BUS CONNECTIVITY

LITERATURE REVIEW
January 2019

We are Living Streets, the charity for everyday walking. Our mission is to achieve a better walking environment and inspire people to walk more.

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Summary

This report reviews the literature on bus connectivity to help Living Streets to develop their Bus Stop Walkability audit. For much of Scotland, both bus patronage and walking levels are falling, but the current decline is more complex than a loss of popularity of either bus travel or walking. Benchmarking with other countries demonstrates substantial potential for growth.

The Scottish decline in bus patronage is three times the average GB decline reflecting changes in Scotland's economy, land use change, and the planning and management of bus services. Bus patronage growth and the success of the towns and cities are inter-dependent. Walking connections to bus may not have been a major factor in the decline of bus use, but they could make a small but important contribution enabling future growth. Door to door integrated transport systems have been a weak area for delivery. There has been no prioritised programme for walking to buses to understand barriers or deliver improvements.

The development of good walking routes to bus stops must consider, bus stop spacing, timetables and routing, the interaction with the local environment, the pedestrian network, land use, urban form, traffic and personal security. Improving one factor may make no difference to door to door travel choices if other factors continue to act as barriers. Factors of particular importance are: bus stop location, pedestrian crossings, high quality lighting, information, surfacing and drainage, shelter/seating, good maintenance, and opportunities for volunteer community adoption of routes.

Well planned development which builds in dependence on higher levels of walking, cycling and bus use has been highly successful. Comprehensive bus improvement programmes by operators and transport authorities, working together in partnership, have been found to deliver short term growth in bus use of up to 50%. Good walking routes to bus stops are relatively less important than travel time and cost factors but can contribute 1-5% of this total.

Technology is improving public transport. Customised, collaborative, local, experiential, and integrated services are set to make combined walk and bus journey much more attractive using new types of sustainable business models. Bus companies and local authorities could benefit from additional support from the community and/or other agencies to deliver effective collaborative solutions for safe routes to buses.

Key components of planning connected bus services are: audit, partnership, planning, community involvement, investment, and promotion, accompanied by monitoring and follow up action maintain high standards. To give bus connectivity higher priority, stronger incentives could be offered for local authorities and private companies to work together in partnership to deliver improvements. Better connections at stops, and using latest technologies, are part of a wider package of measures to change how people experience and perceive bus use in Scotland. Without intervention there is little prospect of reversing existing trends.

Contents

1.0 Introduction

1.1   This project reviews the literature on bus connectivity to help Living Streets to develop their Bus Stop Walkability audit. The review identifies how different factors affect bus patronage, including personal and road safety, physical layout and interchange.

1.2   Planning for bus connectivity, including walking links to bus stops has been recognised as best practice for many years. However, the planning and delivery of these connections has substantial scope for improvement.

1.3   Public expectations and the policy context for integrated service planning are currently changing rapidly. As part of these changes, Living Streets wishes to embed good practice delivering walking and cycling connections to bus stops.

1.4   To enable this programme to build on the existing knowledge base, this literature review considers:

- Chapter 2 - What are the current trends and policy/legislation affecting and influencing the bus sector in Scotland?
- Chapter 3 - What factors influence bus patronage and what is their impact on patronage?
- Chapter 4 - What factors influence transport mode switching, from car use to bus, and what has their impact been on bus patronage? How and why is the walking environment to and from the bus stop important in supporting mode switch from car to bus and increasing bus patronage?
- Chapter 5 - What factors influence interchange with buses (e.g. to or from rail stations)? How does the walking environment influence interchange with buses (e.g. to and from other buses or rail stations), and what has worked to make bus interchange more attractive?

Approach to the work

1.5   The approach has been desk based as follows:

- Review of national statistics.
- Review of industry best practice and design guides.
- Internet searches based on the key words and questions specified in the brief.

1.6   This generated several hundred papers, research reports and project reports which had been used as an evidence base for the above. Key references from these were also reviewed. This generated additional literature trails which were followed through to identify relevant evidence for the focus of this project on walking and cycling connections to buses.

1.7   Research to inform a complex cross-sector problem such as bus connectivity, necessarily draws largely from research findings covering single sectors, modes, and narrower or different programme goals. This is not unusual for research on walking, where there remains no broadly adopted metric about what a walking trip comprises, and how far people need to walk to be counted. Most door to door journeys by bus include short walking trips, many of which are recorded in travel diary surveys, but rarely reported in research findings. A detailed new analysis of the walk stages of bus journeys from the Scottish

Household Survey could potentially yield useful insights, but this would be well beyond the scope of this work. This research instead draws together the literature in different fields, setting data and trends in the context of practice and process, to elicit findings relevant to bus connectivity.

1.8   This literature was then summarised in a draft report in November and December 2018, and subsequently discussed in draft at a meeting with partners in January 2019 before being finalised. These are complex problems requiring collaborative solutions agreed with partners. The findings in this report are intended to frame future delivery where each situation is recognised to be unique, deserving of locally appropriate evidence, design and development.

1.9   The authors are grateful to Living Streets and their partners for their comments, particularly to David Graham at Living Streets who managed the work.

2.0 Trends, Policies and Legislation

Trends in trip patterns

2.1 For much of Scotland, both bus patronage and walking levels are falling, but some places have rising bus patronage and/or increased levels of walking. This indicates that the current decline is more complex than a loss of popularity of either bus travel or walking, reflecting wider changes in lifestyles, employment and expectations.

2.2 Some trends have been particularly marked in Scotland. The decline in bus patronage of 6% over the last year is three times the average GB decline as shown in Figure 2.1[1]. Closer analysis of the very limited regional figures published by Transport Scotland shows that the decline has been concentrated in North East Scotland and Greater Glasgow, two of the areas experiencing the greatest economic restructuring.

