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Flexible transport services: A new market opportunity for public transport

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ABSTRACT

The term Demand-Responsive Transport (DRT) has been increasingly applied in the last 10 years to a niche market that replaces or feeds (usually via small low floor buses or taxis) conventional transport where demand is low and often spread over a large area. More recently, the concept of DRT as a niche market has been broadened to include a wider range of flexible, demand-responsive transport services and is increasingly referred to as Flexible Transport Services (FTSs). The contention of this paper is that well-implemented FTS has the potential to revitalise bus-based public transport services which are traditionally based on fixed networks with variable geographical coverage and levels of service.

1. Introduction

In an ideal world public transport would be as convenient as private transport, suggesting that 'all public transport should be demand responsive.' The term Demand-Responsive Transport (DRT) has been increasingly applied in the last 10 years to a niche market that replaces or feeds (usually via small low floor buses or taxis) conventional transport where demand is low and often spread over a large area. More recently, the concept of DRT as a niche market has been broadened to include a wider range of flexible, demand-responsive transport services and is increasingly referred to as flexible transport services (FTSs). The contention of this paper is that well-implemented FTS has the potential to revitalise bus-based public transport services which are traditionally based on fixed networks with variable geographical coverage and levels of service.

Historically, DRT evolved from door-to-door dial-a-ride services (sometimes referred to as Special Transport Services – STSs) provided by statutory authorities and community groups for restricted usage (usually the disabled and elderly). Interested users would telephone in their requests some days before they intended to travel and the operator would plan the service manually the day before the trip. These traditional services have often been criticised because of their relatively high cost of provision, their lack of flexibility in route planning and their inability to manage high demand.

As already noted many of the earlier limitations have subsequently been overcome through the introduction of transport telematics/Intelligent Transport Systems (ITSs) and the development of a much broader definition of flexible transport services (FTSs) which is discussed below. In Gothenburg, for example, as long ago as 1992 the city invested in PLANET, an advanced DRT system for Special Transport Services (STSs), and a fleet of shared-ride taxis and specially equipped vans.

Telematics-based FTSs have the scope to bring public transport closer to the flexibility and convenience of private transport, whilst retaining a fare structure more in line with public transport journeys as opposed to the most flexible – but costly – private hire and taxis.

This paper is organised as follows: Section 2 considers the current state-of-the-art in FTS noting in particular the role of transport telematics in enhancing the potential capability of flexibly organised and delivered public transport services. Sections 3 and 4 focus on the challenge of providing public transport in rural areas and focus in this context on the use of taxi-based services which are widely recognised as one of the most effective forms of DRT.[2] Whilst the context in this paper is on the provision of flexibly delivered services as part of the public transport mix in rural areas, the discussion is equally applicable to areas of low demand that exist within urban and peri-urban areas whether this is at the urban fringe or within areas where for socio-demographic reasons there is insufficient demand to make a conventional, fixed route, viable or suitable for subsidy. The discussion highlights a number of questions that are important to the further development of FTS; the development of a research agenda is discussed in Section 5.

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[2] For example, the Nexus (Tyne and Wear) *LinkUp* DRT is advertised as 'the bus you book like a taxi'.

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2. Today's flexible transport services

Telematics-based FTSs are based upon organisation via Travel Dispatch Centres (TDCs) using booking and reservation systems which have the capacity to dynamically assign passengers to vehicles and optimise the routes. Automated Vehicle Locationing (AVL) systems are used to provide real-time information on the status and location of the fleet for the route optimising software; it is not uncommon for one software supplier to have products for both the taxi and (niche) DRT markets. FTS is an emerging term which covers services provided for passengers (and freight) that are flexible in terms of route, vehicle allocation, vehicle operator, type of payment and passenger category. The flexibility of each element can vary along a continuum of demand responsiveness from services where all variables are fixed a considerable time before operation (e.g. a conventional public transport bus route) to services whose constituent variables are determined close to the time of operation. Taxi services typify the demand responsiveness of public transport.

