CHAPTER 15

THE ROLES OF 'CONVENTIONAL' AND DEMAND-RESPONSIVE BUS SERVICES

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ABSTRACT

Purpose – *The roles of 'conventional' (fixed-route and fixed-timetable) bus services is examined and compared to demand-responsive services, taking rural areas in England as the basis for comparison. It adopts a 'rural' definition of settlements under a population of 10,000.*

Design/methodology/approach – *Evidence from the National Travel Survey, technical press reports and academic work is brought together to examine the overall picture.*

Findings – *Inter-urban services between towns can provide a cost-effective way of serving rural areas where smaller settlements are suitably located. The cost structures of both fixed-route and demand-responsive services indicate that staff time and cost associated with vehicle provision are the main elements. Demand-responsive services may enable larger areas to be covered, to meet planning objectives of ensuring a minimum of level of service, but experience often shows high unit cost and public expenditure per passenger trip. Economic evaluation indicates*

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user benefits per passenger trip of similar magnitude to existing average public expenditure per trip on fixed-route services. Considerable scope exists for improvements to conventional services through better marketing and service reliability.

Practical implications – *The main issue in England is the level of funding for rural services in general, and the importance attached to serving those without access to cars in such areas.*

Social implications – *The boundary between fixed-route and demand-responsive operation may lie at relatively low population densities.*

Originality/value – *The chapter uses statistical data, academic research and operator experience of enhanced conventional bus services to provide a synthesis of outcomes in rural areas.*

Keywords: Bus; demand-responsive; evaluation; fixed-route; rural

INTRODUCTION

In recent years, considerable interest has been shown in the role of demand-responsive public transport services, especially in serving areas of low density, or specialist trip purposes. This has been accompanied by technical innovations, notably in booking and routeing systems, which enable a set of individual passenger requests to be merged efficiently. A great deal of managerial and research attention has been devoted to such services. There is, however, a range of innovations made largely on a commercial basis in 'conventional' public transport receiving less attention. Since they have not been the focus of research programmes or academic publication in the same manner as demand-responsive services, awareness outside the public transport operating industry tends to be limited. The roles of such services affect, in particular, the thresholds at which demand-responsive services become an appropriate alternative to fixed-route operation.

Examples in this chapter are drawn largely from experience in rural areas of Britain, which has also been the focus of much research on demand-responsive operations. They may be less applicable in areas of much lower density and/or higher car ownership, such as rural areas in the United States, but could be seen as broadly comparable to conditions in other European countries of similar population density. The issue of

defining 'rural' is considered, indicating that this is broader than just very small settlements. Alternative patterns of bus service are described, stressing the scope for serving villages as intermediates points on inter-urban routes. The cost structure of both fixed-route and demand-responsive service is examined. Issues specific to demand-responsive services are then reviewed, including the question of cost per trip made. Evaluation criteria for provision of rural bus services are examined, drawing upon alternatives to traditional marginal economic benefit analysis. Scope for improving the attractiveness of fixed-route operation is examined, drawing in particular on the experience of the Norfolk Green company in the East of England. Recent trends in Britain indicate that constraints on local authority funding are affecting the scope for both demand-responsive and fixed-route services, with some cases occurring of demand-responsive reverting to fixed-route operation to reduce costs.

WHAT IS A 'RURAL' AREA?

In focussing on issues specific to 'rural' areas there is a danger in looking at relatively extreme cases, or very small settlements. While these represent the greatest challenge in public transport provision, they may not be typical of rural areas as a whole. Much of the rural population in countries such as Britain lives in a range of intermediate-sized settlements from smaller villages to market towns. The latter may not be large enough to fall in the 'urban' category that receives specific research attention (they may not, e.g. be of sufficient size to justify frequent internal services), but nonetheless generate demand for public transport. In addition, lower density rural fringe areas on the edge of larger conurbations may experience issues similar to more isolated rural areas. An aspect of growing importance may be the increased centralisation of services such as health or education, making smaller towns in rural areas less self-contained, and increasing the need for inter-urban movement to higher order centres.

These issues are illustrated in changes to the 'rural' definitions used in travel surveys and the population census in Britain. The National Travel Survey (NTS) is an extensive household survey, operated continuously in England since 1986, in which a seven-day travel diary is compiled by all household members. The stratified sampling procedure identifies a 'rural' stratum for which distinct data are produced. Until recently, any settlement of under 3,000 was classified as 'rural' but this has been raised to a

population of 10,000 (and earlier data retrospectively reclassified), thus including smaller market towns and some urban areas.

The Government Statistical Service (2015) applies a number of definitions to differentiate between rural settlements within this threshold of 10,000, principally:

'Rural town and fringe' (8.8% of the population of England in 2011).

'Rural villages, hamlets and isolated dwellings' (8.9% of the population in England in 2011).

An overall picture of travel by residents of rural settlements in England is shown in Table 1. As one would expect, car ownership is much higher in the rural settlements. Although trips per person per year (by all modes) are similar, the total distance travelled per person is substantially higher at approximately 9,000 miles compared with approximately 6,500 for England outside London as a whole – the 'rural town and fringe' distance is some 33% higher, and 'rural village, hamlet and isolated dwelling' some 49% higher. This is to be expected, given the greater distances from opportunities for employment, education and other activities.