Figure 2.1 – Rolling average Bus Passenger Journeys
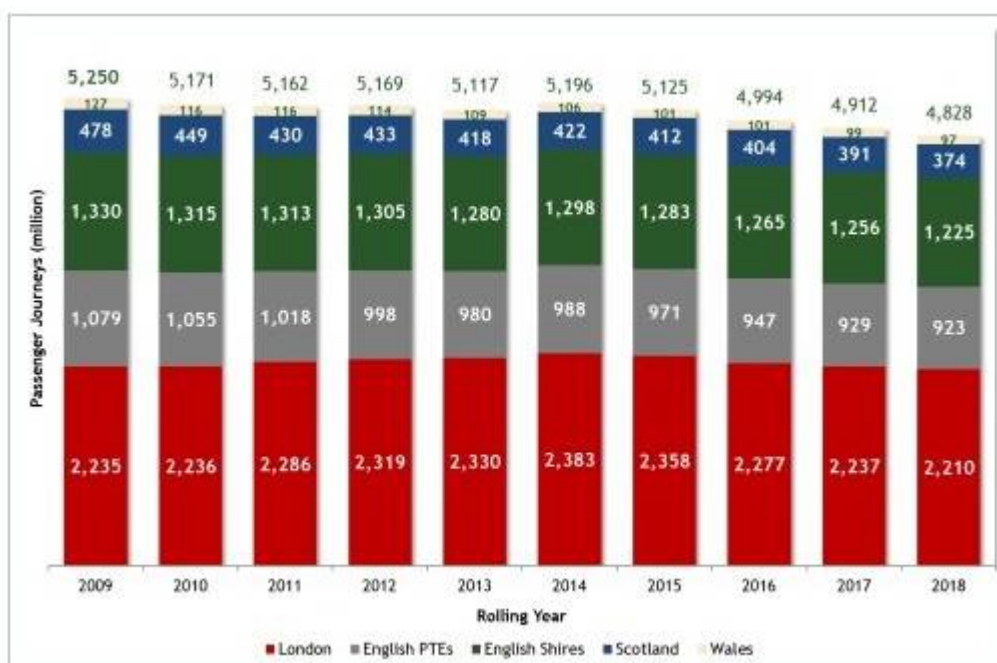
2.3 The total 24% loss of bus passengers in Scotland since the peak achieved in 2008 reflects many changes in Scotland's economy and transport over the last decade[2]. There are many reasons for the fall:

- The economy continues to be weak, with the sectors which are relatively more dependent on bus facing the greatest challenges.
- Online retail sales now make up 17% of total retail spending in 2018, compared with 10% only five years ago. This not only affects bus travel for shopping, but also commuting by bus for employees of retailers.

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[1] The Bus Passenger Monitor, collates and analyses data from bus companies and national statistics
[2] Bus Passenger Monitor 2018 - http://passtrans.co.uk/content/index.php/bus-blog/2202-quarterly-bus-statistics-offer-a-glimmer-of-hope

- High streets away from the major cities are relatively less dependent on rail, and more dependent on bus, and these places also have been declining fastest.
- Small towns have been struggling the most, and a relatively high proportion of Scotland's population lives in small towns[3].
- Bus fare rises in Scotland have been relatively high. The national fare rises for Scotland over the last 5 years of 9.0% are more similar to the 10.4% rises in the English shire counties than the 6.6% seen in the major cities, 3.4% in Wales or even the fall in fares of 2.7% in London[4].
- Changing working patterns have allowed more flexible working from different types of location. Bus is less competitive at serving these patterns than more fixed employment locations[5].

2.4   Bus patronage growth and the success of the towns and cities are inter-dependent[6]. Edinburgh with amongst the strongest economy of any part of Scotland also has the highest level of bus patronage. In Edinburgh 26.3% of the population use buses every day which is nearly three times the national average of 9.7% (Table 2.1)[7].

2.5   Glasgow has a much larger urban rail network than Edinburgh, with 5.8% of the population using trains every day compared to 1.5% in Edinburgh. Combined rail and bus in Glasgow is 7% lower than combined rail and bus in Edinburgh.

Table 2.1 – Daily Bus Use in 2017 by % of population and Scottish Council Area

	Adult (16+) use of buses every day	Bus as main mode of travel to work
Edinburgh, City of	26.3	27.0
Midlothian	15.3	18.6
Glasgow City	15.2	15.8
Dundee City	15.1	16.4
Aberdeen City	11.6	10.3
West Dunbartonshire	10.9	7.0
North Lanarkshire	9.0	6.0
Renfrewshire	9.0	5.8
West Lothian	9.0	7.0
Inverclyde	8.2	7.1
Dumfries & Galloway	7.4	8.0
East Renfrewshire	7.3	1.5
East Lothian	7.2	10.2

[3] Scottish Executive 2001. Rural Accessibility. Central Research Unit
[4] Bus Passenger Monitor 2018 - http://passtrans.co.uk/content/index.php/bus-blog/2202-quarterly-bus-statistics-offer-a-glimmer-of-hope
[5] CPT 2017. Trends in the Scottish Bus Industry.
[6] ITS Leeds 2012. Buses and Economic Growth
[7] Transport and Travel in Scotland 2017 https://www.transport.gov.scot/publication/transport-and-travel-in-scotland-2017/

	Adult (16+) use of buses every day	Bus as main mode of travel to work
Fife	7.1	8.6
North Ayrshire	6.9	10.2
Perth & Kinross	6.7	11.7
South Ayrshire	6.4	6.4
East Dunbartonshire	6.0	1.2
Argyll & Bute	5.7	2.6
East Ayrshire	5.6	8.4
Highland	5.0	8.0
South Lanarkshire	5.0	6.0
Stirling	4.7	2.6
Clackmannanshire	4.2	1.8
Eilean Siar	4.1	7.9
Scottish Borders	3.8	2.1
Angus	3.6	5.2
Falkirk	3.6	4.9
Shetland Islands	2.7	5.3
Aberdeenshire	2.0	1.6
Moray	1.9	1.8
Orkney Islands	1.3	6.4

2.6   Rural areas typically have much lower levels of bus use, but not all rural areas follow these patterns. Council areas with largely rural populations such as Dumfries and Galloway have much higher levels of bus use (7.4% making daily use) than councils with predominantly urban populations such as Falkirk, where only 3.6% of the population make daily bus journeys. The low level of bus use in Falkirk has been explained by the relative competitiveness of journey times, safety and attractiveness of travel by car and bus[8].

2.7   Bus km travelled per head of population in Scotland was 651km in 2015[9] which is:

- Amongst the lowest when comparing 28 EU countries.
- Less than a half the level of bus use in Denmark and Finland, despite these countries also having dispersed populations and a few major cities.
- Only 61% of the average for the EU28 and less than 30% of the countries most reliant on buses.

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[8] Smarter Choices Smarter Places – Final Report https://www.transport.gov.scot/our-approach/active-travel/smarter-choices-smarter-places/#49334
[9] Scottish Transport Statistics 2017 https://www.transport.gov.scot/publication/scottish-transport-statistics-no-36-2017-edition/

2.8   Data on short walking trips is poor[10]. Inconsistency in the way that walking trips have been recorded is particularly problematical when multi-modal trips are involved, such as to bus stops. In the Scottish Household Survey, the convenience of access to public transport is recorded, and 82% of people report access as convenient[11]. Rural residents report access to public transport as less convenient than the average for Scottish residents. People over the age of 40 also find access slightly less convenient (80% compared with 82% finding it convenient). Men and women are equally likely to report access to public transport as being convenient.

2.9   This analysis suggests that the walking connections to bus may not have been a major factor in the decline of bus use. However, it also suggests substantial potential for the bus market in Scotland to grow to levels of bus use more common internationally. Walking and cycling routes to bus stops could be one factor that could help.