Demand responsiveness can also vary within and between modes in terms of the type of service that is offered. Drawing on a British example of a registered bus, that is a bus service which is permitted to carry passengers at separate fares, this can be the traditional fixed route public transport, it could be a semi-fixed DRT route with perhaps fixed points along its route from which it can deviate, it could be a flexible area-based DRT with no fixed points other than a notional start and end point and which only runs on demand by users, or it could be a service primarily designed for some other purpose (e.g. the delivery of post or school children) which has been registered as a bus service to provide additional supply. Flexibility is not restricted to the bus mode and can be seen in both the taxi and private car sectors. For the taxi, the most demand-responsive service is the single ride for the private passenger since this gives door-to-door access. However, where shared-ride taxi journeys (either spontaneous or pre-planned) are allowed, this decreases the demand responsiveness and importantly the cost. In the car mode, there can be differences in flexibility from the most flexible private car to a car pool where, like the taxi example above, a reduction in flexibility is offset by a reduction in cost. One of the issues highlighted by environments in which flexible transport has been promoted is that there is often a mismatch between demand and supply. Only one person might demand a journey in a particular area and the operator only has a minibus. Or five people living reasonably close plan an outing and the operator has a traditional four-seater taxi. Better matching between supply and demand for all modes can be increased by brokering vehicles and operators.

Many applications of FTS are associated with serving particular classes of user and this use reflects their origins. However, even in the UK where there is a history of experimental FTSs, there are examples of services which are open to all users. *LinkUp* in Tyne and Wear is a typical open access (i.e. for everybody) FTS. Services operate a fully flexible route in a predefined area with fixed timing points to provide journeys at times when regular services are not operating or where direct services are not available. Passengers are picked up and set down at the meeting points which are all existing bus stops and predefined places such as shopping centres, doctors' surgeries and leisure facilities. The service also picks up and drops off passengers at any doorstep with a small additional fare, if requested and possible. It is necessary to pre-book the service at least 45 min before travelling.[3] The service is supported financially by Nexus (the Tyne and Wear Passenger Transport Executive).

An interesting recent development which has been enabled by the application of telematics is the move to integrate Special Transport Services (STSs) with other forms of FTS in a joint operation. For example, Nexus now combines operating contracts for their Care Service and the *LinkUp* services which are dispatched via a common dispatch centre under a single brand. This service is supplemented by *TaxiLink* which provides a door-to-door service using accessible taxis for users with greater mobility difficulties. This experience has also been partly mirrored in Scotland where the Strathclyde Passenger Transport open access Ring and Ride services may also be used by registered Dial-a-Bus users.

Similar but more extensive developments have occurred in the Netherlands. This followed a Government initiative to promote a national approach to the combination of mobility services for users with special needs and open access DRT services filling the gap in services between mainstream public transport and conventional exclusive ride taxi services. *RegioTaxi*, a combination of a community transport, STS and the provision of open access shared-ride taxi service for non-eligible users has become very popular and since start-up in 2000, *RegioTaxi KAN* in the Arnhem-Nijmegen region has grown to almost 1.4 million passengers per year. About half of the users are eligible for a higher subsidy and half are the general public paying a larger portion of the transport cost. Their fare is still about half of that for a corresponding exclusive taxi ride. Similar developments can be seen throughout Europe (Denmark, France, Germany and Switzerland) at varying degrees of scale of operation. The role of taxis in the provision of public transport in areas of low demand is considered in more detail below.

The use of IT in the delivery of FTSs and the ability to explore extended brokerage between both users and suppliers were the motivation behind FAMS (Flexible Agency for Collective Mobility Services), an EU funded project. Fig. 1 shows the structure of the FAMS business model for FTS. FAMS tested the concept of a virtual agency to coordinate, multimodal DRT service delivery at sites in the Angus region of Scotland and in Florence in Italy (Ambrosino, Boero, Eloranta, Ferrari, & Finn, 2004). The project provided valuable evidence to demonstrate that technologies such as GSM, GPRS, SMS, real-time scheduling and dispatch technologies could provide improved services in high density urban and low density rural areas. These concepts continue to be developed in the newly-launched FLIPPER project (Nelson & Masson, 2009).

In North America, the term *paratranist* is used to embrace ADA-complementary paratransit *and* all other forms of DRT (Lave & Mathias, 2000). As in Europe, there is approaching 40 years experience with dial-ride, shared taxis, ride-sharing, fixed route and route-diversion jitneys, shuttles, etc. Schofer et al. (2003) define DRT as 'specialised transportation for older persons, persons with disabilities … also provided to the general public, particularly in areas with lower population densities or lower levels of demand'.

