DESIGNING FLEXIBLE TRANSPORT SERVICES: GUIDELINES FOR CHOOSING THE VEHICLE TYPE AND LEVEL OF FLEXIBILITY

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Abstract

A recent report by the Passenger Transport Executive research group concluded that cuts in local government funding as a result of the 2010 spending review will lead to a 20% reduction in bus services. Furthermore, 70% of councils in England have already reduced funding for subsidised services or increased fares. It is also expected that the 20% cut in the Department for Transport's bus service operators' grant, planned for 2012-2013, will further impact on bus services with the withdrawal of many routes which were previously regarded as stable and commercially viable.

All of this is leaving local communities and vulnerable users more isolated, particularly in rural areas. As a result local authorities are being forced to look at new ways of maintaining services while still reducing costs. They have once again begun to seriously consider the role that flexible transport services (FTS) or demand responsive transport could have within local transport infrastructure provision.

This paper offers a new approach to guide local authorities in the selection of the most appropriate vehicle types and levels of service flexibility which should be offered in the design of FTS for different environments. The guidance is evidence based and has been derived from detailed analysis of the economic performance of seven FTS pilot applications plus a further five feasibility studies conducted as part of the FLIPPER project (funded by the EU Interregional Cooperation Programme INTERREG IVC). A major conclusion from the analysis is that the product of the demand multiplied by the average trip distance provides a very strong indicator as to the type of vehicle which should be used and the level of flexibility which should be offered.

The paper will introduce the FLIPPER project and the FTS which it has supported. The data collected to enable cross site evaluation of these services will be described and the results of the analysis presented. Finally a set of service design recommendations on vehicle type and service flexibility are provided for different environments (displaying different levels of demand and average trip lengths).

It is hoped that this will prove to be a valuable aid in helping decide on the most suitable and cost effective FTS solutions in both urban and rural environments across Europe.

Introduction

A recent report for the Passenger Transport Executive research group (MVA Consultancy 2011) concluded that cuts in local government funding as a result of the 2010 spending review will lead to a 20% reduction in bus services. Furthermore, 70% of councils in England have already reduced funding for subsidised services or increased fares. It is also expected that the 20% cut in the Department for Transport's bus service operators' grant, planned for 2012-2013, will further impact on bus services with the withdrawal of many routes which were previously regarded as stable and commercially viable.

All of this is leaving local communities and vulnerable users more isolated, particularly in rural areas. As a result, local authorities are being forced to look at new ways of maintaining services while still reducing costs. They have once again begun to seriously consider the role that flexible transport services (or demand responsive transport) could have within local transport infrastructure provision.

Broadly speaking, Flexible Transport Services (FTS) are transport services which differ from conventional public transport in that they do not run on fixed routes. Rather, the route and timings are determined by user demand. The key characteristics are that they require pre-booking and operate on demand.

FTS have been around since the 1970's in the form of Dial-a-Ride services for the elderly and disabled and other specialist transport services for restricted groups. Since 2000 there has been a shift in social policy across many European countries as part of the accessibility and social inclusion agenda (CEC 2003, SEU 2003). In the last decade the EU has introduced several directives and regulations aimed at making the entire public transport system more accessible and useful for all and there is a move from focussing on providing dedicated services for disabled people (especially mobility impairments) towards accessibility for all people. Flexible transport services for the general public have been increasingly viewed as a means of meeting this need in improving accessibility for all in rural areas (Nelson et al 2010). Many services have been introduced to plug gaps in the transport network and to act as feeder services to accessible mainline conventional bus or train routes which exist

Since 2003, many services have been introduced in the UK on social inclusion grounds, often with the impetus of a time-limited external grant, such as the Rural or Urban Bus Challenge fund (Brake et al 2004). There has been considerable monitoring and evaluation of many of these services (Mageean and Nelson 2003, Scottish Executive 2006, Laws et al 2009) which has revealed that although they do provide a socially important lifeline for many of their users, the cost of provision based on passenger numbers tends to be high - daily passenger numbers are relatively low, fares are often equivalent to conventional buses and total fare revenue often doesn't even cover drivers wages. The impact of this has been that many services introduced on social inclusion grounds have subsequently been withdrawn or face the threat of withdrawal on financial considerations because they are not sustainable without continued external funding. For instance of the six counties featured in Brake et al 2004 (West Sussex, Surrey, Gloucestershire, Lincolnshire, Wiltshire and Northumberland) which introduced FTS with RBC funding, only Lincolnshire and Wiltshire still provide flexible services for the general public.