Policies for Bus Connectivity

2.10   Connected transport systems, and integrated transport aims, feature strongly in top level policy aims. However, practical programmes for door to door integrated systems have continued to be a weak area for delivery[12]. In Scotland, the main policy drivers for integration since the 2006 national transport strategy, and 2017 strategy refresh, have been information and ticketing projects comprising[13]:

- Customer screens at key rail station and a journey planning app.
- Cycle parking at stations.
- Improved co-ordination of timetables for rail, bus, tram and ferry services
- Saltire cards issued for the National Concessionary Bus Travel Scheme.
- Bus investment funding for interchange construction and enhancement and information at bus stops.

2.11   Detailed planning of bus services, and their interaction with local streets is identified in national strategies as being largely a matter for local government. Local government is also required to form partnerships to tackle joint problems, and to support bus services through:

- The planning system to control the location of developments and the availability and cost of car parking.
- Managing traffic and roads efficiently, and providing and enforcing bus lanes and bus priority at junctions, enabling operators to run services quicker, more reliably and at less cost.
- Providing safe, accessible and attractive bus stops, bus stations and transport hubs.

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[10] Government Office for Science 2018. Walking in the UK Transport System. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766764/WalkingUKtransportsystem.pdf

[11] Transport Scotland 2018. Transport and Travel in Scotland 2017

[12] DfT 2013 Door to Door – A Strategy for Sustainable Transport Integration

[13] Transport Scotland 2016 – Scotland's National Transport Strategy - https://www.transport.gov.scot/our-approach/strategy/national-transport-strategy/

- Working in partnership with operators and Traveline Scotland to ensure there is good access to information about routes, timetables and fares, including in real time.

2.12 Key to the delivery of these programmes is the recognition by operators and authorities that they have a shared interest in, and a positive contribution to make towards, good, cost effective local public transport services. These shared interests have often proved to be insufficient incentives for joint working. Reviews of practice have revealed that mistrust between bus operators and transport authorities is more common than effective partnership working[14]. However, mistrust has been overcome by local authorities which have: taken buses seriously within their planning and budgeting; used their powers effectively; and been clear about what improvements they want to deliver for passengers and communities.

2.13 Walking to rail stations has been promoted through station travel plans, and safe routes to stations projects, across the UK with considerable success[15]. In Scotland, ScotRail's adopt a station programme has generated community action for 275 stations, with improvements to the quality and amenity of many walking and cycling routes to stations, including interchanges with buses[16]. Some authorities have invested in routes to bus stops such as the 2008 Strathclyde Partnership for Transport pilot "safe routes to public transport" projects, covering both bus and rail as discussed in Chapter 4.

2.14 At a national level the Scottish Household Survey[17] identifies that satisfaction with interchange is six percentage points higher in urban areas than in accessible small towns[18].

2.15 The largest national funding programme in Scotland for cycling and walking links has been the grant funding from Transport Scotland to Sustrans to deliver the 'community links' programme. This includes routes to town centres and railway stations[19]. Many paths also connect bus routes, but connections to bus services are not specifically identified in the programme aims. Different road uses are often competing for limited road space.

2.16 Investment to integrate walking routes with bus stops is delivered within: roads and streetscape investment, development planning/regeneration, transport integration investment programmes, and active travel investment. However, none of the performance monitoring of the effectiveness of these programmes

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[14] Campaign for Better Transport 2017. Three Stages to Better Bus Services.
https://bettertransport.org.uk/sites/default/files/pdfs/bus-services-act-guidance.pdf
[15] Rail Safety and Standards Board (2012) - *Evaluation of the pilot programme of Station Travel Plans*
https://www.rssb.co.uk/library/research-development-and-innovation/research-brief-T918.pdf
[16] https://pureportal.strath.ac.uk/files-asset/12382977/str54.pdf
[17] Transport Scotland 2018 Transport and Travel in Scotland 2017 - Scottish Household Survey Local Authority results.
[18] 76% of the population of urban areas agree with the statement about bus transport that "it is easy to change with other modes of transport" whereas only 70% of the population agreed with this statement in accessible small towns. In rural small towns 73% of the population agreed with the statement.
[19] Sustrans 2018 – Community Links
https://www.sustrans.org.uk/sites/default/files/file_content_type/03.08.18_cl_portfolio_web.pdf

focuses on routes to bus stops. As a result, other programmes with measured outputs and outcomes gain higher priority for funding[20].

People, Places and Connections

2.17   Recent analysis (Figure 2.3)[21] suggests that over 50% of change in bus patronage can be explained by the changing transport needs, which have resulted from changes to socio-demographics, changes in household car ownership, changes to economic and labour market structures, and changes to the availability of alternatives to transport such as digital connections. The remainder of the change in bus patronage can be explained by changes to the price, quality and availability of alternative transport modes.

Figure 2.3 - Factors Affecting Bus Patronage
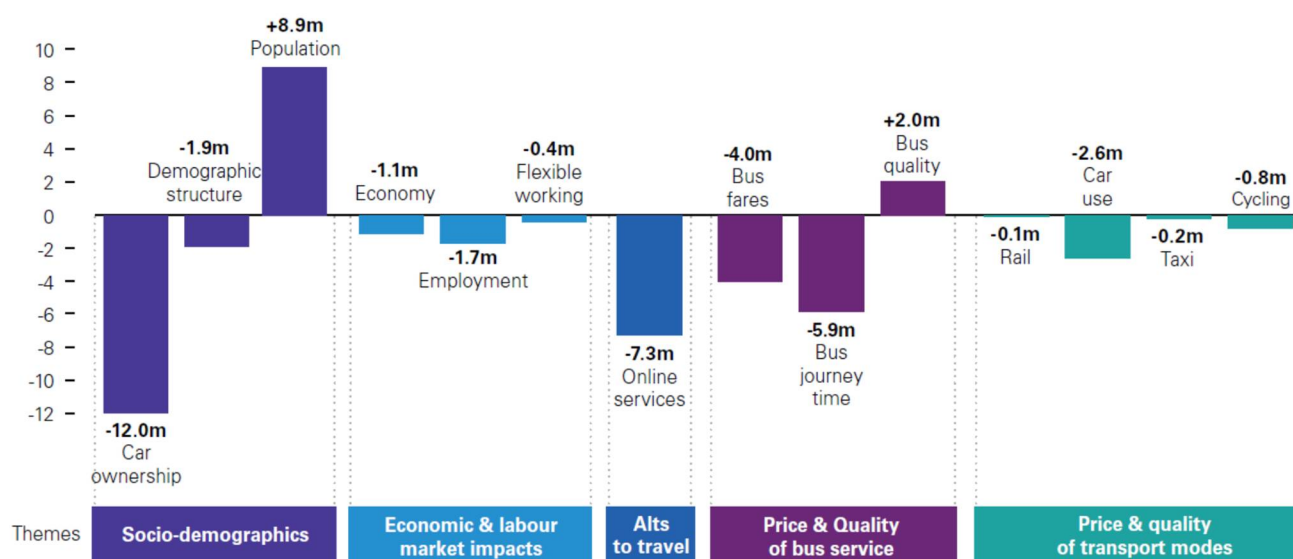
2.18   The role of connected bus services in helping to support the vitality of Scotland's places is measured in local town audits through: accessibility, local service quality, and indicators of quality and impression of place[22]. The local performance of walking and bus routes is scored in terms of: the quality and availability of well-maintained safe walking routes with clear signing to local services and transport interchanges, good lighting, and attractive street furniture. Clutter on streets in town centres negatively affects viability including poorly located bus shelters, but well-located attractive seating including at bus stops are considered to positively integrate bus services into local places.

