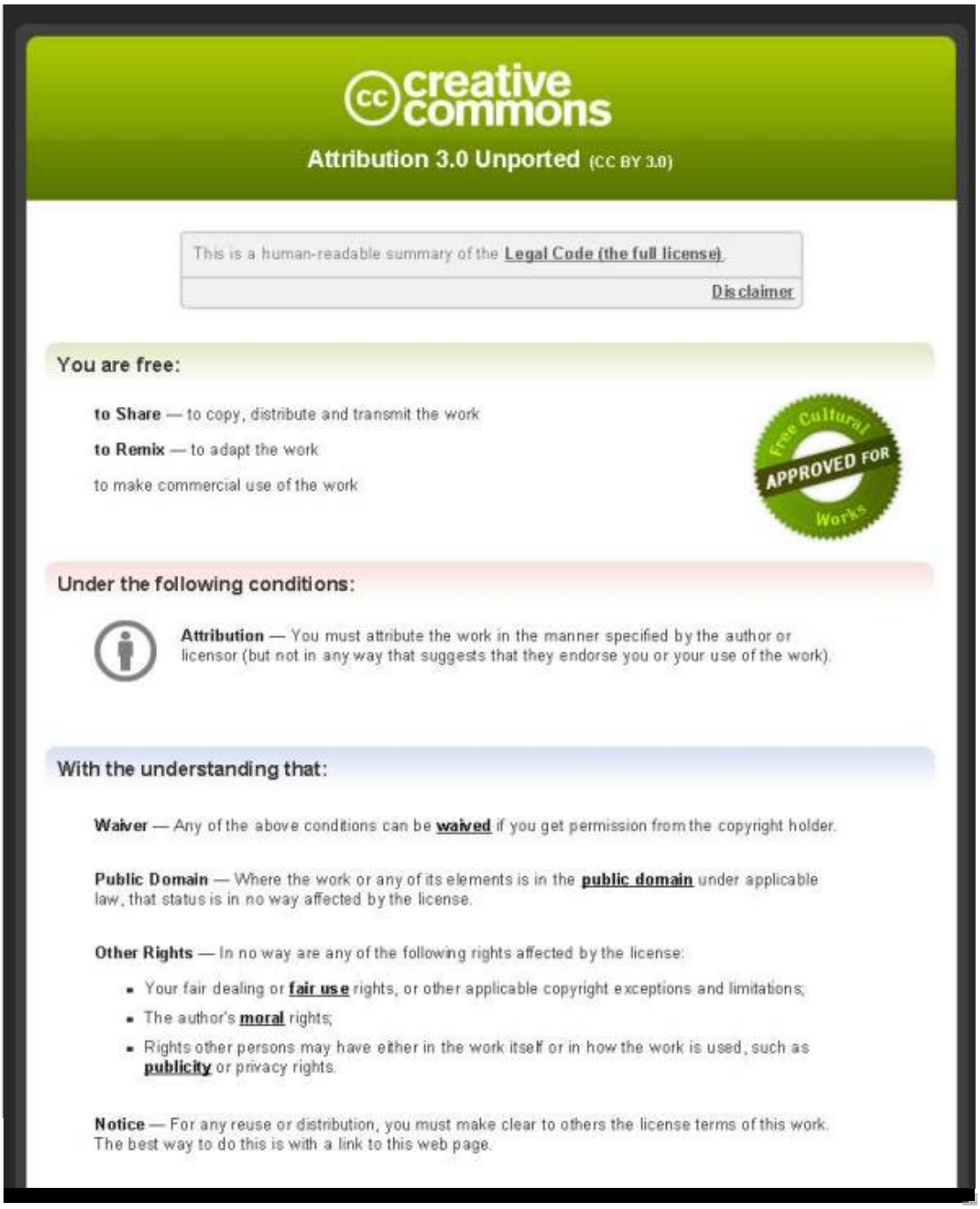

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A survey of Demand Responsive Transport in Great Britain

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ABSTRACT

Ever since the 1970s, Demand Responsive Transport (DRT) has been promoted as a transport solution in circumstances where more traditional services are not economically viable, although so far a range of barriers has prevented its widespread adoption. More recently, new developments in operational and vehicle technology, coupled with significant cuts to public transport subsidy budgets, promote a willingness to explore 'institutionally challenging' options such as integrating transport provision across a range of different sectors. This has once more pushed the DRT concept forward as a possible option for saving money whilst retaining opportunities for accessibility.

Accordingly, it is now useful to explore the current provision of DRT in Great Britain, in order to determine what type of services exist and to examine which are working well and why. Specifically, the paper draws on a national survey of DRT providers to examine the design, performance, rationale and likely futures of DRT schemes.

Key findings suggest a growing role for stakeholders from the voluntary sector and the private sector, the latter resulting in a greater use of smaller vehicles. Linear regression models highlight that passenger numbers are influenced by the size of operation (in terms of seats offered) and by the use of smaller 'car' vehicles, particularly in rural areas. Increasingly, objectives highlight the importance of DRT in providing access and geographical coverage, though insufficient revenue presents a challenge in achieving this. The long term financial sustainability of such schemes continues to be questioned, with a limited number of schemes recognised as commercially sustainable. Naturally, therefore, cost and funding remain dominant concerns of DRT service providers. The organisational response to funding reductions has been diverse. The result is that DRT services have either been withdrawn or, in some cases, replaced conventional bus services due to DRT being a more cost-effective way of meeting local needs.

