for prospective passengers.
235. There are numerous sources to analyse travel desires in real-time as well as post hoc. There are then multiple ways in which such data can be exploited for the benefit of operators, planners, passengers and city authorities.
236. Ticketing – smartcards and contactless – provides a tracked capability, and as we have seen, algorithms can be deployed to fill knowledge gaps even where the fare structure or card recognition ceases (eg a flat fare). Contactless payments can, with users' acquiescence, be tracked to show previous and next locations, which provide an individual travel diary, and en masse a statistically significant sample. Beyond the public transport domain, there is twitter, Bluetooth, i-Phone and others – where mass data on electronic traffic volume can estimate passenger volume to and from stations and bus stops. Also, the greater the extent to which multiple transport apps are loaded onto individual hand-held devices and then used, the more the ability to achieve statistical validity.

237. A long-established data requirement for public transport is to anticipate exceptional demand, previously reliant on prior knowledge of ticket sales for large crowd events (eg, O₂, sports matches), direct liaison between the event managers and the transport operators (the police are likely also to be involved with specific events), and sometimes simply using the Mk1 human eyeball, and past years' travel data, for example with Boxing Day retail sales.
238. At the least, such information may enable better capacity to be supplied on the day, maybe specific road traffic interventions and better crowd management. With foresight, some of this can be established on a regular pre-planned basis and related costs might be capable of incorporation in longer term bus contracts. The benefits include avoiding higher on-demand supply costs (eg extra staff and buses, quickly) to address short term requests, or, worse for the passenger, station closures due to unforeseen overcrowding, or a poor bus passenger experience with long queues, waits and crowded vehicles.

Benefits for different parties

239. Some beneficial examples are summarised below.
- **Operators** already track services including variability in headways, and make early changes to try to sustain reliability. With new algorithms, they may be able to respond better to emerging build-up of passenger volume and target bus resources appropriately, hour by hour. However, as noted above, the ability to flex the service in that way could need to be built-in to new contractual agreements and KPIs, otherwise the contractual rules might inhibit this.
 - **Planners** can define networks, routes, stops, worthwhile interchanges and networks more precisely. This can be particularly helpful where there are high boarding and alighting numbers at intermediate locations and there is a desire to optimise bus services to support the journey patterns. They can now identify stress points in networks and propose remedies. The costs and benefits can now be estimated with greater certainty, and targeted for better BCR. Off-vehicle passenger flows, now more observable, may flag up a business case for services to be extended or redirected to reach other locations.
 - **Passengers** can benefit from a more focussed service pattern, better suited to their travel preferences. Travel information including apps can better support their varied journeys. In turn passengers can have greater trust in the local services and the operators, and how interchanges and the wider network can work for them. Over time, this can feed into greater use of public transport, which is of wider public benefit.
 - **City authorities** can budget for more certain usage volumes on public transport. Improvements to local access routes to bus stops, stations and interchanges may be justified with clearer data. Public trust in the city authorities can rise if there is a clear correlation between supply of better facilities and their relevance for individuals and families.

New types of routes on offer

240. Mainstream planning and operations can benefit considerably from such data, as discussed in this report. Its emergence has also opened up important new propositions for accessibility and service availability, in areas and for flows not always within the ambit of commercial operations. Campaign for Better Transport has referenced the University of Hertfordshire's bus services, originally set up in 1992 to assist student travel. These are now an established local bus network serving nearby communities as well. Detailed travel analysis, availability of travel diaries and social mobility assessments has enabled a combined University and community operation.
241. UNO, previously known as UniversityBus, was created to provide student transport to the University from local areas; improve east-west travel across the county of Hertfordshire; and,

to create new links between Hertfordshire and North London. UniversityBus became UNO in 2005, a bus service not only for University staff and students but also the entire Hertfordshire community. Hertfordshire CC and districts, and local bus operators are all involved with the operation. (See herts.ac.uk/about-us/case-studies/local-community/uno-buses.)

242. There are comparable services elsewhere which started with a similar context, for example the University bus network in Bristol, to serve the far-flung campuses of the University of Bristol and the University of the West of England. These have their own smartcard, and are available for ordinary passenger travel. They are a large-scale supplement and, in some cases, a better travel option than the First Bus local operations.
243. London sees large-scale utilisation of non-TfL-procured buses for complementary services, such as local authority education buses, hospital fleets etc. There may be merit in an exercise to analyse the scope for getting better general utility from these less-visible networks. Hackney Community Transport is a significant example which has now moved into some contractual agreements with TfL, thanks to availability of better transport planning data. The HCT Group is a social enterprise in the transport industry, providing over 20 million passenger trips on buses every year. The HCT website notes that:
 - “We deliver a range of transport services – from London red buses to social services transport, from school transport to Park and Ride, from community transport to education and training. We reinvest the profits from our commercial work into further transport services or projects in the communities we serve”.