Digital and Physical Opportunities

2.19   Travel patterns and behaviour are changing. Over the last 20 years data from the national travel survey shows that people have reduced the number of trips

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[20] HM Treasury, Cabinet Office, National Audit Office,Audit Commission, Office For National Statistics – A Framework for National Performance Information https://www.nao.org.uk/wp-content/uploads/2013/02/fabric.pdf
[21] CPT 2017. Trends in the Scottish Bus Industry Final report by KPMG.
[22] Scotland's Towns Partnership 2017. USP Your Town Audit Manual. This draws from research reports on the relationship between the many factors that affect town vitality.

they make by 16%[23]. They travel 10% fewer miles than they did in 2002 and spend 22 hours less travelling than they did in 2008. These changes are in large part due to the ways the economy and society are evolving as a result of technological change. The rate of change is accelerating, and there is a wide variance in the projections of future travel demand. As highlighted in paragraph 2.11, many of the key variables that affect travel demand can be influenced by transport authorities. These include the digital information systems to inform, plan, guide and manage travel demand.

2.20   Managing door to door transport using technologies that use relevant and timely information to integrate modes, ticketing and feedback based on customer preferences, have not yet been deployed at a scale which permits reliable research conclusions. However early examples of such approaches report the ability to substantially influence travel behaviour. This relates particularly to parking, but also bus use by people who had not travelled on buses for decades, and walking with more people choosing active travel[24].

2.21   The way people spend their travel time is evolving[25] as a result of technology changes. The new technologies enable new types of activities to be undertaken whilst on the move, or from remoter locations leading to more travel. However, there have also been changes that can reduce the needs to travel, such as the increase in the proportion of people who mainly work from home from 10.6% in 2011 to 14.1% in 2015[26]. Homeworking does not necessarily lead to less travel. Substitution of online connections for physical travel can alter journey types and travel patterns, particularly in lower density locations with limited local services[27]. Building technology into new lifestyle choices is also an opportunity for growth in all modes of travel including walking, cycling and bus use.

2.22   Figure 2.4[28] shows that these trends are likely to continue to affect buses in the short and longer term. Of particular note is that the strongest short-term driver of demand for more bus travel will come from better integration between modes of travel.

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[23] The Future of Travel demand and the Implications for Policy and Planning. 2018
http://www.demand.ac.uk/wp-content/uploads/2018/04/FutureTravel_report_final.pdf
[24] Customer Relationships in Shopper Travel Behaviour – Final Report 2011
http://www.loopconnections.org.uk/wp-content/uploads/WiganPlus.pdf
[25] Lyons, G., Jain, J., and Holley, D. (2007). The use of travel time by rail passengers in Great Britain. Transp. Res. Part Policy Pract. 41, 107–120
[26] Scottish Household Survey http://www.gov.scot/Topics/Statistics/16002
[27] Scottish Executive 2006. Scoping study to assess the implications of E-working and other ICTs on travel behaviour and traffic reduction in Scotland https://www2.gov.scot/Publications/2006/05/23112408/0
[28] CPT 2017. Trends in the Scottish Bus Industry Final report by KPMG

Figure 2.4 – Trends Affecting Bus Patronage in Scotland

	Demand driver	Near term outlook (under business as usual)		Longer term outlook	
Transport Needs	Socio-demographic	Bigger and older population with increased car ownership	🔴	Greater sharing of assets leading to reduced car ownership	🟢
	Economic & labour market	Increased levels of self-employment, flexible contracts and multi-site working	🟡	Potentially large disruption to labour markets with continued increased flexibility in work and work location	🔴
	Alternatives to travel	Increased use of online services and e-commerce	🔴	Increased use of online services and e-commerce	🔴
Transport Choices	Price & quality of transport modes	Modest improvements to the attractiveness of rail, cycling and ride-hailing services	🔴	Transformation of the vehicle market and reform of vehicle charging mechanisms reflecting marginal costs	🟢
	Integration between modes	Increased use of technology to integrate modes, increased flexibility in demand responsive services	🟢	Increased use of technology to integrate modes, increased flexibility in demand responsive services	🟢
	Government policy & expenditure	Continued pressure on resources for revenue and capital expenditure	🟡	Uncertainty surrounding longer term policy	🟡

🔴 Negative 🟢 Positive 🟡 Uncertain

2.23 Technology is increasingly enabling transport providers to plan walking to bus stops better by tracking journeys in real time. Combined walk and bus journey times have been used as a metric to plan bus stop locations. In some cities spacing bus stops above 450 metres can increase walking times to bus stops more than the in-vehicle travel time savings from fewer bus stops[29]. New companies are emerging to use these analytics to support better door to door planning by operators and public authorities[30].

2.24 The UK public transport watchdog Transport Focus has suggested that technology will improve public transport in eight main ways. All of these improve the links between local active travel and the bus network, as shown in Figure 2.5[31]. Customised, collaborative, local, experiential, and integrated services are set to make combined walk and bus journey much more attractive using new types of sustainable business models[32] .

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[29] LI, Q., KOH, W. P. & LIANG, Y. R. 2017. A Data Analytic Approach to Monitor Citywide Bus Journey Speed Using Smartcard and GPS Location Data: A Case Study in Singapore. Intelligent Transport Systems World Congress 2017 (29 Oct - 2 Nov). Montreal, Canada

[30] https://techcrunch.com/2016/02/18/swyft-aims-to-be-the-waze-for-sfs-dysfunctional-public-transit-system/

[31] Transport Focus: The world around me – macro factors of change; www.transportfocus.org.uk/key-issues/future-of-transport/the-world-around-me,

[32] Transport Systems Catapult. Travel needs and UK Capability Study. https://ts.catapult.org.uk/wp-content/uploads/2016/04/Traveller-Needs-Study.pdf

Figure 2.5 – How Technology Can Improve Public Transport

Characteristic	Outcome
Customised and flowing experience	More bespoke and individualised information and services; easy to find out about and to use
Collaborative travel	Users work with providers; peer to peer advice and assistance; incentives and rewards
Useful mobility	Public transport infrastructure and journeys valuable for productive activity
Going local	More frequent local journeys; transport hubs more integrated with surroundings
Considered and constrained travellers	Fewer and shorter journeys, possibly more suited to public transport
Public transport as app	Technology an ally with transport (information, on demand, feedback)
Emotional journeys	Pre-journey as important as journey, ensuring people's moods are safeguarded
Public and private transport mash up	Journeys not modes; less 'ownership' of transport; mix of private and public transport; spectrum of options with seamless transfer

3.0 Planning and Influencing Bus Travel Demand

Planning and Connections

3.1 Current bus travel demand is a function of long-term network planning and delivery[33]. The current growth and decline of bus services in the UK partly reflects the history of service planning, development and investment. Integrated service delivery with effective partnership working between operators and public authorities is complex. Some estimates suggest that less than 10% of UK bus services have achieved their potential, leaving substantial scope for improvement[34].