With the passage of the American with Disabilities Act (ADA) the growth in demand for FTS has been tremendous; the first ADA-complementary paratransit services began in 1992 and by 2004 paratransit ridership increased by 58.3 per cent, to more than 114 million trips, most of which were ADA-complementary (Chia, 2008). Chia (2008) emphasises that the increase in paratransit trips and the substantial difference in service trip costs when compared with the cost for other modes are prompting transit agencies to seek more effective and efficient ways to meet the growing demand for ADA-complementary paratransit services.

The CONNECT Consortium (2005) contrasts the Nordic and North American experience with STS noting that the big difference is that the tax funding for both mainstream and flexible public transport is proportionally much less in the car-oriented USA. Nevertheless, 20 of the 30 largest FTS providers are North

[3] More information is provided in the *LinkUp* leaflet available at <http://www.nexus.org.uk/wps/wcm/connect/Nexus/Bus/LinkUp/>.

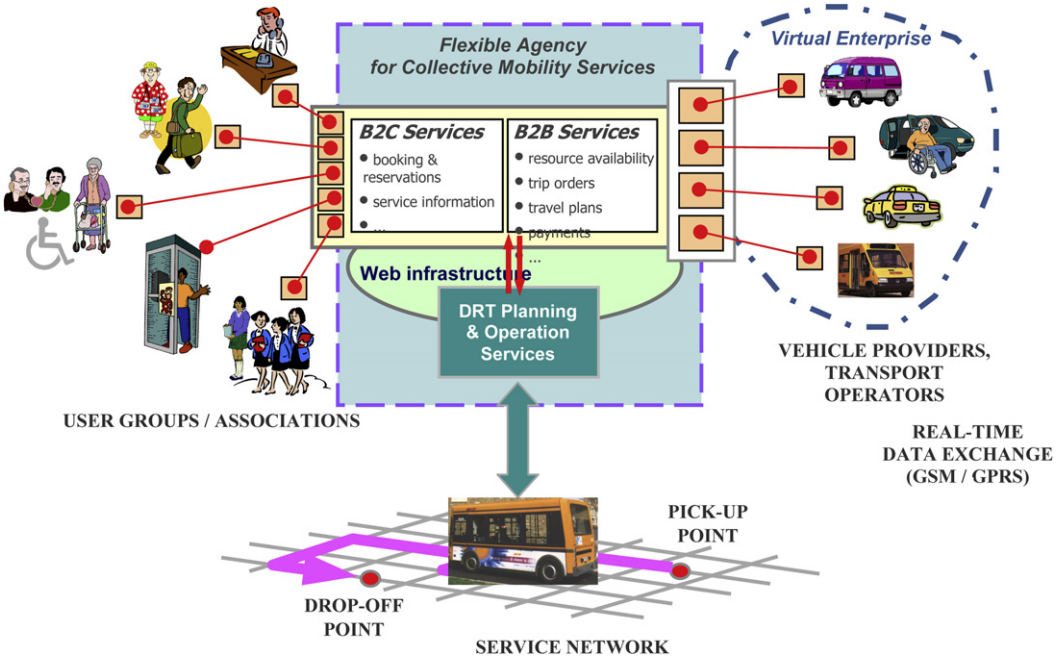

Fig. 1. The FAMS virtual agency for flexible transport services. Source: Ambrosino et al. (2004).

American, although few of these operations provide open DRT services that are beyond the ADA regulations. Pittsburgh is a notable exception where the Pennsylvania State Lottery is a good source of funding for elderly care services including senior mobility. Other interesting examples of open DRT, although still at a moderate scale are the shared-taxi services in the state of Wisconsin or Taxibus in Rimouski, Canada. Small-scale, 'general public DRT' is gaining greater acceptance across the USA such as the Dry Creek 'call-n-Ride' in Denver and comparable schemes in Chicago, Dallas and the Northern Great Plains.

3. The rural transport challenge and the role of 'unconventional modes'

The provision of transport solutions in areas of dispersed demand is problematical because the level of demand is usually insufficient to 'justify' the provision of conventional, scheduled services. This is particularly true in the UK where deregulation in 1985 created a system of services commercially provided by bus operators and with local authorities 'filling the gaps' in the commercial public transport network with subsidised services supplemented by a voluntary sector which has continued to address the needs of more specialised travel requirements (Brake & Nelson, 2007). Local authorities often have funding constraints and many services in rural areas or areas of low demand have been discontinued since the level of subsidy required is too high to justify within the set of competing requirements. Thus, against a background of the requirement to achieve sustainable transport whilst improving social inclusion, conventional solutions have not proved satisfactory. 'Unconventional modes' is the terminology used by the UK Department of Transport guidance when it is referring to (niche) DRT services. In this section, it is given a liberal interpretation and refers to FTSs more generally.