It is therefore clear that if FTS are to offer a viable option of maintaining services, while still reducing costs compared to supported conventional bus services, more considered choices are required when designing and commissioning the services.

In some European countries there is a history of using taxi operators to provide FTS (Westerlund and Cazemier 2007, Mott MacDonald, 2008). Taxis offer an already existing vehicle resource as well as a booking capability and hence can offer significant reductions in operating costs. Until recently the UK has provided limited examples of taxi operators providing FTS. The Transport Act 2008 made a number of amendments to previous legislation (primarily the Transport Acts of 1985 and 2000) which reduced legislative barriers to community transport and taxi operators providing FTS. It relaxes restrictions on the sizes

of vehicles that may be used on registered local bus services, including FTS, creating a more level playing field to allow community transport and taxi operators to entitlement to the same subsidies and opportunities as commercial PSV operators (see Halcrow Group 2009). Local government guidance on the LG Improvement and Development website[1] promotes the use of shared taxis for providing DRT. They state:

> *"Taxis are a much underused mode by procurers of DRT. And yet there are few places where the availability of shared taxi opportunities would not add value to public transport networks by offering a lower-cost alternative to private taxis."*

There is now an increasing trend in the UK of using taxi operators to provide FTS. However, the guidance on when it is better to consider taxis or minibuses for a particular FTS is lacking. Several resources and documents to help in the design and implementation of FTS do exist (Ambrosino et al 2004, Enoch et al 2004, Brake et al 2006, TCRP 2009, Brake et al 2010) but these tend to provide general guidance rather than prescriptive rules on particular aspects of design. Within these documents it is stated that degree of flexibility and choice and size of vehicle depends on level of demand (and availability of suitable operator/vehicle) but the guidance stops short of detailing the ranges within which different vehicle types and levels of flexibility are likely to be most appropriate.

This paper offers a new approach to guide local authorities in the selection of the most appropriate vehicle types and levels of service flexibility which should be offered in the design of FTS for different environments. The guidance is evidence based and has been derived from detailed analysis of the economic performance of seven FTS pilot applications plus a further five feasibility studies conducted as part of the FLIPPER project (funded by the EU Interregional Cooperation Programme INTERREG IVC).

The next section of the paper introduces the FLIPPER project and the FTS which it has supported. The key results from the analysis of a cross site evaluation of these services are then presented. Finally a set of service design recommendations on vehicle type and service flexibility are suggested for different environments (displaying different levels of demand and average trip lengths).

FLIPPER project and pilot FTS implemented

The overall objective of FLIPPER is the transfer of experience, knowledge and good practices about Flexible Transport Services (FTS) among different European Regions with the aim of increasing the social inclusion of disadvantaged citizens groups and/or areas, reducing energy consumptions and environmental impacts thus encouraging sustainable social/economic growth. This has been achieved though Knowledge Transfer via Training courses, Workshops and dissemination activities and by Knowledge Raising activity amongst partners realised through the development of 11 FTS feasibility studies, 7 of which have been followed through to full pilot applications. A summary of each pilot site is given below:

- **ITALY, Borgo Panigale (Bologna)** - *"FTS for urban area in Bologna, Italy, with the function to link a low density area with main transport service line and the local administrative centre".* Before the introduction of FTS there was no PT service in the area. The FTS will provide access from the rural community to local facilities and also act as a feeder service to the nearest main PT lines including main urban and long-distance routes to and from Bologna city centre. Existing limousine (private hire taxi) services are utilised to provide the service with the operators receiving a retainer fee plus any fares collected. An existing dispatch centre employing open source software is utilised for bookings. The service is open to everyone. The service operates from Mon. to Fri. (7.00am to 8.30pm) and on Sat. (7.00am to 1.30pm).
  - *Main characteristics: rural area; open to all; retained taxi service; shared booking resource; fully flexible; feeder to main PT line.*

[1] LG Improvement and Development (formerly the IDeA) supports improvement and innovation in local government by working with councils to develop and share good practice: http://www.idea.gov.uk/idk/core/page.do?pageId=15947041