3.2 Bus service planning guidance suggests inclusive and collaborative approaches with[35]:

- Appropriate coverage to ensure bus services can be accessed easily by walking
- Direct comprehensible bus routes that achieve competitive journey speeds using bus priority lanes in congested locations.
- Routes serving locations where the volume of people travelling merits high capacity road vehicles rather than demand responsive services such as shared taxis.
- Optimised interchange to achieve competitive door to door journey speeds whilst recognising interchange penalties
- Helpful timely information systems that tell customers what they need to know
- Efficient ticketing and payment for travel to ensure competitive pricing.
- High quality and comfortable vehicles
- Effective management of safety and security door to door.

3.3 Figure 3.1 shows an example of good practice, where attractive walking routes to well-planned bus services include high quality bus stops with real time information.

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[33] Scottish Executive - An Action Plan for Buses https://www2.gov.scot/Resource/Doc/157450/0042432.pdf

[34] Roger French was Managing Director of what is often regarded as the UK's best bus company for 18 years and wrote a critical review of the industry on his retirement http://www.passengertransport.co.uk/2013/11/roger-frenchs-horror-file-of-bus-photographs/.

[35] Public Transport, its planning, management and operation' (5th Edition); Peter White 2009. Routledge. Principles of Bus Service Planning. Alan Howes http://stsg.org/principles-of-bus-service-planning,

Figure 3.1 – Bus Stop in Dundee City[36]

3.4 Walking distances to bus stops are the factor most commonly considered in these bus planning guides[37], but a combined approach to transit orientated land use and transport development is also a key part of good development planning practice[38]. Places benefitting from land used development increasingly adopt the national guidance to identify safe walking routes to bus stops, including the bus connections to ensure good access to opportunities.

3.5 Demand is a function of both need and provision. When development and transport are planned together, combined bus and rail use are much greater. High public transport use is also associated with more walking and cycling[39]. Some estimates suggest that bus and rail use can be 45-50% higher when local land uses, and the associated walking and cycling infrastructure, are well integrated.

3.6 A range of effects on patronage from planning and implementation of bus quality partnerships of between -25% and 50% is observed from comparisons between bus services in the UK.

3.7 In the worst-case scenario bus operators make minimal improvements in routes, bus stop facilities, information and services letting patronage decline by up to a quarter. The best-case scenario involves effective planning of bus

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[36] Scottish Executive 2006. Improved Public Transport for Disabled People.
https://www2.gov.scot/Publications/2006/05/16145515/10

[37] How far do people walk to catch a bus? https://www.wyg.com/uploads/files/news/WYG_how-far-do-people-walk.pdf

[38] Scots. National Roads Development Guide. http://www.scotsnet.org.uk/documents/national-roads-development-guide.pdf

[39] Litman, Todd. 2010. Evaluating Public Transportation Health Benefits. Victoria Transport Policy Institute (VTPI).
https://www.apta.com/resources/reportsandpublications/Documents/APTA_Health_Benefits_Litman.pdf

routes, stops and facilities using bus quality partnerships[40] to achieve bus patronage improvements of up to a half the baseline level[41].

3.8   When packaging action to improve services, the various components can be difficult to untangle. Time and cost of journeys are most important, followed by reliability of service provision. Other factors have relatively lower effects but good walking routes with bright street lighting have been identified as being important[42]. Cause and effect are often related. People who depend on good bus routes choose to live nearer to them. Higher levels of bus dependence by people who live in locations with good access by bus, may be largely a function of personal choice, so the precise impact of high-quality walking routes is not clear.   Perhaps a more useful perspective on this challenge is that development which builds in dependence on higher levels of walking, cycling and bus use will the increases being sought[43].

3.9   Currently, Scotland falls well behind other countries in delivering places conducive to high levels of walking, cycling and bus use. Current travel patterns largely reflect the socio-demographic characteristics and economic geography of the country[44]. Progress implementing the principles of Designing Streets has been slow and many developments do not yet match the aspirations of these policies[45]. In the latest international comparisons, people in Scotland travel about 1420 km per head each year by bus and rail combined, compared with 2425 in Denmark, 2600 in Sweden and 1300km in the Netherlands (where there are 848km cycled per head)[46].

Investment and Incentives

3.10   Delivering better planned and connected systems requires investment and incentives that support these goals. Current public and private investment and incentives are defined more narrowly than is desirable[47]. However, this is changing as the balance of transport spending shifts towards placemaking and

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[40] E.g. Hitrans 2014. East Inverness Bus Investment Fund Project included improved bus stops and shelters, information displays, real-time information, bus priority wifi on buses and at interchanges.

[41] AECOM 2009 The Role of Soft Measures in Influencing Patronage Growth and Modal Split in the Bus Market in England Final Report. Department for Transport quoting results from a review of bus quality partnerships by TAS.

[42] Robert Cervero (2007), "Transit Oriented Development's Ridership Bonus: A Product Of Self Selection And Public Policies," Environment and Planning, Vol. A, No. 39, pp. 2068-2085; https://pdfs.semanticscholar.org/1544/b10809eba6fc48ad681fb1aa4aac7f10a812.pdf

[43] Designing Streets. https://www.gov.scot/binaries/content/documents/govscot/publications/publication/2010/03/designing-streets-policy-statement-scotland/documents/0096540-pdf/0096540-pdf/govscot%3Adocument

[44] RAC Foundation 2013 – On the Move. https://www.racfoundation.org/wp-content/uploads/2017/11/on_the_move_scotland-latinopoulos_et_al-jun2013.pdf

[45] Scottish Government 2013 – Implementation of Designing Streets 2013 https://www.gov.scot/publications/implementation-of-designing-streets-policy-research-report/

[46] Transport and Travel in Scotland 2017.

[47] Strategic Infrastructure planning. International best Practice. https://www.nic.org.uk/wp-content/uploads/Strategic-Infrastructure-FINAL-for-web_v2.pdf

access to opportunity. Traditionally transport funding was allocated predominantly by transport mode and service[48].