1. Introduction

For the purpose of this paper, public transport can be categorised as being Demand Responsive Transport (DRT) if

- the service is available to the general public (i.e. it is not restricted to particular groups of user according to age or disability criteria or place of employment);
- the service is provided by low capacity road vehicles such as small buses, vans or taxis;
- the service responds to changes in demand by either altering its route and/or its timetable; and
- the fare is charged on a per passenger and not a per vehicle basis.

While such provision is common in economically less developed countries where institutional and/or land use factors prevent conventional buses from meeting demand (Cervero, 1997), in the UK and Western Europe as a whole such flexible transport options have largely been focused on meeting the needs of mobility impaired passengers.

Interestingly though, ever since the 1970s there have been a number of occasions when DRT has been seen as the solution to a variety of transport problems, particularly in circumstances where more traditional services are not economically viable, although so far a range of technological, social, market, economic and institutional barriers has prevented its widespread adoption (Enoch et al., 2004). Yet this lack of take up may be about to change.

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Specifically, there are three elements that are now coming together in this regard:

1. There have been a number of direct technological improvements to the DRT 'product' in terms of routeing and scheduling software for example, alongside more indirect technological implications arising from the widespread adoption of internet-equipped smart phones mean DRT is now potentially more efficient and effective than ever before.
2. There are wider societal trends including a rapidly ageing population and potentially far higher levels of unemployment, coupled with still rising car use (and its associated impact on increasing levels of car dependence in the form of, for example, lower density development) are combining to ensure that the need for non-private car-based transport is becoming increasingly important, although the ability of trains and buses to meet those needs is actually decreasing.
3. In the UK there are significant cuts to public transport subsidy budgets promoting a willingness to explore 'institutionally challenging' options such as integrating transport provision across a range of different sectors.

The aim of this paper, then, is to examine and assess the design and performance of DRT schemes in Britain and the conditions in which they operate, so as to evaluate which are working well and why. Specifically, it first reviews existing literature, and then explains the method adopted. Next, the current UK context relating to DRT is briefly explained, and the survey results are presented, before possible DRT futures are discussed and conclusions are drawn.

2. Previous work

2.1. Operational context

Considering the operating context, in developing countries DRT options typically serve busy urban corridors, thus attracting sufficient numbers of passengers to create a profitable service by being more attractive to users than public transport options by virtue of their being quicker and more comfortable (Adeniji, 1987; Vuchic, 2005, Cervero and Golub, 2007). Whilst often introduced in an unregulated market, the institutional and regulatory framework can evolve over time to be accepted as part of overall approach to supply, often in a manner designed to improve quality and safety but sometimes in a manner designed to reduce supply in the longer term (Finn, 2012). By contrast in economically more developed countries, DRT for the general population tends to be regulated, and most commonly operates in either suburban or rural areas of low demand thereby requiring subsidy, though there are some notable exceptions in niche markets (see for example Cervero, 1997; Davison et al., 2012).

2.2. DRT scheme design

In looking at the choice of vehicles for DRT, in rapidly developing cities such as Bangkok there are a whole range of types from motorised vans, cars and motorcycles, to man-powered pedicabs (Cervero and Golub, 2007). By contrast in economically more developed countries, the basis of current provision for the general public has mainly developed from transport designed for more specialist markets; particularly Dial-a-Ride provision for mobility impaired individuals (similar provisions are made in the USA in response to the Americans with Disabilities Act) or provision from the community transport sector (Brake et al., 2007). Such services are largely provided through the use of accessible minibuses, though more recently, there is recognition of an increasing diversity (e.g. Mulley et al., 2012). This has been driven in part by changes to regulations, together with evidence that taxis can provide a cost effective alternative to conventional public transport and DRT bus-based options in deep rural areas (CfIT, 2008; LEK Consulting, 2002). Whilst there is a risk that a diverse range of vehicle types held by an individual operator can lead to extra costs (Mulley et al., 2012), Mulley and Nelson (2009) explored how flexible transport systems organised via travel dispatch centres can now use technology to mitigate this, noting that institutional barriers are now the major block on progress in Europe, the USA and Australia. Interestingly, the Ghana Private Road Transport Union, as one of a number of organisations in Africa and Asia which has adopted a cooperative approach to DRT provision may offer a potential solution to this issue. Here, both minibus and shared taxi operations are combined under a single operation and regulatory regime (Finn, 2012).

In terms of service design, DRT is flexible across time and space. In developing countries, the 'jitney' or 'dolmus' concept of (largely) fixed route but non-scheduled DRT is particularly common, whereas in Europe and North America it is usually (though certainly not universally) the case that the timetable is fixed and the route varies (Enoch et al., 2004). TCRP (2004) defines 'flexible transit services' as being anything between an ADA service and a fixed route bus, and notes that route deviation, where vehicles operate along a fixed route but can accept request to deviate to meet demand, is the most common.