The pattern for public transport is more complex than might at first appear. While the trip rates by local bus clearly differ with settlement size as shown in Table 1 – 61 for England outside London overall, 34 in rural town and fringe, 19 in rural villages, hamlets and isolated dwellings (levels below the national average of 44% and 69%, respectively) – this effect is much less marked for differences in distance covered (9% and 49%, respectively), reflecting the higher average trip lengths in rural areas. Hence, bus use by residents of rural towns and fringe areas is not as far below the national average as might be assumed.

Some ambiguity is created by the 'other private transport' category that includes dedicated school buses, which in other contexts might be seen as part of public transport provision (they are often provided by the same operators as local bus services, under contract to local authorities. Furthermore, in some areas the authority may place 'statutory' pupils on scheduled local bus services, so it makes sense to take the two modes together). This is more evident in the data for school travel, showing a combined 'private' bus and local bus share of 26% in rural towns and fringe areas, and no less than 41% for the rural village, hamlet and isolated dwelling (compared with 18% for England as a whole) – these differences are even more marked when secondary age pupils are considered, rather than all ages.

The volumes of trips and miles travelled by 'other public' transport (primarily rail and taxi) for the rural areas may seem high at first sight, when

Table 1. Characteristics of the Rural Transport Market in England 2013-2014.

	Type of Area		
	England excluding London	Rural town and fringe	Rural village, Hamlet and isolated dwelling
Variable			
Car driving licence holders[a]	74	82	89
Households with at least one car or van[b]	75	85	94
Cars and vans per household[c]	1.16	1.37	1.74
Trips per year by main mode[d] (and distance covered, miles): all modes	922 (6,536)	974 (8,718)	946 (9,732)
Walk	202 (184)	200 (161)	105 (95)
Car/van driver	382 (3,256)	456 (4,837)	540 (5,715)
Car/van passenger	208 (1,828)	239 (2,619)	241 (2,897)
Other private transport	26 (199)	25 (243)	26 (293)
Local bus	61 (279)	34 (253)	19 (143)
Other public transport	44 (790)	20 (605)	15 (590)
Trips to/from school:[e] percentages by mode			
Walk	42	42	10
Bicycle	2	0	1
Car/van	35	32	44
'Private' bus	4	11	16
Local bus	14	13	25
Surface rail and other modes	3	3	4

Notes: This table has been compiled from tables in 'National Travel Survey: England 2014' published by the DfT in September 2015. It shows combined data from the NTS sample for two calendar years, 2013 and 2014. Values of under 0.5 are shown as 0.

[a]Percentage of all those aged 17 or over holding a licence (from NTS Table 9901).

[b]Percentage of households (from table NTS9902).

[c]Absolute number per household (from table NTS9902).

[d]'Main mode' is that used for the greater part by distance of each trip. 'Other private transport' comprises bicycle, motorcycle and private hire bus other public transport' includes 'non-local' bus, rail, taxi/private vehicle, and ferries Data are taken from tables NTS9903 (trips), and NTS9904 (distance, shown in brackets).

[e]From table NTS9908. Note that 'private' bus includes dedicated school services.

the limited provision of rail service is taken into account. However, it should be borne in mind that all travel within Great Britain (GB) by residents of rural areas is included – hence, for example, members of an affluent car-owning household in a low-density area may drive to the nearest railhead and carry out considerable volumes of travel by rail, even if there is no station adjacent to the settlement in which they live.

More detailed tabulations from NTS data supplied for earlier work (White, 2015) indicate a low level of taxi and private hire vehicle (PHV) use in rural areas – an average of about five trips per person per year between 2002 and 2012, compared with a national average for England as whole of about 10 over this period (Department for Transport [DfT], 2015a, table NTS0303). This is to be expected, given the low provision of taxis and PHVs in such areas – commercial operation is more likely to be justified in areas where a succession of trips can be handled by each vehicle and driver, and hence taxi use is generally higher in larger urban areas. In aggregate, there is little evidence for taxis and PHVs acting as a substitute for lower levels of bus provision and usage in rural areas. The most recent statistics on taxi and PHV provision per 1,000 population confirm a low level of supply – 2.3 in local authority administrative areas classified as 'mainly rural' and 'largely rural', compared with an average of 4.5 in England as a whole (DfT, 2015b).

DEVELOPMENT OF RURAL BUS SERVICES IN BRITAIN

Although the first bus services in rural parts of Britain appeared before 1910, the phase of rapid growth occurred in the 1920s. Small vehicles run by local operators pioneered links from villages to nearby market towns, often replicating the catchment areas of the country carriers, and running on the same market days. However, much higher speeds, frequencies and lower costs to the passenger greatly increased ridership. Timetables of such services indicate relatively little 'peak' provision for journeys to work or school, but a schedule geared to shopping, personal business and entertainment. In parallel with this, a service pattern developed in which inter-urban links were provided along main roads, typically running via a string of intermediate villages. This combination of village-to-town and inter-urban movements justified higher service frequencies. The level of service a settlement of a given size received thus varied greatly by whether it was in a

relatively isolated area or convenient to serve by such an inter-urban route. A description of the Lincolnshire case is provided by White (2013).