Over the last 10 years more innovative solutions have been enabled by the development and application of transport telematics/Intelligent Transport Systems (ITSs), which allow more flexible transport services in terms of time and space. In addition, new ways of thinking about the provision of all types of what might be considered public transport has led to more flexible transport modes becoming available. This has included a recognition that brokerage of demand and supply are important elements. So, for example, a 'bottom up' approach to meeting demand which responds directly to end user needs; permitting the general public on education contract services; the use of taxis for shared public transport; and the provision of vehicles enabling access to work have emerged. Critically, these innovations are tending to operate independently leading to overlap as well as leaving gaps and misunderstandings about the purpose, delivery and receipt of services. An example of this has arisen with the introduction of 'free' (concessionary) local public transport to older people in Scotland (introduced in April 2006) and in England (introduced in April 2008) and the experience of many older users that this does not apply to all (but does apply to some) FTS. To address these issues, future public transport services will need wider area network planning, greater co-operation between service providers and a greater understanding of end user requirements.

Wright, Nelson, Cooper, and Murphy (in press) provide a detailed analysis of a focused on-demand-responsive service using community-based drivers and taxi companies known as Transport to Employment (T2E) which builds on the concept of shared taxi to provide an illustration of the benefits to be gained by the sharing of transport resource. T2E is a centrally co-ordinated shared transport service providing access to workplace, training and childcare in the remote and rural communities of East Sutherland, Easter Ross and Southern Caithness in Highland Scotland. A particular characteristic of the T2E service area is its remoteness and sparse population, even relatively small distances between individual and employer (e.g. 10 km–25 km) represent a significant barrier where transport (both public and private) is not available.

The T2E service is delivered through a centralised booking office that is responsible for planning, co-ordinating and delivering services to meet community needs. The booking office is tasked with planning routes and ordering travel services to reflect requests made to the service. Both telephone and on-line booking[4] has been

[4] www.t2e.org.uk.