The level of technology used in DRT provision can be influenced by the size, scale and the level of flexibility, or in some cases the availability of funding (Enoch et al., 2004). In larger, more complex systems there is significant potential for technology to deliver efficiency in routeing and scheduling. This element of design is one area where there has been a greater proliferation in more developed countries, through projects including but not restricted to SAMPO and SAMPLUS, although a publication by the World Bank (2012) discusses how, for example, GPS tracking is being utilised in Jeepneys in Manilla.

2.3. DRT scheme performance

When introducing DRT, the rationale in developing countries has been essentially commercial, with private operators seeking profit, whilst in more developed countries such opportunities have been restricted to niche markets, e.g. airport shuttles (e.g., Ambrosino et al., 2004) meaning that social objectives have tended to dominate. This is highlighted by Laws et al. (2009), who in a survey of publicly funded DRT schemes in England, found the main motivations for introducing a scheme were either to social inclusion or else related to funding availability.

The rationale for introducing a scheme can in turn influence the performance, which can be considered both in terms of market appeal, and for subsidised schemes, of cost per passenger. The market appeal for public transport more widely, in particular road-based options, is largely identified as being the captive market without access to a car (White, 2009). As a solution to a lack of car access, DRT services can be highly resource intensive by nature, influenced in part by the expectations a 'Dial-a-Ride' type service (Brake et al., 2007). Of the English schemes surveyed by Laws et al. (2009) meanwhile, just over half required a subsidy of over £5 per person per trip with those operating in rural areas requiring higher levels and being less cost-effective than those with suburban or urban elements.

In learning from such experiences, Brake et al. (2007) suggest that for DRT to be commercially viable in the UK and Europe, providers of flexible transport options should pool resources and work in partnership to cater for need. Another solution is to price DRT fares to better reflect the service provided (Enoch et al., 2004). This in turn could attract commercial operators, who are generally absent from the UK market for example.

3. Methodology

The method adopted comprised a survey of public transport officers in Great Britain representing Transport for London and passenger transport executives (government agencies responsible for transport policy and planning in metropolitan areas), county councils and unitary authorities. The survey was also distributed to community transport (CT) operators (i.e. voluntary providers of DRT), though as Nutley (1988) also found identifying such organisations proved to be challenging. The survey took place between March and October 2011. Contact was initially made by telephone and then a link to a web-based survey was emailed to the most relevant person. Non-respondents were contacted a further two times, firstly as a reminder, and secondly to arrange a time for a telephone interview. The survey was also publicised via trade publications and respondents were encouraged to share the link with relevant contacts.

The survey expanded on the approach used by Laws et al. (2009), whose 2005 survey focused on a list of DRT schemes registered with the UK Department for Transport. In total, the survey questionnaire was sent to 36 authorities, responsible for 99 registered schemes, of which 28 authorities replied, providing and a response for 48 schemes (a response rate of 48%). The 2011 survey questionnaire also collected a range of scheme level data to allow comparison over time, as can be seen from the summary of content in Table 1.

The survey results were then analysed using both qualitative and quantitative methods, namely using discussions including verbatim responses to emphasise survey findings and descriptive statistics. In addition, a simple linear regression model was developed to determine the relative importance of the factors that influence the use of DRT schemes. The statistical relationship is shown as follows:

$$Y_i = \beta_0 + \beta_k X_{ik} + \varepsilon_i \quad (1)$$

in which, Y_i is the dependent variable representing passenger trips on all DRT schemes in a local authority area i, X_{ik} is a vector of explanatory variables such as the number of schemes in a local authority area, or the type of vehicle, k is the number of explanatory variables, ε_i is the independently and identically distributed error term with a zero mean and a constant variance, β_0 is the intercept and β_k is the slope coefficient for explanatory variable k. The model can be estimated using the Ordinary Least Squares (OLS) estimation method.

Table 1
Summary of questionnaire content.

Section heading	Overview of content
Background	Organisational information
Provider level data	Basic details of each scheme, how DRT is integrated with other public transport options and user needs, user and trip numbers, the vehicles and technology used
Scheme design for the most and least cost effective DRT schemes	Licensing, stakeholder involvement, financing including fares, user and trip numbers, objectives, and performance
Previous DRT schemes	How schemes have changed and the rationale for changes and withdrawals
Proposed and future DRT schemes	The reasons for introducing further schemes and how these services will differ from existing provision
Lessons learnt	How lessons learnt has informed design, stakeholder roles in overcoming future challenges

4. DRT regulatory framework in Great Britain

Prior to reporting the survey results, it is first helpful to be aware of the regulatory frameworks that apply.

In brief, DRT services can be operated by bus, CT, or taxi/minicab operators. However, the choice as to which runs a particular scheme is crucial, as it is this that determines exactly how each service is treated by the tax and insurance authorities, as well as by what legislation and regulations they abide by when licensing routes and/or service areas (Enoch et al., 2004). The options are summarised in Table 2.

First, DRT provided as a local bus service (Public Service Vehicle) must be registered with the Traffic Commissioners. Such services generally have nine seats or more and are eligible for Bus Service Operators Grant (BSOG) and reimbursement of concessionary fares, whilst passengers over the age of retirement or with a disability affecting mobility are eligible to travel for free on public transport. In addition, they are not liable for Value Added Tax (VAT).