Following the Road Traffic Act of 1930 a system of quantity regulation was introduced, which enabled larger 'area' companies to take over smaller independents. This process of consolidation in some cases resulted in almost complete dominance by the larger firms by the end of the 1930s, but this pattern varied greatly by area. Bus use in Britain nationally peaked around 1950, then falling as car ownership rose. This was particularly marked in rural areas, although most operations continued on a commercial basis until the 1960s. Subsequently, specific public funding was introduced, firstly in the form of a rebate for part of the fuel tax paid, and then specific powers for local authorities to support such services through contracts. However, the incumbent operator remained in a strong position, although not necessarily the most efficient provider.

Following the deregulation of local bus services from October 1986 under the Transport Act 1985, operators were required to register those services that they wished to run 'commercially' (i.e. financed from passenger revenue, fuel duty rebate and compensation for concessionary travel). It was envisaged that in lower density areas many services could not be justified on this basis, and hence powers were introduced to permit (but not to compel) local authorities to ensure continuation of such services through a competitive tendering process. Such bids could be made by any licensed operator, enabling lower cost local operators to gain such services from larger incumbents. While some of the thinking behind the Act appeared to envisage largely separate commercial and tendered service networks, in practice a far more complex pattern emerged, with the busier inter-urban routes in rural areas often registered commercially for Monday to Saturday daytime operations, as were some lower density urban services (hence continuation of evening and Sunday services in both cases would depend on local authority funding). The relative strength of the inter-urban routes is also associated with the higher bus trip rates by residents of rural towns and fringe areas identified in Table 1.

The 1985 Act clarified the position regarding volunteer-driven and minibus services, which had expanded considerably from the 1970s, in some cases with official encouragement (e.g. the pioneering service in Norfolk supported by the local subsidiary of the National Bus Company). Under section 19 of the Act, services operated for designated groups of users but not open to the general public were regularised, typically serving groups such as the elderly or disabled, or youth clubs. Section 22 provides for services operated for the general public. Greater flexibility is provided for such operations than the

fully regulated conventional services (although this has raised issues of fairness in competition, especially when competing bids are made for tendered operations). In general, smaller vehicles (under 16 seats) are operated, but larger vehicles are also permitted. While similar in some respects to demand-responsive services, these may have much lower costs due to use of volunteers, and often run for much more limited periods of the day and week.

Deregulation also enabled some innovations to be made in rural bus service provision, for example, through faster schedules, and use of smaller vehicles. In particular, a shift from nationally agreed wages and working conditions to local negotiations produced much greater variation, reflecting lower wages in rural areas. Contrary to expectations, services in some rural areas substantially improved – for example, an analysis of the network in Cornwall by Linn (2015) shows that service frequencies increased considerably between 1979/1980 and 2013, notably through replacement of occasional services by regular-headway operations, peak vehicle requirement rising from 90 to 166.

An 'accessibility' indicator measured through NTS household surveys (provision of an hourly bus service within 15 minutes' walk) indicated a substantial rise in 'rural' areas (on the old 3,000 population definition) from 46% of respondents in 2002 to 61% in 2012, averaged over Great Britain as a whole, probably influenced by improved levels of rural services and demand-responsive provision DfT, 2012).

At the same time, traditional market-day services in the lower density areas continued to decline, with a greater focus now evident on routes offering more attractive frequencies throughout the week where demand can justify this.

CONCESSIONARY TRAVEL

Another important factor has been the extension of concessionary travel from a permissive power to a mandatory requirement since 2001. In general, such concessions relate to those over statutory pensionable age (based on that for women) and the disabled. From a half-fare in 2001, this provision was extended to free travel other than the morning peak in 2006, greatly stimulating travel by this sector of the population. Particularly, large increases were evident in some rural areas, both in take-up of the pass itself, and its usage, for example, in the case of Salisbury district (Baker & White, 2010). Compensation is based on the 'no better off, no worse off' principle, that is, that the operator's net income remains unchanged. This

largely relates to revenue effects. For example, if ridership doubles at off-peak periods following introduction of free travel, with no additional operating costs incurred, then it would be appropriate for the operator to be compensated at 50% of the fare otherwise paid – compensation rates are broadly of this magnitude, but vary greatly between areas. Where a relatively generous rate was set in some cases (e.g. 70%), this stimulated additional provision of commercially registered services, but where rates are low, they can affect viability of services even where good loads are carried. Further complications arise in respect of services operated under sections 19 and 22 of the 1985 Act, the former (those restricted to specific user groups) not being subject to the requirement to offer the free concession, whereas the latter (being open to the public in general) have to do so.