3.11   Investment in transport is very difficult to measure. As a derived demand, most spending is by non-transport sectors on things like new roads for developments, services paid for by retail, leisure, health, education and other service providers, and by consumers and businesses and consumers purchasing transport such as retail home delivery. Indirect spending on transport has been increasing relative to direct spending, including large integrated government funds such as city deals[49].

3.12   There are good examples where growth in bus use have been achieved through investment by operators and transport authorities working together[50]. However, buses have been less glamorous public transport than rail-based solutions. At a time when investment is more constrained than for many years, development and growth funding increasingly dominates investment. Growing cities like Leeds have prioritised bus stop infrastructure, information and facilities in its city public transport investment plan. Although Scottish cities have invested in bus improvements none of new integrated investment funds such as the Scottish city deals, have yet prioritised flagship bus projects, although other transport investment features heavily, such as roads around Inverness.

3.13   Integrating buses into major trip attractors has been highly successful in attracting and maintaining investment from development[51]. However, it remains more common for development to fund road and railway infrastructure than bus improvements. This often occurs due to focus on capital investment within development funding and the relatively low infrastructure costs for buses.

3.14   There are consistent learning points about what needs to change to support more bus use and related walking. This requires stronger incentives for[52]:

- Local authorities and private companies to work more in partnership.
- Performance improvements to be related to the needs of market development and economic growth.
- Use new technologies, including apps and smart ticketing, to improve services.
- Reflect modern lifestyles, land use patterns and travel needs when planning transport networks and services.
- Long-term, ring-fenced public funding.

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[48] http://stsg.org/connecting-scotland-new-ways-to-fund-better-transport

[49] https://www.gov.scot/policies/cities-regions/city-region-deals/

[50] Greener Journeys 2018. Bus Infrastructure Investment

[51] 3.8 million bus users interchange at Gatehead metrocentre, and Dudley Merry Hill shopping centre has also become the major public transport hub in that part of the West Midlands BCSC 2006. Access, Information and Flexibility. The Future of Retail Transport.

[52] CPT 2018 The Health of the Bus Market - http://www.cpt-uk.org//_uploads/attachment/4677.pdf
Campaign for Better Transport - https://bettertransport.org.uk/sites/default/files/research-files/Buses-in-Crisis-2018_0.pdf, Transform Scotland http://transformscotland.org.uk/wp-content/uploads/2017/12/Local-Bus-Services-in-Scotland-Transform-Scotland-response-2017-12-05.pdf

- Employ a wider range of transport operators and types of services, including private buses and taxis; community transport; school and health service transport; and car share schemes[53].

3.15 These proposals are not new[54] but the current decline of bus patronage could introduce a new level of urgency to the need for change[55].

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[53] E.g. In the Aberdeen City and Aberdeenshire 2014 public transport strategy community transport, taxi and bus networks are designed and planned to connect through high quality interchanges
https://www.aberdeenshire.gov.uk/media/7991/passengertransportstrategy.pdf
[54] Scottish Executive 2003. Barriers to Modal Shift. Central Research Unit
[55] CPT 2017. Trends in the Scottish Bus Industry Final report by KPMG

4.0 Door to Door Journey Opportunities

Factors affecting journey quality

4.1 Private travel by car is usually door to door. Other travel options could become more competitive with car travel if they were also offered door to door, including four key elements that together affect the quality of the overall journey[56]:

- Information - Accurate, accessible and reliable information about the different transport options for their journeys.
- Payment and accountability - Convenient and affordable tickets, for an entire journey.
- Connectivity - Regular and straightforward connections at all stages of the journey and between different modes of transport; and
- Infrastructure and facilities - Safe, comfortable transport services and facilities.

4.2 Performance measures to assess the effectiveness of door to door services have been defined in terms of seven main categories as summarised in Table 4.1[57].

Table 4.1 – Quality of Door to Door Journeys

Factor	Measure
Time factors	• Travel time including walk access time, wait time, and in vehicle time • Scheduling of activities and scheduling of transport services by time of day • Time budgets available to each population group for each trip type
Cost factors	• Public transport fares • Affordability for the people concerned
Capacity	• The capacity of buses, trains and other vehicles to accommodate travel at the desired time
Information and booking	• Information availability from which to plan journey • Time spent planning and booking journey • Availability of information during journey • Convenience of purchasing and ticketing options
Reliability	• Uncertainty about journey times • Uncertainty about journey quality e.g. availability of a seat
Security	• Real and perceived safety accessing PT • Real and perceived in vehicle safety
Attractiveness	• Comfort of waiting areas and vehicles • Attractiveness of walking routes to access PT • Assistance and helpfulness of staff • Support services when travelling e.g. catering

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[56] DfT 2013 – Door to Door Strategy

[57] DfT 2003 – Making the Connections https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_policy/---invest/documents/publication/wcms_asist_8210.pdf

DfT 20904 - Guidance on Accessibility Planning- http://dhc1.co.uk/content/accessibility_developing.pdf

4.3   Although these factors are presented separately, it should be noted that for an attractive door to door journey all factors must be accepted by any traveller considering alternative journey options. Improving already good vehicles makes no difference to the attractiveness of door to door travel if other factors act as barriers to travel[58].

4.4   Many trips involve a combination of several modes. Accountability for customer service, from door to door, must be led by a single organisation, retailing the trip and acting on a traveller's behalf to ensure that high standards are achieved throughout the journey[59].

Understanding What Makes a Good Route to a Bus Stop

4.5   Good walking routes to bus stops must account for a wide range of factors. These have been classified in terms of: the interaction with the environment, the pedestrian network, land use, urban form[60], traffic and personal security[61]. Ways of considering each effect are reviewed in Table 4.1 including findings of research suggesting how each element can be assessed.

Table 4.1 – Factors Affecting the Attractiveness of Walking Routes

Factor	Definition	Assessment
Pedestrian environment	• Surface evenness/condition/tactile signals • Footpath width • Gradient, ramps, steps, handrails • Guard rails, street furniture, obstructions • Benches, meeting points, toilets • Road crossings - carriageway width, crossing placement, type (e.g. zebra, pelican, at grade traffic signal, subway) • Drainage and potential for splashing from adjacent roads • Cleanliness/litter/dog fouling/graffiti	• Made in relation to the target group of people. • Surface cracks can be a problem for people with a physical or visual • Impairment. • Gradients and ramps affect every age group differently. • Zebra crossings prioritise pedestrians but some vulnerable pedestrians have concerns about these.
Pedestrian network	• Connectivity and continuity of paths • Frequency of road crossings • Desire lines and sight lines	• Attractive walking routes have better sight lines and fewer discontinuities
Urban form	• Adjacent land uses and visibility of paths from buildings • Functionality of footpaths for local social and economic activities • Human scale, legibility and sense of place • Car dominance	• More use of public space encourages more walking journeys • Quantity of land given over to car traffic and the priority given to car movement

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[58] Scottish Executive 2003. Barriers to Modal Shift.