Second, CT organisations (which operate on a not-for-profit basis) can provide DRT services on restricted PSV licences. Thus, exemptions under Section 22 of the 1985 Transport Act (UK Parliament, 1985) allow for the provision of a local bus service by a not for profit organisation. And Section 19 of the 1985 Act

Table 2
Summary of DRT operating regime options.

Licensing	Operator/route characteristics	Vehicle characteristics	Grant eligibility/tax status	User groups
Public service vehicle	Private for profit operator. Registered with Traffic Commissioners (TCs).	Standard licence: vehicles ≥ nine seats Special restricted licence: vehicles ≤ eight seats operating a local bus service[a]	BSOG[c]; national concessionary fares. VAT exempt.	General public
Section 22 permit	Organisation operating without a view to profit. Registered with TCs.	Vehicles with ≥ nine seats (permit may specify ≤ 16 seats) operating a local bus service[a]	BSOG[c]; national concessionary fares. VAT exempt.	General public
Section 19 permit	Organisation operating without a view to profit Registered with TCs.	Standard permit: vehicles ≤ 16 seats Large permit: vehicles ≥ 17 seats	Conditional access to BSOG[c]. VAT exempt.	Restricted to qualifying groups
Hackney carriage	Private for profit operator, registered with District Council. DRT route licence from TC.	Vehicles ≤ eight seats which can ply for hire[b]	None. VAT liable.	General public
Private hire vehicle	Private for profit operator, registered with District Council. DRT route licence from TC.	Vehicles ≤ eight seats which must be pre-booked	None. VAT liable.	General public

Sources: VOSA, 2011; VOSA, 2009.

[a] A local bus service can be of any overall length, as long as throughout its length passengers can get off within 24.15 km (15 miles) or less (measured in a straight line).
[b] Ply for hire: the ability to stand at ranks or be hailed in the street by members of the public.
[c] BSOG – Bus Service Operators Grant is a scheme that refunds some of the Fuel Duty incurred by operators of registered local bus services.

allows organisations operating without a view to profit for the benefit of the community to provide services to specific groups of users as recorded on the permit (though this can also include 'persons living within a geographically defined local community, or group of communities, whose public transport needs are not met other than by virtue of services provided by the body holding the permit' (VOSA, 2009, p. 20)). Note, some restrictions have now been relaxed under the Local Transport Act (UK Parliament, 2008). So, for instance larger vehicles can now be used under Section 22 permits providing all other requirements are met and smaller vehicles carrying passengers at separate fares can be used under Section 19 permits, whilst it also removes the restriction on driver earnings which formerly applied. In addition, CT operators are exempt from VAT, whilst some authorities responsible for strategic transport planning may also choose to extend the concessionary fare offer to services not registered as a local bus service.

Lastly, smaller vehicles, available for hire and reward, especially those which do not charge separate fares, must be licensed either as a hackney carriage (taxi) or as a private hire vehicle (minicab) within their local district council areas. These are then eligible to collect separate fares either through a designated pick up point (Section 10 of the Transport Act 1985), through advance booking (Section 11) or, in the case of taxis only, as a Taxibus (Section 12), though in the case of the latter a special restricted PSV licence is now required (VOSA, 2011). Hackney Carriages and PHVs are unable to claim for BSOG and are required to pay VAT.

5. Survey results of DRT schemes in Great Britain

The results are based on a response from 68 governmental organisations and 11 community transport operators – though it is worth noting that 11 governmental organisations, including Greater London Authority, reported that they were not involved in DRT provision. The response from governmental organisations equates to a response rate of 47% from authorities responsible for strategic transport planning across Great Britain, the latter received a far lower response rate though it is not possible to include a percentage value as the total number of CT operators is not known.

5.1. DRT schemes currently in operation

With reference to existing schemes, Fig. 1 illustrates scheme introduction and existence based on existing schemes only by organisation type. The earliest scheme which still exists was provided by a unitary authority, and was introduced in 1983. For unitary authorities generally, investment in DRT increased dramatically in the late 1990s coinciding with investment from central government, whereas, at least for the schemes still in operation investment from county councils has tended to happen later. There is also evidence of investment in DRT in a PTE area from 2008 onwards. Meanwhile community transport involvement in existing DRT schemes has increased steadily since the early 2000s.

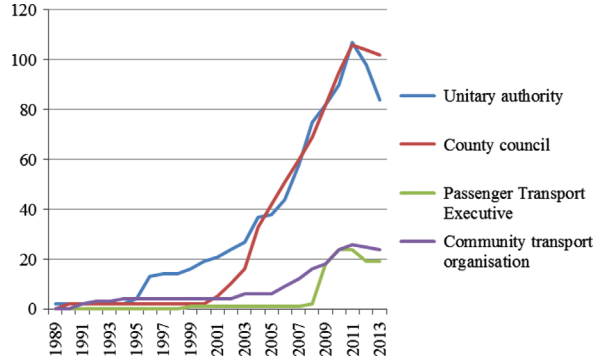

Fig. 1. Timescale of introduction of existing DRT schemes.