Improved funding for rural bus services was also provided under Rural Bus Grant (RBG) and Rural Bus Challenge (RBC) funding from 1998, both for fixed-route operations, and innovative service types such as demand-responsive operations. Considerable expansion and innovation was thereby encouraged, but in some cases not sustained in the longer term, notably where high cost per passenger was observed, and it was difficult to justify continuation of such services after the initial three-year challenge funding.

More recently, funding for rural bus services of all types has come under pressure due to reductions in central government grants to local authorities (in Britain, locally based taxation generates only a small part of such bodies' income, with a high dependence on central government). In the absence of a mandatory requirement to support a particular level of service, local authority funding has focussed on the compulsory requirements to fund the concessionary fare provision, and school transport, and in some (such as Cumbria) almost all discretionary funding has ceased.

THE COST STRUCTURE OF RURAL BUS OPERATION

In common with bus operations in general, the largest single cost element (typically around 60%) is labour, which in turn is dominated by driver cost (approximately 40%), together with other staff (such as maintenance and managerial). Costs related to vehicle capital provision (reflected in leasing, or depreciation and interest, charges) may form the next largest element (dependent on age of vehicle(s) operated), followed by those costs directly related to distance covered (fuel, and some elements of maintenance). Complications may arise in analysing cost structures due to provision of

vehicles by local authorities, rather than financed directly by the operators (Marshall, 2015). However, such provision does constitute a real economic cost, and should be included in any systematic comparison. It should be noted that in addition to peak vehicle requirement in terms of vehicles in service on the road, some spare vehicles will be held to cover maintenance needs, etc. These may be pooled amongst all services in a certain area, and costs apportioned pro rata to specific services. Overall, costs mainly vary by time and peak vehicle provision, rather than distance run as such.

Costs will also vary by vehicle size, smaller vehicles obviously incurring lower capital, fuel and maintenance costs – the extent to which hourly driver costs will be lower depend on the nature of local wage agreements (a feature of the rapid growth of minibus operations in Britain in the 1980s was the existence of lower driver pay rates for 'minibus' drivers. However, these were in some respects artificial, and later superseded by regional variations, rather than those related to vehicle size per se). Nonetheless, while cost per vehicle-km will be lower for smaller vehicles, cost per seat-km is usually higher.

In calculating costs, it is also necessary to allow for 'dead' mileage, that is, that where the vehicle is being moved to points used by passengers, and running empty. For fixed-route services this is typically that between the operating base and the end of the route, usually at the start and end of the operating day. For demand-responsive services, substantial 'dead' mileage may also be incurred during the operating day, as the vehicle is repositioned to meet successive passenger requests. Including the dead mileage would reduce unit cost estimated per vehicle-km, but would of course increase costs per passenger trip made. An example described by Marshall (2015) indicates a dead mileage percentage of 25% in one day's work for a vehicle.

The extent to which costs are escapable in the short run will vary. Clearly, if a particular journey is cut from a fixed schedule, direct savings in distance-based costs are made. Driver costs may be reduced, dependent on the patterns of shift working. However, in the very short run, driver costs may not be escapable (e.g. if a demand-responsive service is guaranteed to be provided during a certain period of the day, and for part of this no trips are requested, both driver and vehicle may simply remain idle – unit cost per bus-km run, or per passenger trip, are thus increased).

In the case of services provided by volunteer drivers, clearly total costs are radically reduced, and a greater proportion will vary directly with distance covered. In the case of demand-responsive services further complications arise from treatment of call-centre costs, and how these may be allocated to individual services when a number of services are handled through a common centre.

Assessment of net financial performance for both demand-responsive and fixed-route services will also depend on treatment of revenue. In addition to fares paid directly by passengers, given the high proportion of free concessionary travel on rural services it is essential to ensure that compensation payments are correctly attributed to the services on a basis of use. In many cases, school and public services may be provided by the same vehicles. Where schoolchildren are placed on scheduled public services that run throughout the day, local authorities may purchase season tickets on their behalf, which consequently form part of operator revenue. However, where vehicles are redeployed at school times to provide dedicated services under a contract, the appropriate contract revenue needs to be attributed. There are also questions of how peak vehicle costing should be applied where education travel effectively determines peak vehicle requirement. For example, in December 2008 Shropshire County Council introduced its 'ShropshireLink' operation, providing a public demand-responsive service, and education journeys. After an initially successful period of ridership growth, a very high net subsidy per passenger trip of £19.96 was estimated, and the service was terminated on 5 October 2013 (replacements have been provided to a certain extent from volunteer-driven community transport services in the areas covered). Utilisation, in terms of passenger trips per vehicle per day, was very low. However, as Udy (2015) has shown, the cost, ridership and revenue allocation assumptions employed where public and school services are provided from the same resources may have substantial effects on the apparent net support per trip, alternative assumptions in this case giving a net cost per trip of about £9 (albeit still a high figure).