Accessing ‘rich data’

244. There are many avenues available to sourcing ‘rich data’, but few have the in-depth skills background already held by managers familiar with smartcard data. The requirements are to scan and analyse data rigorously, to correlate this information with that available from existing trackable products such as smartcards, and then to extend the planning, pricing, service, information and investment options based on the expanded ‘knowledge bank’.
245. On a systemwide basis, this can require a considerable commitment, before yielding results. We have seen that it took 7-8 years before TfL was able to roll out its smartcard algorithms to assist with network planning. However the rewards can be great, as the local supplementary service examples show above. These have also been able to develop by degrees, so that early results were achieved even if improved on later.
246. Cubic Corporation is a worldwide supplier of smartcards and expanded ‘rich data’ analysis, with its ‘Next City’ products (cubic.com/transportation/nextcity; urban-insights.com). Cubic was the originator of the Oyster card design for London, and continues to be the manager on behalf of TfL who acquired the system. Cubic operates Oyster-style systems throughout the World. There are equivalent competing products by other suppliers, such as Octopus (Hong Kong). Apps can also be provided which enable passengers to fill in travel diaries while on the move (for example, see transloc.com/rider-transit-app).
247. Overall, ‘rich data’ is a new world for bus planning and wider public transport design and provision. The potential exists to enlarge the public transport market, by making services more relevant to people’s needs, and offering a better quality experience before, during and after the immediate in-vehicle journey.

References

- Annual Bus Statistics - Department for Transport -Year ending:- March 2016 tables (updated), bus0106, 0109, 0110, and 0113
- Assessment of QOS for Public Bus Transport System A SERVQUAL Based Kano Approach - S. Rita: - Advances In Management. Vol. 3 (4) April (2010) pp. 32-42
- The Attribution Process of Delegation Contracts in The French Urban Public Transport Sector: Why Competitive Tendering is a Myth - Anne YVRANDE-BILLON: - Annals of Public and Cooperative Economics 77:4 2006 pp. 453-478
- Bi-objective bimodal urban road network design using hybrid metaheuristics - Elnaz Miandoabchi: - Central European Journal of Operations Research 25 January 2011 pp. 583-621
- The Bus Driver - Matt Ross: - Regeneration & Renewal 13 June 2008 pp. 13
- Bus Fleet Reliability - Washington Metropolitan Area Transit Authority 2013 Year-end Results
- Bus Network Development Papers - TfL - various dates for different areas of London:- during July 2013 to November 2016
- Bus Quality Indicators – CILT Focus September 2003 pp. 17
- Bus Service Planning Guidelines - TfL: - August 2012
- Buses are for other people - Eric Jaffe: - Atlantic January- February 2015 pp. 36
- Busqual and Repurchase Intention among the Passengers: An Empirical Study - T. Vanniarajan and A. Alleswari: - Journal of Marketing & Communication May - August 2010 Vol. 6 Issue 1 pp. 10-17
- Call for city-region plan for Manchester - John Geoghegan: -Planning 26 March 2012 pp. 13
- Call to fund buses in deprived areas - Joseph Rowntree Foundation: - Regeneration & Renewal, 11 July 2008 pp. 7
- Changes in Spatial and Sectoral Patterns of Employment in Ile-de-France, 1978-97 - Rachel Guillain et al: - Urban Studies, Vol. 43, No. 11, 2075-2098, October 2006
- Citizens' expectations of information cities: implications for urban planning and design – Steve Curwell, Mark Deakin, Ian Cooper, Krassimira Paskaleva-Shapira, Joe Ravetz and Dominica Babicki: - Building Research & Information (January-February 2005) 33(1), 55-66
- Citizens' Involvement and the Representation of Passenger Interests in Public Transport: Dimensions of a Long-neglected Area of Transport Planning and Policy with Case Studies from Germany - Martin Schiefelbusch: - Transport Reviews, Vol. 25, No. 3, 261-282, May 2005
- City region plan seeks extra growth - John Geoghegan: - Planning 18 October 2013 pp. 11
- City-region pioneers mooted - Allister Hayman: - Regeneration & Renewal 12 December 2008 pp. 1
- A Column-Generation Approach to Line Planning in Public Transport - Ralf Borndörfer, et al: - Transportation Science Vol 41, No. 1, February 2007, pp. 123-132
- A Comparative Study of the Telematics Industry in Korea And China - Young-Wook Song et al: - Journal of Internet Banking and Commerce April 2012, vol. 17, no. 1 pp. 1-13
- Contract Renewal as an Incentive Device. An Application to the French Urban Public Transport Sector - Axel Gautier, Anne Yvrande-Billon: - Review of Economics and Institutions Vol. 4 – No. 1, winter 2013 – Article 2 pp. 1-29
- Coordinating Transport and Urban Planning: From Ideologies to Local Realities - Caroline Gallez et al: - European Planning Studies, 2013 Vol. 21, No. 8, pp. 1235-1255
- Cubic Collects \$220 Million Transit Deal - Mike Allen: - San Diego Business Journal, January 31, 2011 pp. 8
- Demand for Improved Public Transport Services in the UAE: A Contingent Valuation Study in Dubai - Genanew Bekele Worku: - International Journal of Business and Management; Vol. 8, No. 10; 2013 pp. 108-125
- Devolutionary DNA - Benjamin Mansell and Michael Pocock: - The Planner, September 2015 pp. 22-25