Both the county (typically more rural) and unitary (which are typically more urban) authority areas account for a large share of the schemes identified by the survey. However, the lower response from county councils as a whole suggests that the number of DRT schemes may potentially be greater in these areas.

5.2. Design of DRT provision

In this section the design characteristics of DRT schemes at the provider level are presented. Reference is also made to scheme levels data, particularly with reference to fare levels.

Details of the vehicles and technology used and integration with other public transport provision are presented in Table 3 alongside details of land use for the range of organisation types.

Whilst the small sample size does not allow for detailed statistical comparisons, these results further emphasise that the average number of schemes per organisation is highest for county councils. Furthermore there is greater flexibility in the vehicles used with a greater average number of cars and buses providing for demand in county council areas, whereas community transport providers

Table 3
DRT design elements by type of provider.

	County council	Unitary authority	Passenger transport executive	Community transport
Number of providers	**16**	**36**	**3**	**11**
Number of schemes				
Total	175	121	40	33
Mean	11.7	3.8	13.3	3.7
No response	1	7	0	2
Number of cars				
Total	127	40	0	33
Mean	9.8	1.8	0	5.5
No response	3	7	1	4
Number of minibuses				
Total	138	129	11	57
Mean	10.6	6.3	5.5	9.5
No response	3		1	4
Number of buses				
Total	9	9	0	2
Mean	0.7	0.3	0	0.3
No response	3	7	1	4
Total number of seats				
Total	1967	2267	148	1100
Mean	179.0	87.2	74.0	183.3
No response	5		1	4
Use of technology				
High	1	7	1	2
Medium	4	8	1	1
Low	4	6	1	3
None	1	5	0	0
No response	6	10	0	5
Coordinated with other transport options (e.g. school transport)				
Yes	11	11	0	2
No	3	23	3	8
No response	2	2	0	1
Integrated with other options (e.g. fixed route bus services)				
Yes	10	18	2	4
No	4	17	1	6
No response	2	1	0	1
Land use				
Urban	0	19	3	1
Rural	16	17	0	10

were particularly reliant on minibuses, most likely influenced by the service registration options, which have recently been relaxed (see earlier). Both community transport operators and county councils have, on average, a higher number of seats across an area when compared to unitary authorities and PTEs (though in the case of the latter this is probably more heavily influenced by poor data availability). Based on the information available there is a limited difference between providers as to the level of technology used. Comparing use of technology by function, the main functions at present relate to communication and booking, though it also has a role in timetabling and scheduling DRT services.

County councils are more likely to coordinate DRT for the public with other transport provision and they are almost more likely to integrate DRT services with other forms of public transport. Coordination involves using the same vehicles for other transport provision, to cater for adult social care and educational needs, which include special educational needs, post 16 and mainstream education; similar to the types of services provided through a human services agency in the USA. The main reason for doing this is to increase the viability of the service through fixed financial investment, particularly when public demand is low, or alternatively to make best use of resources or reduce overall costs. The coordination is achieved either by accommodating users on public DRT or, by reserving vehicles as required. Whilst service integration, linking DRT journeys with other public transport option is achieved either officially as part of the scheduled design or unofficially when sensible connections occur.

When examining the non-concessionary fares for each scheme, the per trip fare level ranged between £1.00 and £8.00. Of the 52 schemes for which fare information was provided, 14 did not offer concessionary fares, three offered them at half the standard fare, whilst 35 offered free fares to those eligible, being reimbursed from national or local government funding sources. This is significant as 31 of the DRT schemes carried passengers where more than 75% of passengers are eligible for concessionary fares.

Next, the survey revealed that the main motivation for introducing a DRT scheme ahead of a more conventional public transport option was due to the following:

- The rural nature of an area '*DRT solutions have been chosen in rural areas where there are few passengers spread over many small settlements. Conventional solutions tend to produce either convoluted routes, irregular services or both*'.
- The mobility needs of passengers '*The schemes are principally targeted at people who find it physically difficult to use conventional public transport services because of mobility issues or remoteness from services*'.
- The withdrawal or unavailability of a service bus '*The DRT schemes are introduced where conventional services were not provided commercially and a full tendered service could not be justified*'.

When considering the main motivations for introducing DRT schemes the majority of respondents introduce schemes to cater for social need, for example: '*To enable residents of the villages to access town services*' and to improve accessibility, for example: '*DRT provides an effective transport solution to settlements that are not served by traditional fixed bus services*', 57 and 52 in agreement respectively. In addition, 43 respondents identify funding availability as a motivator, this includes initial funding from rural bus challenge and more recent funding to support the third sector in providing local services, as part of the '*big society*' agenda, which encourages the local community, including voluntary groups, to respond to local needs (see The Cabinet Office, 2010). Fewer respondents recognise the environment (23 organisations), cost reduction (20) or modal shift (15) and only five respondents are motivated by each commercial opportunity and business reasons.