INDICATORS OF COST-EFFECTIVENESS AND USER BENEFITS

A feature of much economic evaluation in countries such as Britain has been a focus on marginal changes in costs and benefits, typified by the use of cost-benefit analysis to identify gains (or losses) to existing users, together with those experienced by 'new' users (where applicable). A typical case might be the effects of making a fare reduction on public transport, or changes in journey times, reflected in monetised values of time savings. A recent example has been the evaluation of the effects of free concessionary travel by Last (2013), indicating a benefit:cost ratio of approximately 1.24 (albeit this analysis was undertaken some years after the policy was

implemented, i.e. no 'ex ante' economic evaluation was produced by the government before the policy was implemented).

Such techniques have been less applicable in cases where 'all or nothing' changes have been implemented such the withdrawal of a rural bus service, or introduction of a new service (e.g. by a demand-responsive operation), although one could argue that such changes represent far more substantial impacts on the users concerned than, for example, a relatively small change in existing journey times. It is noteworthy that many rural areas which have proposed to make radical cuts were incurring relatively low costs per passenger trip on the services concerned (as an average) – for example, one can derive averages from technical press reports of £1.35 in North Yorkshire (Bus and Coach Professional, 2014), and about £1.33 in Herefordshire (Coach and Bus Week, 2014).

A fairly crude approach has been adopted towards evaluation of tendered rural bus service support, typically using an average value for the net support per passenger trip (i.e. after taking account of fares revenue). Guidelines used by local authorities are typically in the range of £2–£6. However, this does not take into account user benefits in any systematic form, except insofar as different degrees of importance may be attached to different trip purposes – authorities may, for example, give higher importance to journeys for work and medical purposes than leisure trips, although this is not necessarily reflected in an explicit differentiation in the net support per trip regarded as acceptable. An improvement has been made recently, following work by the Mott MacDonald consultancy and the Institute of Transport Studies at the University of Leeds (Mott MacDonald, 2013), which sought to determine the economic benefits of retaining bus service provision, by identifying 'social impact' benefits per return trip for those bus journeys which would not otherwise be made. These were estimated at 2010 values and prices as £3.84 for a concessionary pass holder and £8.17 for a non-holder, values which are similar to some of the crude average thresholds used as cost-effectiveness measures by local authorities currently. This guidance has now been incorporated into 'webtag', the web-based guidance on forecasting and evaluation methods provided by the DfT (2014).

It should be noted that these values relate to trips that would not otherwise be made, and when a rural bus service is withdrawn it does not necessarily follow that all trips on it would cease – some might take place via alternative bus services, demand-responsive operations, etc. A default value of 21% is suggested in the guidance, although this appears to relate to evidence from additional trips being generated (as distinct from diverted) to

an improved bus service. In the case of cuts in a rural service, with few alternatives available, it might be reasonable to assume more substantial effects would arise from elimination of a service: for example, only half of the trips would still be made. Taking the guidance figure of £8.17 for a return trip by a non-concessionary pass holder (above) then one could assume that a value of £4.08 for a one-way trip would be applicable. If it is assumed that half of the trips would no longer be made, then a value of £2.04 per one-way trip applied to all trips on the current tendered service to be withdrawn could be inferred. By the same logic, a value for a concessionary pass holder trip no longer made would be about 96p. Assuming a 50:50 split of concessionary/non-concessionary travellers, the overall average would be about £1.50 at 2010 prices. Factoring up to 2014 prices using a webtag guidance Gross Domestic Product (GDP) deflator of 8% between 2010 and 2014 would bring this value to about £1.62. It is too early to say whether this guidance is being applied in any systematic form – for the moment short-term budget constraints are likely to be more critical – but it could provide a more informed figure for an average net subsidy per trip. A higher threshold may be applicable where very low service levels are being evaluated, since their removal would eliminate the remaining public transport access. As an upper limit, the cost per passenger trip on a subsidised taxi journey at the same fare as bus may be applied.

Fixed-route and demand-responsive services may then be compared on such criteria. Typically, the demand-responsive option is considerably more costly than the average for fixed-route tendered services in the same area. One issue then arising is whether greater user benefits per trip may be produced from demand-responsive services than fixed-route. In principle, this is not necessarily the case. The benefits to a user – for example, making a shopping trip from their village to the nearest market town – are in essence the same whether using a supported (indeed, even a commercially viable) fixed-route service, or demand-responsive. There is danger of making the mistake identified by Dupuit in the 1840s that the benefits of a project are a function of its costs, rather than the sum of user benefits expressed in relation to costs incurred (similar issues arise in respect of political enthusiasm for reopening railways in rural areas at the same time as support to existing bus services is being cut). Having said this, in some cases demand-responsive services may produce greater user benefits per trip when providing a door-to-door facility (rather than to or from designated stops) which may be particularly beneficial to those unable to walk or otherwise access fixed-route stops (Marshall, 2015). About 20–25% of trips on the Lincolnshire Call Connect service are of this form (P. Sanders, personal communication, December 7, 2015).

OPTION VALUES AND RELATIVE VALUATION OF DR AND FIXED-ROUTE SERVICES

As indicated earlier in this chapter, the most common form of economic evaluation tends to deal with marginal changes, such as those to fare levels, or in-vehicle journey times, for services which already exist. However, these may be inappropriate for dealing with situations where the removal (or introduction) of an entire service is proposed, or radical changes in provision (such as demand-responsive vs. fixed-route) are being considered. The concept of 'option values' enables a valuation to be obtained at the community level for the provision of such services (for both users and non-users).