[59] Transport Focus: The world around me – macro factors of change; www.transportfocus.org.uk/key-issues/future-of-transport/the-world-around-me

[60] Handy, Susan, K. Butler, and R.G. Paterson. 2003. Planning for Street Connectivity – Getting from Here to There. Chicago: American Planning Association.

[61] ITS Leeds 2004 - A Review of Factors that Affect Pedestrian use of Streets
http://eprints.whiterose.ac.uk/2337/1/ITS_WP581_uploadable.pdf

Factor	Definition	Assessment
Land use	• Location of services, • Street layout and distances	•
Traffic	• Volume, speed, and composition of vehicles • Noise, emissions/air quality • Traffic response to pedestrian activity including sharing road space	• Numbers of vehicles including goods vehicles • Vehicle speeds • Space between vehicles and walking routes
Safety and Security	• Danger of road accidents • Interaction with other users • Personal security and prevalence of intimidating behaviour	• Record of road accidents • Perceptions of safety by walkers

4.6　These interactions are related. Various assessment methods have been developed which seek to combine selected factors including the attractiveness of environments as places to live and work[62].

4.7　When considering specifically the needs of people walking or cycling to catch buses, factors that emerge as being or particular importance are[63]:

- Locating bus stops in more attractive locations with defensible space closer to the catchment populations.
- Providing pedestrian crossings on direct routes to bus stops since many current crossing points are designing around other pedestrian desire lines.
- High quality lighting including for streets, shelters, and the information with maps and timetables.
- Providing information about the walking and cycling routes at bus stops and shelters, signing local trip attractors.
- Ensuring suitable surface treatment, including drainage, tactile surfaces, and kerbs to ensure safe use on all weathers.
- Shelters and seating to make access more pleasant and comfortable.
- Regular maintenance of vegetation on routes including opportunities for volunteer community adoption and management to support local 'ownership' of the routes.

4.8　The main focus for bus operators is successful operation of buses, rather than how people travel to stops and stations. These companies currently lack the organisational networks to lead the solutions, so planning safe routes to buses requires additional support from the community and/or other agencies. Key components of planning safe routes are: audit, partnership, planning, community involvement, investment, and promotion, with monitoring and continuing action to tackle issues as they arise and secure effective delivery.

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[62] Living Streets 2012 – Making the case for Investment in the Walking Environment.
https://www.livingstreets.org.uk/media/1394/2011-making-the-case-full-report.pdf
Walkscore https://www.walkscore.com/
[63] SPT 2009. Safer Routes to Public Transport. Final Report.

5.0   What Makes Attractive Interchanges?

The deterrent effect of changing mode

5.1   The demand for bus travel is sometimes estimated using government appraisal methods[64]. These approaches consider the attractiveness of each stage of the journey, including interchanging including the quality of services and facilities at interchanges as follows:

- The access time (from trip origin to PT stop).
- The egress time (from PT stop to trip destination).
- Transfer time (between PT stops).
- Origin wait time (time spent waiting for first service on path).
- Transfer wait time (time spent waiting for subsequent services).
- In vehicle time (weighting may vary by mode/vehicle type)
- The journey fare.
- Transfer penalty (based on number of transfers times a fixed penalty, possibly differentiating between different transfer types).
- Distance.
- Overcrowding.
- Quality of service and facilities at interchanges.

5.2   For access, egress and transfer time, the value of the walk time is recommended at between 1.5 to 2 times actual walk time, depending on the quality of the paths[65]. Transfer wait times are 1.5 to 2.5 times the wait time depending on the quality of the waiting facilities. In addition, transfer penalties are suggested of between 5 and 10 minutes to reflect the inconvenience of getting off one vehicle and on another.

5.3   Value of travel time concepts are widely contested[66] including observations that often walk value of times are over-estimated. This can occur for many reasons, particularly the need for more robust behavioural segmentation of the traveller characteristics in the analysis. Recent stated preference surveys for access to bus and rail suggested that the relative costs of cycle access were: €0.11 per minute cycling time including parking the cycle, €0.08 per minute rail journey time, and €0.60 per transfer[67]. These values are broadly consistent with the values in the government guidance.

5.4   The theoretical and practical methods for valuing travel time are currently being reviewed to take account of emerging door to door integrated service offers,

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[64] DfT Web- Tag Unit M3.2 – Public Transport Assignment Modelling
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/427126/webtag-tag-unit-m3-2-public-transport-assignment-modelling.pdf
[65] Mackie, P.J., Wadman, M., Fowkes, A.S., Whelan, G., Nellthorp, J., and Bates, J. (2003) Values of Travel Time Savings UK. Institute of Transport Studies, University of Leeds, Working Paper 567
http://eprints.whiterose.ac.uk/2079/2/Value_of_travel_time_savings_in_the_UK_protected.pdf
[66] Mackie P 2008. Who knows Where the Time Goes?
https://www.tandfonline.com/doi/abs/10.1080/01441640802535870
[67] T.S. Leferink J.F.P. van Mil, J.A. Annema, N. van Oort 2018 Cycling as access and egress mode of public transport: what are the factors affecting the combination? ETC Dublin

and more autonomous vehicle operation, where in-vehicle time can be used differently[68].

5.5   It is likely that as the boundaries between modes become more blurred within door to door service delivery, values of travel time will increasingly converge. Innovative door to door services using technology to plan and manage passenger pick up and drop of in real time have been growing rapidly. This contrasts with the low take up to date of services that combine different modes of transport[69]. This may suggest that the substantial interchange penalties suggested in value of time studies will continue to apply.

5.6   The relative effect of measures to improve bus to bus interchange are shown in Table 5.1[70]. Car users appear to be more attracted to bus travel by ticketing, safety and newer buses than better interchange facilities.

Table 5.1 – The Value of Bus Quality Improvements

Interventions as Savings in Generalised Minutes[71]		
Measure	Bus Users	Car Users
Stops and interchanges		
CCTV at Bus Stops	3.70	2.49
Real time passenger information at bus stops	1.47	1.74
New Interchange Facilities	1.27	
New Bus Shelters	1.08	
On bus		
Trained Drivers	2.46	2.78
CCTV on Buses	1.66	3.18
New Bus	1.19	2.23
On-Screen Displays	1.90	0.89
Simplified Ticketing	0.84	2.06

5.7   Bus to bus interchange only becomes popular where bus frequencies are 10 minutes or better[72]. On these frequent routes, people tend to choose stops with better shelter and information. However, these factors are of much lower importance than bus frequency when influencing interchange. High quality safe interchange facilities with seating, information and other amenities have been

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[68] ITS University of Leeds for DfT 2018 - Programme for maintaining a robust valuation of travel time savings https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716492/scoping-study-on-updating-values-of-travel-time-savings-phase-1.pdf

[69] Despite a large promotional effort by the Finish government over more than a year MaaS has not yet reached 0.5% of public transport journeys. This contrasts with competing single mode technology services such as BlaBlaCar, Lyft and Uber which now provide between 25% and 50% of shared transport trips in leading cities. https://www.citylab.com/perspective/2018/10/helsinkis-maas-app-whim-is-it-really-mobilitys-great-hope/573841/

[70] AECOM 2009 The Role of Soft Measures in Influencing Patronage Growth and Modal Split in the Bus Market in England Final Report. Department for Transport

[71] DfT TAG Data Book Table M3.2.1 https://www.gov.uk/government/publications/tag-data-book

[72] Currie, G., Loader, C., 2010. Bus network planning for transfers and the network effect in Melbourne, Australia. Transportation Research Record 2145, 8-17. https://journals.sagepub.com/doi/10.3141/2145-02

observed to reduce interchange penalties by up to 25%, consistent with the DfT recommended values.