Disabled factored into bus stop upgrades - Paul Hemsley: - Government News, April/May 2012 pp. 9

The Economic Performance of European Cities and City Regions: Myths and Realities - Lewis Dijkstra, Enrique Garcilazo & Philip McCann: -European Planning Studies, 2013 Vol. 21, No. 3, 334–354

Eco-town plans 'fail in key areas' – Tamar Wilner: - Regeneration & Renewal 27 June 2008 pp. 4

An Empirical Analysis of Urban Form, Transport and Global Warming - Fabio Grazi: - The Energy Journal, Vol. 29. No. 4. Copyright ©2008 pp. 97-122

Entry deterrence and quality provision in the local bus market - Jan Peter Van Der Veer: - TRANSPORT REVIEWS, 2002, VOL. 22, NO. 3, pp. 247-265

Evaluating City Bus Service Based on Zone of Tolerance of Expectation and Normalized Importance - Kai-Chieh Hu: - Transport Reviews, Vol. 30, No. 2, 195–217, March 2010

The Facts about BRT - Samuel Zimmerman and Herbert Levinson: - Planning, May 2006 pp. 34 - American Planning Association

Fictions of the City: Culture and Mass Housing in London and Paris - Matthew Taunton: - Basingstoke, Palgrave Macmillan, 2010

From fieldbus to Ethernet – Mike Spear: - Process Engineering May 2004 pp. 331-32

From Megastructure to Megalopolis: Formation and Transformation of Mega-projects in Tokyo Bay - Zhong-Jie Lin: - Journal of Urban Design, Vol. 12. No. 1, 73–92, February 2007

Future of the bus - Peter Nash: - CILT Focus, August 2010 pp. 28-30

The Future of Transport - Andrew Saffrey: - CILT Young Professionals, Institute Special 36 CILT Focus, October 2016

Future of Urban Mobility 2.0: Imperatives to shape extended mobility ecosystems of tomorrow - Arthur D. Little for UITP: - January 2014

Good things come in small buses - Yuliang Hong et al: - CILT Focus June 2006 pp. 42-46

Governing Paris - Planning and Political Conflict in Ile-de-France - Philippe Subra et al: - European Planning Studies Vol. 16, No. 4, May 2008 pp. 521-535

Greater Paris goes ahead with £31bn budget – Building Design on Line May 8 2009 pp. 6

A Green Bus for Every Journey case studies) - Low Carbon Vehicle Partnership:- 2016

The Hammer And Sickle Versailles - Howard Amos: - Newsweek 08/05/2016 pp 58-60

Hong Kong's bus system – a case of successful private participation - Dorothy Chan: - CILT World Issue10 pp. 19-20

Housing, prices and tax policy in Spain - Miguel-Angel Lopez-Garcia: - Span. Econ. Rev. 6, 29–52 (2004)

How policy change aims to drive higher density development - Colin Marrs: - Planning 18 December 2015

Hybrid Evolutionary Metaheuristics for Concurrent Multi-Objective Design of Urban Road and Public Transit Networks - Elnaz Miandoabchi et al: - Netw Spat Econ (2012) 12:441–480

Immobility and Mobility Seen Through Trip-Based Versus Time-Use Surveys - Jean-Paul Hubert et al: - Transport Reviews, Vol. 28, No. 5, 641–658, September 2008

The Impact of Congestion on Bus Passengers (New extended version) - Professor David Begg - Greener Journeys: - 2016