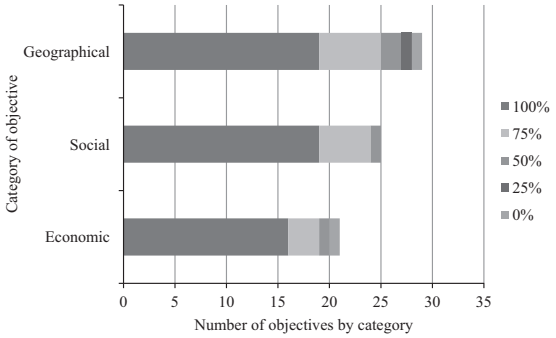

Fig. 2. Scheme objectives by category and achievement extent.

For respondents selecting 'other reasons' responses included improving journey times, catering for specific social needs such as providing a link to the hospital and providing a cost effective service.

5.3. Performance of DRT schemes

In this section the performance of DRT schemes is reviewed, specifically in terms of criteria including the degree to which DRT schemes meet their objectives, the numbers of trips they carry, and the levels of subsidy they cost. It also gives details of the responses made in cases where services are underperforming or not performing as expected.

Obviously, the motivations previously discussed have a clear link to the objectives which the performance of a scheme is assessed against, and from the survey these can be summarised as being geographical, social and economic. As illustrated in Fig. 2, DRT is perceived by the respondents as being generally effective in meeting such objectives across each of the categories. Within Fig. 2

- 'Geographical' relates to providing accessibility, including when conventional bus services have been withdrawn, for example. '*To improve access from rural areas*' or '*To replace [a conventional] bus service*';
- 'Social' refers to providing for the social need of a population or a segment of the population, for example, '*Supporting people to live in the community*'; and
- 'Economic' refers to DRT being introduced in order to provide a more cost effective, or affordable service, for example, '*Better use of subsidy funding*'.

In a small number of cases objectives are not being adequately met. Whilst the objectives cover the range of categories, the reason for not being able to meet them is predominantly cost related. Specifically, funding availability is identified as '*the primary enabling factor*' in ensuring DRT scheme success, such that revenue funding streams are now recognised as being vitally important in influencing the scope of DRT provision: '*Capital funding was key in getting very high quality accessible buses but revenue funding is very challenging and can limit scope*'.

Cost effectiveness is highlighted as essential when selecting DRT as a transport option. Indeed, for some authorities introducing DRT schemes has been seen as offering a way to continue providing public transport in response to budget cuts. '*The requirement to reduce the local bus budget by £1m has led to the need to consider DRT against withdrawing of services completely.*' A further factor influencing the introduction of DRT is the response of local politicians, for instance '*members, after hearing of such a scheme elsewhere in the country, have determined that this is an idea we should be pursuing*'. Thus, in cases where the members are supportive of the scheme then they tend to push it forward,

Table 4
Scheme characteristics by per trip subsidy level.

	No subsidy	£0.01–2.00	£2.01–5.00	£5.01–10.00	£10.00–20.00	£20.01+	Total
Number of Schemes	**4**	**5**	**20**	**19**	**8**	**8**	**64**
Annual passengers per scheme							
Total	26,844	24,110	30,739	4139	1149	2700	
Mean	8948.0	8036.7	2794.5	689.8	287.3	900.0	
No response	1	2	9	13	5	5	
Annual trips per scheme							
Total	48,820	48,877	167,503	137,898	24,376	1536	
Mean	16273.3	24438.5	13958.6	11491.5	4062.7	768.0	
No response	1	3	8	7	2	6	
Cost effectiveness of scheme							
Most cost effective	3	4	19	12	1	2	41
Least cost effective	1	1	1	7	7	6	23
Scheme expected to be sustainable							
Short term	1	1	7	7	3	2	21
Medium term	1	2	7	10	2	2	24
Long term	3	2	8	9	2	3	27
No response	0	0	2	0	0	1	3
Exit strategy							
Yes	0	1	7	2	2	3	15
No	4	4	12	15	6	5	46
No response	0	0	1	2	0	0	3

although the opposite can also be true and if the politicians prefer a conventional bus service for their constituents then it is difficult to transfer investment to DRT.

As illustrated in Table 4 per trip subsidy for provision ranges between schemes operating without subsidy to in excess of £20 (the highest subsidy reported is £93 per trip, although the second highest is £34), the majority receive £2.01–5.00 or £5.01–10.00 per trip.

Details were provided for the most cost effective schemes and conversely the least cost effective schemes, noting that some respondents only have one scheme to report on. There is clear differentiation in per trip subsidy for these schemes which is influenced by some of the other factors. In assessing a scheme as being cost effective the majority of respondents refer to low levels of subsidy per person or high occupancy rates: '*[DRT is] most established with a lower per passenger subsidy and higher usage*'. This is also identified as a function of design, for instance, services that do not operate when not booked, or when the level of flexibility provides most efficient use of vehicles: '*We provide a fully demand responsive service, with the flexibility to schedule multiple passengers to one vehicle through an effective booking system.*' Both technology-based and manual booking systems are identified as elements of a cost effective service, though one example in particular highlights the benefits of using taxis: '*Taxi-buses have very competitive operating prices, plus the booking function is achieved at a near-zero additional cost on top of the core business of a taxi firm.*'

Less cost effective services are identified, in part, for opposing reasons '*high cost and low vehicle occupancy*', which can occur when forecasted demand is higher than actual demand. Alternative reasons are driven by service design and the target audience. Providing vehicles to high specification, computerised booking and long operating hours are identified as requiring upfront investment '*however, these costs were considered necessary to get quality and accessibility of service*'. Furthermore, in another case capital front end costs are expected to take '*a 3-year period to become sustainable and generate funds to replace older vehicles.*' Also, with certain target groups, e.g. journeys to the hospital, the high cost of the journey can reflect the user needs, for example door-to-door provision and trained personnel accompanying the passenger(s) and be justified on that basis.