5.8   In practice, average values can be less important than local factors. As discussed in Chapters 2 and 3, transport operators and authorities working in partnership can deliver much larger increases in patronage than would be suggested by the analysis of generalised travel times and costs. Bus networks evolve incrementally, with routes and times changing in line with demand. Effective programmes invest in the facilities and services that matter most to local customers, including routes to bus stops and interchanges[73].

5.9   Stated preference surveys for rail passengers have often suggested that the value for passengers of improvements to stations are over-estimated[74]. However, recent work used revealed preferences from ticket sales to calibrate the scale of the over-estimation for rail passenger demand forecasting purposes[75]. This found that the stated preference surveys estimated the effects of improved facilities at three times the level found in the ticket sales data. In the absence of comparable stated preference data for bus, it is of note that the improvements to facilities calibrated in this way yielded valuations for improvements as follows:

- 13% of fare value by improving facilities from stairs only to stairs plus lifts and escalators.
- 10% of fare value with improvements from poor intermittent Wi-Fi to continuous Wi-Fi.
- 3% of fare value from improving build quality from poor-quality ambience/architecture to well-designed with featured ambience/architecture.
- 3% of fare value from basic connection between bus and rail station to high quality connection.
- 6% of fare value improving seating from basic facilities to comfortable heated waiting areas.

5.10   Bus fare elasticities are sensitive to local markets, and generally lower than for rail[76], Assuming an average elasticity of -0.4, the expected uplift in passenger demand from improved interchange with rail could be of the order of 1-3%.

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[73] Public Transport, its planning, management and operation' (5th Edition); Peter White 2009. Routledge. Principles of Bus Service Planning.

[74] University of Southampton, Accent and ITS Leeds (2008) Effects of Station Enhancements on Rail Demand, Passenger Demand Forecasting Council, London.
TS Leeds and University of Huddersfield (2012) Evaluating Measures to Improve Personal Security and the Value of their Benefits Rail Safety and Standards Board, London
Steer Davies Gleave (2005) Valuations of Station Facilities Greater Manchester Passenger Transport Executive, Manchester

[75] The Valuation and Demand Impacts of Improvements to Railway Stations 2018 - Rafael Maldonado-Hinarejos, Mark Wardman, Phillip Wheat, Alexander Stead, Jeremy Shires, Tony Magee, Nigel G Harris

[76] N Paulley, TRL; R Mackett, CTS, University College London; J Preston, TSU, University of Oxford; M Wardman, ITS, University of Leeds; P White, TRG, University of Westminster, UK

Walking within transport interchanges

5.11   Best practice for interchange suggests that three main types of space are needed[77]: decision spaces, movement spaces and opportunity spaces. The key features of successful interchanges are: that they should be accessible for all; people should feel safe and secure; information should be clear and unambiguous; they should be pleasant places of a form consistent with the local urban realm and sense of place; and movement space should enable efficient flows of large numbers of people.

5.12   At large rail to bus interchanges designs commonly assume that people will walk up to 1200 metres, but for smaller stations up to 400 metres is more common[78].

5.13   Much of the evidence on the effects of investing in bus to rail interchanges has been observed as part of larger projects, that include changes to the frequency and routing of bus services, in addition to walking and cycling access between services. However, one recent case study for Mansefield interchange improvements delivered a 7% increase in bus patronage largely from improved walking routes between the bus station and the town centre, and a pedestrian bridge to the train station. Of the 7% increase in bus patronage in the first year after opening, 2% of the trips were interchanging with trains[79].

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[77] https://wricitieshub.org/sites/default/files/pdf_7.pdf

[78] Interchange times sampled from the database of platform to platform journey times at http://www.nationalrail.co.uk/stations_destinations/default.aspx and the data on bus connections

[79] An economic evaluation of local bus infrastructure schemes 2015. Greener Journeys https://greenerjourneys.com/publication/an-economic-evaluation-of-local-bus-infrastructure-schemes/

6.0   Conclusions

6.1   The decline in bus patronage in Scotland of 6% over the last year is three times the average GB decline, and is primarily related to the changes in Scotland's economy, changing lifestyles and the policy and planning framework. There is potential for substantial bus market growth to achieve levels of bus use more common internationally.

6.2   Planning of walking and cycling routes to bus stops is a key part of land use development planning, but has been given little attention within transport investment. Within recent transport investment, competition for road space has been challenging, and designers have struggled to give both bus passengers and cyclists levels of priority that improves bus connectivity.

6.3   Technology is improving public transport and customised, collaborative, local, experiential, and integrated services are set to make combined walk and bus journey much more attractive using new types of sustainable business models.

6.4   All bus trips involve a combination of modes, most commonly with walking. Accountability for customer service from door to door must be led by a single organisation, retailing the trip and acting on a traveller's behalf and ensuring high standards of traveller experience throughout the journey. Bus companies and local authorities could benefit from additional support from the community and/or other agencies to deliver effective collaborative solutions for safe routes to buses.

6.5   Key components of planning connected bus services are: audit, partnership, planning, community involvement, investment, and promotion, accompanied by monitoring and follow up action maintain high standards.

6.6   Attitudes towards, and demand for the use of buses is a function of long-term planning and delivery. Comparisons nationally and internationally suggest that for perhaps as much as 80% of Scotland, bus patronage could be 44-50% higher by implementing effective packages of improvements. Packages could include measures focused on to routes, services, ticketing, information, marketing, facilities and connections. Of this improvement up to 5% could be contributed by improvements to the local bus stops and walking routes.

6.7   Investment packages for bus improvements and connections continue to be much less common in major capital investment programmes such as city deals, and land use development. To give bus connectivity higher priority, stronger incentives could be offered for local authorities and private companies to work together in partnership to deliver improvements. Better connections at stops, and using latest technologies, are part of a wider package of measures to change how people experience and perceive bus use in Scotland. Without intervention there is little prospect of reversing existing trends.

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