Importance of user perception in evaluating level of service for bus transit for a developing country like India: a review - Shreya Das et al: - Transport Reviews, 2013 Vol. 33, No. 4, 402–420

Improving routes – Bob Taylor: - Builders Merchants Journal

The Journey of the Green Bus - Low Carbon Vehicle Partnership: - 2015

LA Banks on Buses - Christopher Swope: - American Planning Association May 2006 pp. 32-36

Leadership challenges in the inner city: planning for sustainable regeneration in Birmingham and Barcelona - Austin Barber et al: - Policy Studies Vol. 31, No. 4, July 2010, 393- 411

Les Coûts Des Déplacements Urbains: La Durabilité Du Modèle En Question - Jean-Pierre Orfeuil: - Revue d'Economie Financiere pp. 1-14

Liverpool's decision to suspend bus lanes is 'flawed and data deficient' - : - CILT Focus April 2014 pp. 8

London 2050 (Part 5): Peak Tube - Jonathan Roberts: - London Reconnections, 16 April 2015.

London Congestion Charging - Georgina Santos: - Brookings-Wharton Papers on Urban Affairs: 2008, pp. 177-204

Long Term Planning Process: London and South East Market Study - Network Rail, October 2013

Low-floor bus design preferences of walking aid users during simulated boarding and alighting - Clive D'Souza: - IOS Press 1051-9815/12 © 2012

Manchester City-region may oversee transport – Allister Hayman: - Regeneration & Renewal 21 December 2009 pp. 2

Manchester councils forward city-region authority proposal - Domenic Donatantonio: - Planning 2 April 2010, pp. 4

Manchester moves on central projects – Ben Lee: - Planning, 31 October 2008 pp. 7

A Model for Assessing Federal Livability Principles - Josh Ellis: - Planning December 2011 pp. 4

New Addington Bus Network Review [example of detailed bus route options assessment] - TfL: - July 2014

A New method for determining the population with walking access to transit - S. Biba et al: - International Journal of Geographical Information Science Vol. 24, No. 3, March 2010, 347–364

Not everything called a TOD is really Transit-orientated Development - Adam Millard-Bell: - Viewpoint 2002

The Paris Banlieue: Peripheries of Inequity - Marc Angélil and Cary Siress: - Journal of International Affairs, Spring/Summer 2012, Vol. 65, No. 2. Pp.57-67

Planning Cities For The Future: The Successes And Failures Of Urban Economic Strategies In Europe - Peter Karl Kresl: - Edward Elgar. 2004. 192 pp.

Planning Models for a Bus Rapid Transit System (BRT): The Case of Metrobus in Mexico City - Fernando Lámbarry, Mara Maricela Trujillo & Luis Arturo Rivas: - International Journal of Business and Management; Vol. 8, No. 15; 2013 pp. 130-143

The Planning of headways in urban public transit - A. Grosfeld-Nir and J.H. Bookbinder: - Annals of Operations Research 60(1995) 145 -160

Railway and Spatial Strategies in the South East: Can Coordination and Delivery be achieved? - Tony Bolden & Reg Harman: - Planning, Practice & Research, Vol. 23, No. 3, pp. 303–322, August 2008

Reading Buses – Austin Birkes: - CILT Focus, June 2016 pp. 15

Relationship of Walk Access Distance to Rapid Rail Transit Stations with Personal Characteristics and Station Context - Jinbao Zhao and Wei Deng: - Journal of Urban Planning and Development, December 2013 pp. 311-321

A Review of the Rural Bus - John Hibbs: - CILT Focus May 2003 pp. 61-65

Road Space Reallocation According to Car Congestion Externality - Carlos Alberto, González Guzmán and Francesc Robusté: - Journal of Urban Planning and Development, September 2011 pp. 281-290

A Roadmap to Growth - Greener Journeys: - 2015

Smartcard data for bus network planning - Catherine Seaborn, Nigel H M Wilson and John Attanucci: - CILT Focus November 2009 pp. 24-30

Social stakes of urban renewal: recent French housing policy – Pierre Gilbert: - Building Research & Information (2009) 37(5-6), 638–648

South East Region buses - Bob Mitchell: - CILT Focus June 2015 pp. 66-67

A Spatially Disaggregated Approach to Commuting Efficiency - Michael A. Niedzielski: - Urban Studies, Vol. 43, No. 13, 2485–2502, December 2006

Station draft views sought - Mike Greene: - Planning, 22 August 2008 pp.7

Strategic Spatial Planning in Berlin–Brandenburg: A Requiem for Balanced Development? - Michael R. Murray & William J. V. Neill: - Planning Practice & Research, Vol. 26, No. 1, pp. 107–121, February 2011