A study by Shires, Johnson, Mackie, and Fowkes (2014) examined the case of fixed-route services in Shropshire, principally routes operating from smaller market towns to the county town of Shrewsbury. The Bridgnorth – Much Wenlock – Shrewsbury service then operated hourly Mon–Sat daytimes. Surveys in Bridgnorth and Much Wenlock indicated a Willingness to Accept (i.e. how much individuals would be willing to accept in council tax reductions in exchange for worsening to service to two-hourly, or a demand-responsive) a service reduction from hourly to two-hourly of about £50 per head per annum for bus users in Much Wenlock (and about £5 for non-users), with £25 and £8, respectively, in Bridgnorth (which has alternative routes to other towns). An alternative demand-responsive service (described as equivalent to a pre-booked taxi service at the same fare as the existing bus) generated much higher WTA figures – for example, £100 vis-à-vis the existing hourly service for bus users in Bridgnorth (Shires et al., 2014), that is, the demand-responsive service was perceived as much *less* attractive than the fixed-route provision at a two-hourly interval [subsequent to the study being conducted, the previous operator was replaced in July 2015 by a tendered service operated by an independent, but hourly fixed-route operation retained].

A parallel outcome was observed by Lulham (2011) surveying an area in north Kent served by a low-frequency fixed-route, where most respondents expressed a preference for this service rather than replacement by a notionally more frequent demand-responsive operation.

'Cross-sector' benefits may also arise where public transport access is provided to medical facilities, or social activities, given the alternative costs of provision (either of specialised transport services such as non-emergency ambulances, or care at home). These may be greater in the case of door-to-door transport services, but are nonetheless applicable in principle to all types of public transport service (and have also been argued to apply to free concessionary travel).

A complicating factor is that in some cases a demand-responsive service has been introduced as part of a package enabling existing fixed-route services to be recast in the form of more direct inter-urban links. This may enable the fixed-route service to operate with lower subsidy per passenger trip (or even commercially), but the demand-responsive service takes over some of the trips previously handled by the fixed-route service to/from low-demand points. This issue has been raised in respect of the 'Bwcabus' service in west Wales, for example (Clark, 2015), in which the high subsidy per passenger trip on the demand-responsive service contrasts with a much lower figure for the combined demand-responsive and fixed-route operation.

A related issue is whether a passenger usage objective or an overall planning objective is being assessed. For example, an existing rural network may offer poor service coverage outwith the main inter-urban routes, perhaps confined only to certain days of the week. Fixed-route provision to ensure a minimum service level provision on all days of the week would be prohibitively expensive, but setting up a demand-responsive service which circulates within the area concerned could enable such an objective to be met. One can see in the case of the 'Call Connect' DR services in Lincolnshire that very comprehensive coverage of the county is now provided (almost all rural areas other than that around the City of Lincoln), while the lower frequency fixed-routes have been cut back. Over 322,000 passenger trips were carried in 2014 (Coach and Bus Week, 2015). However, it should be borne in mind that just one of the upgraded interurban services introduced in Lincolnshire, service 6 between Lincoln, Horncastle and Skegness, carried per 350,000 passengers in 2004 (Le Masurier, Barker, Housely, & Cross, 2005). An average unit public expenditure per passenger trip of between £2 and £5 is incurred, varying by service. The busiest single service carries about 30,000 passengers per year (P. Sanders, personal communication, December 7, 2015).

In terms of the contrast between a usage and planning objective, the Wilford peninsula in Suffolk (lying south east of Woodbridge) may be considered. A low-frequency fixed-route service was replaced by a demand-responsive service, providing more comprehensive coverage of the area in terms of both settlements served and period of operation. However, total usage fell and cost per passenger carried increased substantially (Marshall, 2015). While total public expenditure was reduced, support per passenger trip increased. In the case of Lincolnshire, a comparison between a fixed-route service operating south of Lincoln (48/49) and a Call Connect service in the Bourne area (15B) indicates a substantially lower cost per community served by the latter, covering a wide area with many small settlements, and able to access smaller estate and rural roads (Sanders, personal communication, 2015).

A further issue in the outcome produced by demand-responsive operations is the success (or otherwise) of providing feeder traffic into fixed-route inter-urban services. In theory, this may provide valuable links between low-density areas and major urban centres (see Figs. 1 and 2 of interchanges at Spilsby and Horncastle). However, usage in practice can be more limited, in part due to interchange difficulties, and complexity of ticketing and trip-booking arrangements for the demand-responsive element. In the Suffolk case, for example, the degree of connecting trips appears very small (Marshall, 2015). In the Lincolnshire Call Connect case, the proportion of feeder traffic is approximately 5% (P. Sanders, personal communication, December 7, 2015), although it should be borne in mind that most of the services are based around smaller market towns, which will serve as the focus of travel for most users. They are now operated on a 'many to many' basis within their areas of coverage – for example, to serve a doctor's surgery outwith the town centre – although in practice most trips are to or from the local urban centre (P. Sanders, personal communication, December 7, 2015).