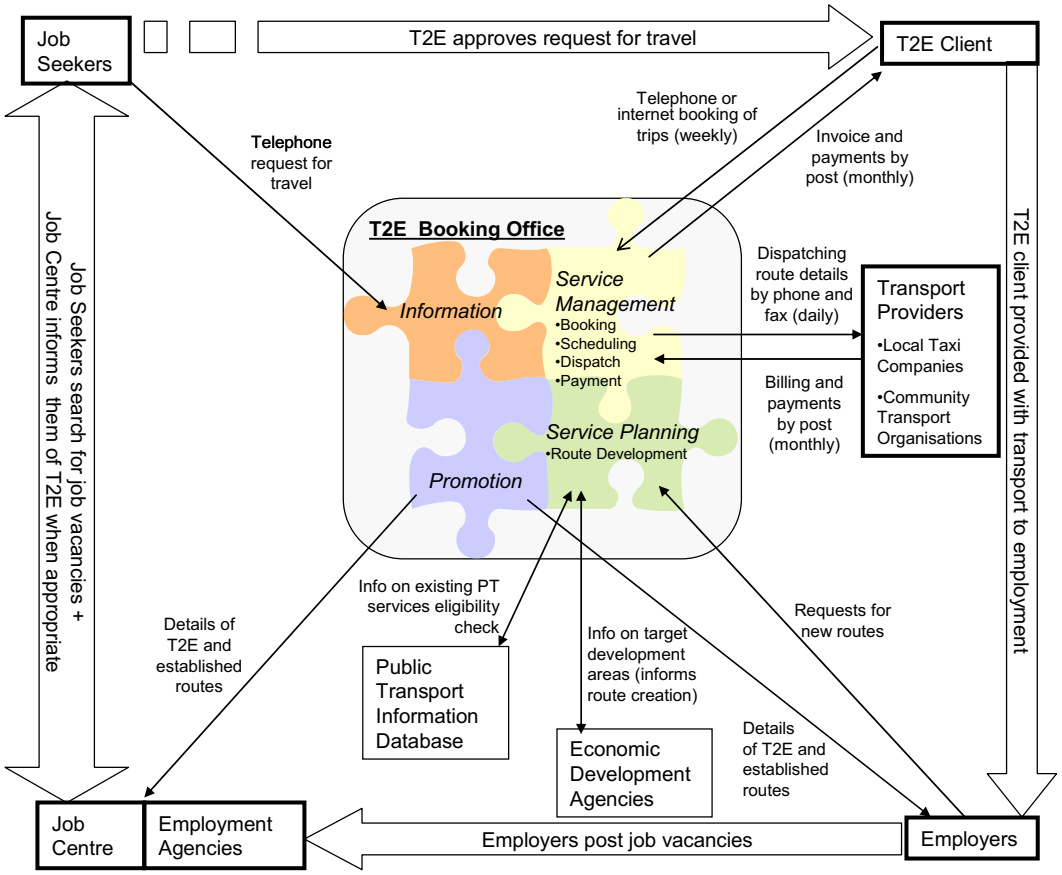

Fig. 2. Illustration of operational model for providing T2E services. Source: Wright et al. (in press).

adopted. Fig. 2 illustrates the processes and information exchange between all the different actors involved in delivery of the T2E services.

T2E has sought to operate on a low-cost basis, reflecting the need to provide reliable services without imposing fare levels that would themselves become a barrier to use. This has been achieved from a user perspective as targets for the number of users have been reached and high levels of satisfaction and acceptability have been recorded. However, detailed investigation of the passenger and route details shows that the majority of the routes are not self-supporting and require significant additional funding to maintain their operation. Wright et al. (in press) demonstrate that the social value created by T2E has been assessed against the project's investment (the grant funding) to assess its 'sustainability' using Social Return on Investment (SROI) analysis. This revealed that the combined benefit to individual user and the state is about £9000 per year, per user (while the user is still in employment) and that the measurable social benefits outweigh the investment by more than 3 to 1 for current usage patterns.

However, whilst T2E can be considered successful when measured against its objectives, it is typical of many of the successful UK schemes. It is small in terms of the numbers of passengers (although the geographical coverage is considerable) and it is targeted at a specific and identifiable group of patrons. The question as to why FTS schemes in the UK are small and often experimental in nature was the basis of the recent interest, by the UK Commission for Integrated Transport (CfIT), in the role of taxis as part of the public transport mix in rural areas. CfIT is an independent body advising the UK Government on integrated transport policy, established in 1998, which has aroused renewed interest in the potential for shared taxis following the publication of *A New Approach to Rural Public Transport* in November 2008. This examines the role that taxis and other demand-responsive transport services could have alongside more conventional public transport in rural areas and argues that the UK would benefit from demand-responsive transport schemes similar to those that have developed in the Netherlands and Switzerland (CfIT, 2008). Their recommendations are set against the background of the Eddington report (2006) (which examined the long-term links between transport and the UK's economic productivity, growth and stability, within the context of the Government's broader commitment to sustainable development), the Stern (2009) review on the economics of climate change and the 'Towards a Sustainable Transport System supporting economic growth in a low carbon world' agenda (DfT, 2007); all of which suggested that the UK Government is serious about providing an environment in which accessibility can be provided by public transport as a feasible alternative to reliance on the private care.

CfIT's work concentrated on rural areas (as compared with areas of low demand in general) because whilst poverty and social exclusion exist in both urban and rural contexts, the probability of becoming 'transport disadvantaged' in rural areas is higher. The study aimed to uncover the barriers to providing accessible public transport in the UK by examining the differences between successful FTSs in both the UK and Europe. As identified above, rural areas have specific problems which make conventional transport an unlikely solution: many of the demands for journeys are time sensitive (journeys to work, journeys for health purposes) and the assumption that these are simply journeys that can be combined to fill a single vehicle is just not practical. A more flexible

approach to public transport and one which recognised that matching of a collection of demands through a booking system to appropriately sized vehicles using vehicle brokerage could provide a sustainable accessible service for rural dwellers. In particular, CfIT was interested in examining the role that taxi-sized vehicles could play in the public transport mix given their success in certain parts of Europe.