TfL upgrades key planning tool to help address London’s future transport challenges - TfL Press Office: - PN-013, 18 January 2017

Towards a general microeconomic model for the operation of public transport - Sergio R. Jara-Díaz and Antonio Gschwender: - Transport Reviews, 2003, VOL. 23, NO. 4, 453–469

Transport Economics and Policy: A Practical Analysis of Performance, Efficiency and Marketing Objectives - John Hibbs: - CILT Focus, September 2003 pp.87-88

Transport for Greater Manchester - Jon Lamonte: - CILT Focus, January 2015 pp. 30-34

Transport for London Business Plan – TfL: - December 2016

Transport Mode Choice by Commuters to Barcelona’s CBD - Javier Asensio: - Urban Studies, Vol. 39, No. 10, 1881–1895, 2002

Travel in London - TfL: - Report 8, 2015, and Report 9, 2016

A Two-Stage Urban Bus Stop Location Model - José Luis Moura & Borja Alonso: - Netw Spat Econ (2012) 12:403–420

UK national, regional and local transport policies in the 21st Century - Paul Fawcett: - CILT Focus, June 2009 pp. 39-42

Urban Development, Redevelopment and Regeneration Encouraged by Transport Infrastructure Projects: The Case Study of 12 European Cities - Aspa Gospodini: - European Planning Studies Vol. 13, No. 7, October 2005 pp. 1083-1084

Using Bus Rapid Transit to Mitigate Emissions of CO2 from Transport - Simon McDonnell, Susana Ferreira and Frank Convery: - Transport Reviews, Vol. 28, No. 6, 735–756, November 2008

The Value of the Bus to Society - KPMG / Institute for Transport Studies at University of Leeds - Greener Journeys: - 2016

Value of Time and Service Quality for Bus Travel in Bangkok: Valuation and Policy Implications - Sittha Jaensirisak, Sumet Ongkittikul: - TDRI Quarterly Review 5, vol.30 no.4 December 2015 pp. 4-12

What is the state of play with London's tram renaissance? - Dr Mark J Gannon: - CILT Focus April 2011, pp. 20-23

What Parameters Influence the Spatial Variations in CO2 Emissions from Road Traffic in Berlin? Implications for Urban Planning to Reduce Anthropogenic CO2 Emissions - Diana Reckien, Maren Ewald, Ottmar Edenhofer and Matthias K. B. Ludeke: - Urban Studies, Vol. 44, No. 2, 339–355, February 2007

White Plains sets mixed-use, pedestrian-friendly vision for transit district – Ryan Deffenbaugh: - WCBJ, December 16 2016 pp. 2

Work Experience - David George: - Regeneration& Renewal, 28 November 2008. pp 22

Working for the benefit of passengers – Jan Woolf: - CILT Focus, August 2004 pp.19

Method of engagement

There was a short timescale for the commission, which was agreed on 15th December 2016. A report was requested for the end of January 2017. Requests for information were sent to World, European and British-based organisations.

Meetings took place with TfL's Head of Network Development-Buses, Chief Executive of Greener Journeys, Policy Director of the Confederation of Passenger Transport, and Chief Executive Officer of the Campaign for Better Transport. Correspondence was received from UITP (large library resource), Urban Transport Group, other UK bus industry and integrated transport authority leaders, Cubic Corporation, and other sources including transport commentators.

Informal meetings and other liaison were held with present and past senior bus industry leaders with experience of London operations. This secured unattributable professional judgments and critiques about how TfL's processes are currently perceived by others familiar with the industry. Their views and comments have been most useful to take on board as part of the report's insights.

Website researches offered other information. London TravelWatch has amassed considerable passenger-focused information on its website; this is available to the Transport Committee and is not repeated here. Similarly, Transport Focus's website is accessible. Greener Journeys has a clear website advocating the strategic importance of bus travel for the purposes of environmental and economic benefit. Urban Transport Group is another useful site. 'MyUITP' is a comprehensive data source. Wikipedia although not wholly reliable was nevertheless a rapid point of access to European city transport and land use planning information.

A visit to the Chartered Institute of Logistics and Transport Knowledge Centre revealed hundreds of possible items of literature and research, and their assistance was invaluable.

JRC is grateful to all who were able to offer information or guidance. Any errors or omissions are down to JRC, not to the individuals and organisations who gave their help and views freely.

Jonathan Roberts, 3rd February 2017

Jonathan Roberts Consulting Ltd
Bridge House
BA4 4TE
07545 641204
jrc@jrc.org.uk
www.jrc.org.uk