Fig. 1. Interchange at the town of Horncastle in East Lincolnshire in 2000, showing a 'Call Connect' minibus operating on the fixed-timetable service to Louth (a larger market town to the north), on which demand-responsive diversions are offered. Connections are made with the 'InterConnect' Service 6, Lincoln – Horncastle – Spilsby – Skegness, on which two low-floor single deckers (one for each direction of travel) are shown to the left (following growth in demand, double-deckers are now used) [P. R. White].

MARKETING AND SERVICE QUALITY IN BUS OPERATION

While the primary factor in the decline in bus use per head from 1950 was the growth in car use, the service offered by the industry must also be considered. Measures to reduce costs in the face of lost revenue often comprised service reductions in the hope of making pro rata cost savings, or staff reductions such as elimination of conductors in favour of one-person-only operation (opo) which affected service quality by increasing dwell time at stops. In some cases, net savings were not proportionate (e.g. cutting off-peak services did nothing to reduce peak period costs such as vehicle depreciation; extended dwell time with opo may have required additional buses and drivers to be inserted in order to maintain frequencies). A major impact of deregulation in 1986 was a sharp reduction in staffing levels and costs associated with activities not directly affecting the passenger (such as

Fig. 2. A fully demand-responsive service (then marketed as 'Call Connect Plus', now simply 'Call Connect') at Spilsby in 2002, an 8 seater with rear wheelchair access. The upgraded bus stop behind the vehicle provides an interchange point with InterConnect 6 and other fixed-route services [P. R. White].

management overheads, and engineering costs), resulting in a marked drop in real total operating costs of about 45% between 1985/1986 and 1999/2000 (White, 2014). These factors applied to both rural and urban operations – indeed some more strongly in the rural case, such as the effect of regional differences in wage rates (see above).

However, cost cutting alone cannot sustain the long-run future of an industry, and it is necessary to stimulate ridership and revenue through positive marketing and service quality initiatives. Examples drawn in part from the experience of Norfolk Green (B. Colson, personal communication, October 15, 2015) include:

- Improving service reliability (probably the most important factor from the passenger's perspective) by realistic scheduling, securing priority measures and ensuring staff availability to cover all advertised scheduled operations.
- Improvements in vehicle quality. Low-floor accessibility has for many years been a compulsory requirement for all new vehicles, with a requirement for all those in public service to meet this standard shortly. In addition to users such as those in wheelchairs who may derive particularly large benefits, this facility also stimulates off-peak ridership by those with children in pushchairs, and shopping trolleys. Other improvements include better-quality seating, lighting, heating and ventilation.
- Better-quality passenger information. Even simple improvements in bus stop displays, or distribution of printed timetables in the catchment area of a route, may significantly increase ridership. A website can be provided giving all route, timetable and fares information. This can be taken further by real-time information, through displays at stops, websites or via mobile phones (the latter being particularly beneficial in rural areas: many operators now offer a tracking facility). A telephone answering service operating seven days per week, with extended operating hours in periods of bad weather, provides a direct link to customers.
- Adjustment of service patterns to match current and potential demand, rather than following existing networks. A limitation of deregulation in 1986 was that it may have helped to ossify the network by splitting commercial and tendered services – the latter often became a 'gap filling' exercise as operators deregistered commercial services. A more comprehensive review, whether initiated by a public authority or a commercial operator, may enable a much more appropriate network to be devised.
- Identification of new market opportunities: for example, improved services to new housing areas, serving 'out of town' shopping or medical

facilities, or improved Sunday services to match changes in shopping activities. The leisure and tourism market may be particularly sensitive to such innovations, such as the 'Coasthopper' developed from a set of very low-frequency services along the west and north Norfolk coast by Norfolk Green, to offer facilities attractive to tourists and also a much better service than before for local residents, on which ridership rose from 64,000 passengers in 2001 to 570,000 in 2014, also providing a stimulus to the local tourist industry in terms of additional income: of the ridership in 2014 about 250,000 represented local residents, and 320,000 tourists.

- Adopting distinctive 'brands' expressed through vehicle liveries and marketing, making users more aware both of specific operators and bus service provision as a whole. Selling points for individual services such as high frequency, or direct routeing reinforce this.
- Allocation of drivers to specific routes or route groups to improve driver-customer relationships, which may be further enhanced by not having assault screens.

In some cases, these measures may incur increased costs, but these may be exceeded by net gains in revenue. This is particularly evident for quality improvements on inter-urban routes, such as the Stagecoach 'Gold' brand or Arriva's 'Sapphire'. Even for supported services, the net support required for a given service level may be reduced by more positive efforts to stimulate ridership by higher quality of service (as distinct from increased frequency) rather than simply providing a minimum standard. Initiatives have also been taken in other countries to adopt more positive approaches to marketing and service quality in 'conventional' types of service operation, for example, in the rural Värmland region of central Sweden as described by Rönnbäck (2010).