Commentators often identify the deregulated nature of the UK institutional arrangements and the culture that exists which requires a high level of passenger contribution to the fare box as the main issues for the lack of a successful public transport service in the UK. However CfIT found that whilst there were of course differences between mainland European schemes and those successfully operating in the UK, these differences were greater than could be simply accounted for by the institutional framework. In particular, the most important findings included that many of the European schemes had political support at a national level and were planned at a regional level as part of an integrated network, that the schemes were larger in Europe than in the UK and that the operators saw FTSs as a 'job', in contrast to UK schemes where FTSs are often off-peak and use the spare capacity which is available in between the school trips and are often not included with existing arrangements for integrated ticketing and passenger information. Of course, a deregulated framework can impose difficulties for achieving sustainable public transport in rural areas not least because significant subsidy of services which run over parts of the commercial network could have the outcome of making the commercial network unviable. Moreover, because local authorities are responsible for funding non-commercial routes, routes are often seen as stand alone and their funding competes with the funding of all services which fall outside the commercial network. In contrast, mainland European country-level funding is more holistic, seeing passengers as passengers without the categorisation often found in the UK such as school children, mobility impaired, social services passenger or travelling for a health appointment. The more holistic approach benefits from a single budget for transport, often agreed at the national level (which may include national or regional targets for the provision of transport services) whereas the UK approach, because it is predicated on meeting a restricted set of needs often enshrined in legislation, has a number of different budgets which are the responsibility of different individuals within the local authority or related institution. Successful partnership between budget holders is a prerequisite to unlocking the benefits in these cases (Brake, Mulley, & Nelson, 2006).

The CfIT study and subsequent recommendations were based on the most in-depth research undertaken in the UK to date on taxi-based FTS with a remit specifically to examine barriers to implementation and a cost comparison between UK and mainland European schemes. The choice of schemes to examine was drawn from a long list of possible successful schemes both in mainland Europe and in the UK. For the UK, the largest known taxi-based FTS schemes were chosen (Connect2 in Wiltshire and Devon Fare Car in Devon) and yet, the mainland European schemes were five to fifty times bigger in terms of passenger numbers. The research also revealed that the greater scale of operation in mainland Europe tended to be associated with a lower subsidy requirement of under 40 per cent of gross cost in comparison to a typical larger UK scheme of between 60 and 80 per cent subsidy of gross cost and smaller UK schemes where almost all their gross cost is met through subsidy. Various explanations of this significant difference were explored and the conclusion was that the most likely reason is that the mainland European schemes are longer established and have therefore had longer to develop a patronage base and fare income as well as having been able to find ways of exploiting economies of scale. The economies of scale appear to come from a number of ways but very relevant to this discussion is the way in which the *RegioTaxi* scheme in the Netherlands has centralised booking throughout the country and there are likely to be additional economies in administrative overheads when there is a large operator running FTSs in more than one area. There may also be savings associated with acquiring and maintaining the vehicle fleet and certainly in the Netherlands, a more varied fleet is observed in this taxi-based scheme. Supporting this conclusion is the way in which the larger UK schemes, operated at a county level, are approaching the size where the costs and subsidy requirements are comparable to the mainland European schemes considered in the study. Added to this is the difference in culture between those schemes operating in the UK and mainland Europe. European schemes are generally seen as part of public transport, their operators seeing their contribution as part of the public transport mix in contrast to the UK, where FTS is regarded by local authorities as a way of providing public transport when there is spare capacity between essential services such as education services and by operators as a way of providing additional income when their vehicles would otherwise have low use.

Public transport generally has a role to play in the drive to contain the carbon emissions of the transport sector particularly if trips made by a private car in single occupancy are replaced by trips in vehicles which have multi-occupancy. In addition, if taxi-based trips replace conventional bus services there are the advantages not only of the use of a smaller vehicle, with lower emissions, but also that a flexible trip will only be made if it is requested by a passenger. There is a lack of documented evidence giving the comparative environmental costs of vehicles, even when the vehicles comply with specified regulations. In general, newer vehicles tend to be more fuel and emissions efficient and newer forms of energy as alternatives to petrol and diesel are known to be cleaner. The only evidence in this respect is from a recent modelling experiment looking at the emissions of DRT services as an alternative to more conventional services (Diana, Quadrifoglio, & Pronello, 2007). This considers a number of scenarios in an urban (North American), as opposed to a rural, context and concludes that the organisational form can have an impact on air quality pollutants. In particular, because DRT services have the possibility of using smaller vehicles, DRT services outperform fixed route services in almost all the scenarios tested. The environmental performance of public transport has such a role to play in improving environmental quality and this is an area that requires further research.