The key finding here is that no more than half of all schemes reported are expected to be financially sustainable in the future, even for those operating at a relatively low per trip subsidy, a proportion which falls to only a quarter for those schemes currently receiving a higher per trip subsidy. Yet despite this seeming lack of confidence, only 15 organisations have a formal exit strategy in place should the scheme be forced to cease operating, although a further 15 schemes without a formal strategy include details of what would happen in that event. Unsurprisingly perhaps, such plans typically involve reducing investment in schemes and/or drawing on alternative budgets (e.g. from social service, education or conventional bus subsidy funding streams) and then providing a more integrated service.

To determine the relative importance of the factors that influence the use of DRT schemes a linear regression model was developed. Summary statistics of the data employed in the model are presented in Table 5.

The linear regression model shown in Eq. (1) was then fitted with the survey data shown in Table 5. The results are presented in Tables 6 and 7.

In the event, two models were derived. The first, (see Table 6) had a model fit (adjusted *R*-squared value) of 0.65 from 28 observations, and saw only 'number of seats' being significant at the 95% confidence level (**). Specifically, every additional seat provided by a DRT service generates an extra 165 trips per year would result, or in other words a 1% rise in seats leads to an increase of ridership of 0.79% *ceteris paribus*.

Meanwhile the second model, (reported in Table 7) replaced number of seats with 'number of vehicles' and had an improved model fit of 0.72 (from 34 observations). Once again, only one variable (number of vehicles) was highly significant, indicating that ridership increases by 2363 for every extra vehicle provided, or that a 1% increase in vehicle numbers leads to a 1.01% increase in patronage. Moreover, in addition in the second model, 'use of booking/reservation software' and 'type of mode' were on the way to being significant with a confidence level of 83% in both cases, thus suggesting that schemes with more riders are more likely to rely on technology and on buses as opposed to taxis.

Table 5
Summary statistics of variables included in the model.

Variable	Observations	Mean	Std. dev.	Min	Max
Passenger trips on all DRT schemes in a local authority area in 2010	30	90,245	423,765	50	2,327,300
Number of schemes by local authority	59	6.254	8.683	1	41
Number of seats by local authority	43	209	254.8765	22	1495
Number of vehicles by local authority	53	18.54717	20.94091	1	113
Land use type	67	Rural=61%; urban=39%			
Use booking or reservation software?	67	Yes=66%; no=34%			
Type of mode	50	Bus-based=72%; other (e.g. taxi-based)=28%			

Table 6
Estimation results for linear regression model 1.

Variable	Coefficient	*t*-statistic	*p*-value
Number of schemes by local authority	289.02	0.29	0.78
Number of seats by local authority	164.74	6.15	0.00**
Land use type (Rural=1; urban=0)	11,853.68	0.82	0.42
Use booking or reservation software?	10,783.92	0.76	0.46
Type of mode (Bus only=1; otherwise=0)	2519.64	0.14	0.89
Intercept	−7769.25	−0.43	0.68
Adjusted *R*-squared	**0.65**		
Number of observations	28		

** Significant at the 95% confidence level.

Table 7
Estimation results for linear regression model 2.

Variable	Coefficient	*t*-statistic	*p*-value
Number of schemes by local authority	794.53	0.99	0.33
Number of vehicles by local authority	2362.60	7.23	0.00**
Land use type (Rural=1; urban=0)	13,254.73	1.08	0.29
Use booking or reservation software?	16,258.55	1.38	0.18
Type of mode (Bus only=1; otherwise=0)	22,209.03	1.38	0.18
Intercept	−34,670.22	−2.16	0.04
Adjusted *R*-squared	**0.72**		
Number of observations	34		

** Significant at the 95% confidence level.

5.4. Perspectives on the future of DRT

Over recent years the context, design and performance of DRT have changed in order to better provide for demand and the needs of the passenger. These changes are summarised in Table 8 and have a strong influence on the future plans for DRT.

Specifically, respondents identify a growing role for taxis, plus potentially commercial bus operators and further integration of DRT with other public transport options. Some local authorities also expect to plan services aimed at catering for a wider market, for instance using DRT to meet commuter need or merging of services to create economies of scale: '*Sample data suggests that cost saving and service improvements can be achieved through enabling more shared use of service provision by existing stakeholders*'.

Overall though, the future of DRT in Great Britain remains uncertain due mainly to the lack of funding in the current economic climate. Indeed, respondents effectively saw two possible (diametrically opposite) outcomes as a result of this.

Thus, firstly DRT schemes will be withdrawn, either generally '*unless passenger numbers can be increased, DRT could diminish*'; or specifically '*all DRT is likely to cease in 2012 due to withdrawal of funding*'.