The initiatives taken by the Norfolk Green operation, developed under the management of Ben Colson as an independent based in Kings Lynn, west Norfolk, and subsequently sold to Stagecoach in 2013, may be seen as an example. In addition to the Coasthopper service (above) existing fixed-route services in the area around Kings Lynn were substantially upgraded, with gains in ridership. Examples below quote percentage ridership growth between the first half of selected periods 2009 and the equivalent periods in 2012:

- Service 46 Kings Lynn – Wisbech – March. Thirty-six per cent growth in passenger trips. Promotion of an existing low-frequency rural service.

- 505 Kings Lynn – Long Sutton – Holbeach – Spalding. Eighteen per cent growth in trips. An example of a very long-established inter-urban service with numerous intermediate settlements served. For many years operated hourly, but following transfer from the former NBC regional company to independent operation in the late 1980s, operated by a succession of firms. Following phases of competition, wholly operated by Norfolk Green by 2009, the Monday–Saturday service being improved to every 20 minutes, and Sundays to half-hourly (some years earlier no service had been offered on that day of the week), almost wholly commercial.
- X8 Kings Lynn – Fakenham – Holt. Growth of 52%. Provision of faster inter-urban links to major towns. Commercialised between Lynn and Fakenham.
- X29 Fakenham – Norwich. Growth of 83%. Replacement of commercial service deregistered by regional operator, giving much faster links than before, operated as hourly from 2009 with reducing subsidy, and commercial Sunday service introduced. Strong promotion, especially for work and other activities in Norwich.

RECENT DEVELOPMENTS IN BRITAIN

Given the unwillingness or inability of rural authorities to support bus services involving even relatively modest expenditure per passenger trip, it is not surprising that demand-responsive services have suffered noticeable cuts. For example, the 'Connect2Wiltshire' services have been replaced by fixed-routes in phases since January 2015, reportedly due to high call-centre costs. Following a review by Flintshire Council of rural bus funding it was decided to concentrate on main routes, with community transport feeders, an 'unaffordable' cost of £6 per passenger on the Deeside Shuttle demand-responsive services resulted in their withdrawal and part-replacement by fixed-routes (Local Transport Today, 2015a). In May 2015 Oxfordshire County Council decided to cut £2.56m from non-statutory expenditure on subsidised bus service, including all dial-a-ride provision (Local Transport Today, 2015b). From 6 July 2015 Hampshire County's 'Cango' services operated as fixed-routes with no pre-booking. While simple cost pressures may be the main factor, the cost of call centres and pre-booking requirements for users may be specific considerations.

In some cases, demand-responsive services appear to have helped to test the market by defining at least some flows which may justify subsequent fixed-route operation, but were not served by earlier fixed-route services.

BRINGING THIS TOGETHER

The aim of this chapter is not to deny the benefits that may be produced by demand-responsive services, but to set these in a wider context, especially the relative costs per passenger trip for demand-responsive and fixed-route services. Many of the issues arising affect both types of service, notably limitations on public spending, and appropriate economic evaluation of benefits provided.

The main question thus arising is where the boundary lies between fixed-route and demand-responsive services. Table 2 is derived from that produced by Wright of Aberdeen University (Wright, 2013) from which one may derive an index of passenger-km per vehicle-hour for which different types of service provision are appropriate. However, the application of such principles to a particular case depends not only on exogenous factors such as population density and car ownership but also the quality of service that may be provided by an existing fixed-route operator and hence the base level for ridership against which other options are being compared.

Table 2. Indicative Guidance for Vehicle Choice Related to Density of Demand.

Trips per Vehicle hour × Trip Length (i.e., Passenger-km per Vehicle-hour)	Suggested Vehicle Choice
Less than 10	Taxi
Between 10 and 20	Taxi(s) or flexible minibus – choice will depend on availability and relative costs locally
Between 20 and 50	Flexible minibus, with lower degree of route flexibility at the higher end of the range
Greater than 50	Largely fixed route bus, with limited deviations

Source: Derived from Wright (2013, Table 4).

For example, where the service quality improvements of the type adopted by Norfolk Green have been introduced a demand of between 20 and 50 passenger-km per vehicle-hour might be raised to greater than 50 per vehicle-hour for a given population pattern, representing a shift from flexible minibus to fixed-route operation as the appropriate option.

There may also be further opportunities to improve 'user friendliness' of services offered both by demand-responsive and fixed-route services, such as easier trip-booking facilities. Demand-responsive services may need to be marketed more effectively to residents within their area, and also to potential visitors (e.g. to tourist attractions in low-density areas) who might help to boost traffic.

A clear limitation of demand-responsive services driven by paid staff is the large element of labour cost, and low labour productivity. While there may be some 'hype' about the introduction of driverless cars now being developed, in the long run this option might be better suited to low-density demand than manually driven operation (although issues of occupancy, and positioning vehicles between successive user requests, would remain). Switzerland's PostBus has just announced an experiment using two nine-seater driverless buses, initially to be tested in the tourist city of Sion (Passenger Transport, 2015).

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