In summary, the evidence from the UK appears to suggest that recent improvements in ITS do allow improvements in the quality of FTSs and moreover, allow the provision of targeted services to specific users as in the T2E scheme described above thus allowing small FTS schemes to be judged successful by reference to the goals set. But in all UK schemes, the subsidy per passenger, the spatial scale of operation being limited to the geography of a county, services in general only being offered in the off-peak, and the relative 'newness' of the scheme work together to provide FTS operations which are more expensive, lower in spatial coverage and have a different culture than those in mainland Europe.

4. How to create successful and inclusive FTS in rural areas

In most countries, easily identifiable groups such as the mobility impaired or visually impaired often have rights in relation to transport accessibility enshrined in legislation. However, groups or individuals who are not so easily defined may also be transport disadvantaged (some literature uses the term 'transport poverty') and yet have no special services dedicated to remove the risk of

their social exclusion. The potential for being transport disadvantaged in rural areas is of course greater since low density and scattered populations mitigate against good public transport being available. The key factor in developing successful and inclusive FTS in rural areas is therefore an acknowledgement by policy makers that it is indeed important to enshrine the rights of all residents to a reasonable level of transport access as fundamental to providing a good quality of life and social inclusion. It is important that this commitment by policy makers should occur, for preference, at a national level if disparities in provision are not going to be marked thus making the essential transport accessibility a function of where an individual has chosen to locate.

It is often argued that for FTSs to be provided, fares need to be high in order to keep subsidy levels under control. This raises two, interrelated issues. First, the evidence from the CfIT study suggests that expanding the size and spatial scale of a FTS scheme allows economies of scale to emerge. Thus fares charged in the larger mainland European schemes were not generally below those charged in the UK schemes but the contribution of subsidy to gross cost was lower because costs were lower. Second, it is clear that the level of demand for journeys will be crucially dependent on the fare charged. There is a general perception that public passenger transport should have uniform fares, irrespective of the cost of provision so that bus fares and FTS fares in the same area should be the same. There is however clear evidence that the concept of a premium fare for a door-to-door service is acceptable and that passengers appreciate the superior level of service of FTS over fixed route (Nelson & Phonphitakhai, 2008). For FTSs, the fare charged should be more closely related to the cost of provision, in contrast to the uniform pricing practice of conventional public transport operations which must involve some degree of average cost pricing. Thus if a premium service of a door-to-door service is provided or a journey is provided at a specific time using a dedicated vehicle, then a higher price or 'fare' should be charged. And, if for example there was a choice between how the passenger could be served – maybe delaying their journey by 1 h and thus use a shared taxi or a journey when they want in a dedicated vehicle – then these alternatives would attract different fares. Fares which are based on a pricing policy more closely related to fundamental economic principles are likely to make the FTS more sustainable in the long run. This would not, of course, necessarily allow the rural 'poor' to escape social exclusion if fares were to be set at a level they could not afford and low income is recognised as the most important determinant of social exclusion. It would of course be possible to increase the level of subsidy to rural services to the point where those socially excluded through low incomes were able to travel. This would be an economically inefficient use of resources (as well as creating high subsidy bills) since individuals previously willing to pay the higher fare would now be benefiting from subsidy. It would be more efficient to introduce direct subsidies to low income travellers perhaps in the form of the Individual Travel Budgets recently investigated by the UK Department of Transport[5] as a targeted form of subsidy.

On the supply side, it is clear that an effective FTS must have access to a range of vehicles – both in terms of type (accessible or conventional car, for example) and size if demand and supply are to be better matched than is possible with a fleet of uniform vehicles. In the short-term this can be achieved by effective vehicle brokerage, perhaps by the creation of a dedicated brokerage agency but in the longer term this will emerge when operators of different vehicle types recognise that FTS is a service which can offer a full-time wage, rather than a way of providing income in the gaps provided by their main service as is the case in many UK schemes. This suggests that economies of scale may well be apparent from the involvement of larger operators as in the successful taxi-based schemes in mainland Europe but the FAMS approach, discussed above, may also offer a solution through using information technology to create a virtual agency.