Meanwhile the second scenario would see the role of DRT increasing. This might be

- in response to a decrease in investment in fixed-route bus service provision, '*I predict an inevitable growth as local authorities are forced to make more savings*';
- as a result of the increased focus on third sector contribution to local services: '*The Government's "Big Society" may lead to an increase*'; or
- to cater for the needs of a less mobile population '*It may expand to cope with increased demand among people with impaired mobility*'.

Where DRT remains, local authorities recognise it as primarily meeting rural demand, remaining a niche market product into the future. This is due to the relatively high cost of providing conventional forms of public transport in such areas. Additionally, community transport and taxi/minicab operators, are identified as having a growing role in the future.

6. Discussion and conclusions

This paper has reported the current status of Demand Responsive Transport (DRT) schemes in Great Britain, based on the response of 68 government organisations (i.e. 47% of authorities) and 11 community transport operators, it identifies 369 current DRT schemes.

Looking at the context of DRT, comparisons can be made between the 2005 (Laws et al., 2009) and 2011 surveys firstly as to the motivations for introducing such schemes. Thus, in 2005 the key motivations were funding availability and social need, whereas in 2011 key motivations are social need followed by improved accessibility. Related to this, a further 2011 motivation is to 'fill the gap' caused by the withdrawal of conventional bus services. Second, there are also distinct differences in the objectives for introducing a scheme. So, in 2005 many objectives were related to 'social need' in terms of people accessing services, whereas this emphasis had shifted by 2011, focusing more on the geography of the location(s) served (e.g. in terms of an area's 'rurality'). Next, the importance of the environment as an objective for DRT schemes has apparently declined over last few years, from being a 'secondary' objective in 2005 to being almost ignored in 2011. Such shifts would seem to emerge from the reduced importance in national funding, meaning that it is now local rather than national needs that predominate.

Interestingly, this devolution of responsibilities is also reflected in scheme design, such that a greater range of local stakeholders now appear to be involved in planning DRT services, including parish councils, district councils, local community groups and commercial operators. Other characteristics of scheme design meanwhile were that the majority of services are provided using minibuses, although taxis were actually recognised as providing a more cost effective solution when demand is low, concurring with the findings of LEK Consulting (2002) and CfIT (2008). The scale of DRT provision and the diversity of vehicles used were highest in

Table 8
Developments in design, performance and context of DRT.

	Lessons learnt
Context	DRT provision is increasingly identified as a 'deep rural product' rather than an urban solution. Although successful urban examples exist
	Integration, rather than duplication of existing public transport provision is highlighted as an important element of design in context
	Dial-a-ride and community transport provision has influenced current DRT design and these stakeholders are expected to have a growing role
Design	Investment in planning and consulting at the design phase is essential
	Growing role for technology to assist with coordination and booking
	Increased focus on how taxis can deliver cost-effective DRT provision
	Level of flexibility provided needs to be area and investment specific
Performance	Good communication between stakeholders supported by training as required ensures a positive user experience
	Marketing is required to increase awareness about booking and use of DRT
	Recognising the full cost of provision, in particular the expense of certain elements, such as call centres, is essential

more rural counties, though the number of seats provided was lower than that of community transport operations, in part because of a greater use of smaller vehicles. Finally, in some cases the flexibility of provision has grown in response to an increased knowledge of demand. For other services, fixed times of operation have been introduced to make best use of resources to encourage sharing and to manage customer expectations about the capabilities of DRT. Linked to this, as funding is withdrawn, there is a feeling that there is likely to be a growing role for DRT in ensuring at least some semblance of geographical coverage.

Looking at the performance of DRT schemes, the results of the survey demonstrated that funding, or the commercial potential for DRT, continues to be the factor which requires the most attention from practitioners and policy-makers. However, the evidence would suggest that the removal of Urban and Rural Bus Challenge funding has not had as uniformly negative an impact as expected (e.g. in Enoch et al., 2004; Brake et al., 2007; Laws et al., 2009). Instead, whilst some schemes were withdrawn in several cases follow up investment was sourced most often from other council funding streams.

Although the survey was designed to answer some deeper questions best suited to a qualitative response, the linear regression models from the questionnaire survey have attempted to determine the relative importance of the factors that influence the use of DRT schemes. Albeit the sample size is small, the included variables can explain about 72% variation in DRT trips by Local Authority. The purpose here is to generalise the findings (i.e. inferential statistics) so as to draw significant conclusions from the more quantitative elements of the survey. In seeking to explain the key 'success factors' of DRT schemes meanwhile, an analysis of the survey results showed a strong relationship between the number of DRT trips and the number of vehicles and the number of seats, whilst the second model also implied a (less certain) connection with use of technology and type of mode. Specifically, better used schemes provide more seats and vehicles, and are more likely to use booking and reservation software and buses instead of taxis – all intuitively sensible findings.

As to the future, the perception of the majority of DRT providers is inconclusive. There are two distinct views on how DRT will respond to the economic downturn, one where it plays a growing role in maintaining geographical coverage and social inclusion, the other where there is simply not the funds to sustain such schemes. Should funding be available it is expected that DRT will continue along a similar trend, with a growing role for taxis, increasing '*deep rural*' provision and greater local decision-making as to the level of flexibility.

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