Perhaps the biggest barrier to the successful and inclusive implementation of FTS in rural areas comes from the way in which they are valued by funding agencies. Where FTS schemes no longer exist it is often because they are regarded as 'too expensive' (this is typical in the UK). In the UK, many schemes were initially funded under central government grants and these FTSs have not been extended beyond this funding stream, partly because appropriate exit strategies were not devised but more importantly because they are not on current criteria regarded as worthy of subsidy. Local authorities, as the funders of services which are not provided commercially in the deregulated environment do indeed need to make choices as to where there is greatest value for money from their intervention. But their institutional framework does not allow them to consider the costs properly and most schemes are abandoned on the basis of the full costs of the scheme being too high without making the decision on an avoidable cost basis and allowing a scheme to continue until replacement investment is required. If more schemes had not been closed down on the basis of inability to recover sufficient of the full costs of operation, UK schemes might have achieved greater maturity which allowed the benefits of patronage growth to emerge. Moreover, whilst funding agencies do of course have to make decisions about where subsidy should be targeted, there is little discussion or comparison between the social benefits achieved by different types of route or service. This is particularly true in the UK where the deregulated setting means that subsidy to non-commercial routes is on a route by route basis in rural areas. Funding agencies often look strictly at costs and revenues and perceive subsidy as meeting this gap but the provision of accessibility to rural residents, who might otherwise be transport disadvantaged, creates a range of user and non-user benefits. User benefits include better access to employment, shopping and other activities such as visiting relatives or friends which enhance the quality of life and reduce social exclusion. Non-user benefits include the option value of having a service available in the future if needed (for example, if a person became unable to drive) as well as knowing that the service is available for others, such as relatives. The valuing of these benefits is not yet well established in the literature although initial work suggests they will vary by quality of service (and in the context of rural service, frequency is an obvious quality attribute) (ITS, 2006) and a proper evaluation of all service subsidy would allow a more defendable and efficient allocation to be made.

5. A research agenda for flexible transport services

It is clear that FTSs exist and create an accessible transport system for citizens in some countries but not in others. Some of the reasons for this are quite obvious with perhaps the most notable being central government support for national programmes. In all countries, the provision of accessibility in rural areas will be difficult without subsidy but the best FTS schemes have a level of subsidy not so different from conventional services when they have had enough time to mature and build their patronage base. A significant advance would be to understand how to include other services within an integrated transport policy, thus extending the options to include door-to-door bus travel, shared taxis and car clubs within a common set of flexible options. As information technology improves, the opportunity to introduce such a set of

[5] This research was carried out for DfT by the Centre for Social Research, Loughborough University.

flexible transport options where demand and supply are better matched increases. It is important to bear in mind that many technological solutions are available and that these do not preclude simple options (e.g. a TDC, GSM network and in-vehicle mobile phone). There is however a need to gain a greater understanding of the technological, organisational and operational requirements that are needed within the context of a more proactive approach to mobility management which exploits the overall range of transport resource available.

Within the context of environmental assessment, the evidence as to the benefits of more flexibly organised fleets using a mix of vehicle types is not yet proven. As identified above, there are clear benefits from the substitution of car trips by public transport trips if higher occupancy is achieved. But if a taxi, for example, travels to pick up a single passenger instead of that passenger using a car, there might be adverse affects from dead mileage. So a key to creating environmental benefits might be the creation of higher vehicle loadings. Environmental benefits may also come from the use of more environmentally friendly vehicles for public transport use as opposed to older, more emission prone vehicles of the individual. These issues require further research.

On the demand side there is a need to understand how to provide an integrated public transport network in rural areas that uses a mix of services that users are willing to pay for and for which low income travellers are not penalised. This requires an understanding of travel behaviour, the role played by fares in demand and further research on how to target subsidy at the low income transport disadvantaged rural resident. Perhaps more importantly it requires a clear appreciation of the kind of eco-sustainable and socially beneficial transport which will enhance the status of public transport as a viable alternative to the private car.

From an evaluation perspective, particularly in countries such as the UK where the subsidy for each route is transparent, there is a need to understand the benefits of subsidy in different situations so that resources are efficiently distributed between urban and rural areas and to capture the wider social benefits that flow from the provision of FTS. Importantly too, issues surrounding the partnership of different agencies that could come together to provide vehicle supply and the pooling of subsidy funds requires research. Whilst there is evidence that transport agencies can join forces, there is no real understanding of how to create strong governance so that partnership between providers is long lasting.

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