- **AUSTRIA, Purbach** - *"Ensuring an attractive sustainable mobility service which is affordable and protects the environment."* Purbach is a small and relatively compact town (2700 population) with rural surroundings. It is located next to the lake Neusiedl, an important recreation area for the surrounding regions, including Vienna which is about 1 hour away. Before the launch of the FTS, which is called "GmoaBus", there was no public transport supply available for internal trips in the settlement as the regional bus line and the railway line serves only one stop within the settlement. The GmoaBus is operated with only one 8 seat bus with low-floor and double-wing door. There is no taxi operator in the settlement. The GmoaBus can be ordered only by directly phoning the driver and provides a door-to-door service from and to any address within the settlement. No dispatch centre or software is used. Operation times are Monday to Friday from 5 am to 9 pm and on Saturday from 8 am to 12 am.
    - *Main characteristics: medium density; open to all; contracted minibus service; low tech; fully flexible.*

- **GREECE, Kastoria** - *"DRT service for meeting demands of locals and tourists in the Municipality's area in Kastoria city."* This pilot service is delivered by the Union of Taxis in Kastoria consisting of 70 local taxi operators. The taxi vehicles continue to operate as taxis but are available, when not already booked, to deliver the FTS known as KALOstous. A "cooperation agreement" has been established with the Union of Taxis. This describes the concept and the details of the service including the fares structure, and defines the roles and responsibilities of the partners). The operators keep all fares collected and no retainer fee or contract charge is levied. The telephone call centre of the Taxis Union of Kastoria operates also as a booking office of the new FTS. Therefore, it was not necessary to establish a new call centre. The service is available daily from 7 am to 8 pm.
    - *Main characteristics: urban area; open to all; taxi partnership; shared booking resource; fully flexible.*

- **GREECE, Volos** - *"FTS for disadvantaged social groups."* Reorganisation of municipal boundaries in Greece combined with budget cuts has meant that organizations responsible for providing transport services to disadvantaged social groups like DOYK (Municipal Organization for Health and Social Affairs) in the municipality of Volos have an increasingly tough task. There are at least 1200 people with registered disabilities who live in Volos, among them 320 have serious mobility problems due to physical disability. While DOYK provide transport for around 90 people on a daily basis, of whom 60 are people with serious mobility problems, there is clearly scope to reach greater numbers of this disadvantaged social group. Additionally there is a large number of elderly people with mobility problems who face problems with their transportation in the city. The pilot study has revised the operation of three existing minibus services and added a fourth specially designed and equipped minibus with ICT equipment operating in the expanded municipal area. The new minibus is dedicated to the pilot FTS from 8 am to 3 pm Monday to Friday. DOYK manage a call centre in cooperation with Optimization Systems Laboratory of the University of Thessaly using the InMotion to optimize routes and services offered.
    - *Main characteristics: urban area; specialist service for mobility impaired; high tech leased vehicle; fully flexible pick-up to designated drop-offs.*

- **SPAIN, Island of Formentera** - *"FTS for a small Spanish Island of relatively low density population in winter season and a great number of tourists in summer season".* Formentera is the smallest inhabited island of the Balearics with a resident population of 9.000 persons which is almost quadrupled by the presence of tourists in summer. There are regular bus lines between all towns and tourist sites, as well as the main beaches around the island, as well as a taxi service (24 licences). However these bus lines are under utilized in the winter season. The main aim of the pilot was to replace the L1 CIRCULAR fixed route bus service with an on 'demand' service during winter using taxis. The L1 line connects the most populated settlements of Formentera in a circular form. A Travel Dispatch Centre and ITS booking system was introduced which also supports the

use of voice intercoms at selected bus stops to enable booking. The service is available between 7 am and 8 pm seven days a week.

- *Main characteristics: medium density; open to all; connecting main settlements; contracted taxi; fixed route but operates on demand.*

- **IRELAND, South Tipperary** - *"DRT service in South Tipperary focused on Health and Disability service users."* This pilot provides a flexible service to serve Clonmel Hospital from Slieveardagh and Cashel - rural areas with very low population density. These areas are poorly served by public transport and access to health care is problematic for residents with no access to cars. Distances between these rural areas and Clonmel hospital are long (28km to Slieveardagh and 21km to Cashel). The service is provided by a not for profit community transport provider called Ring-a-Ling with strong links with the community through its 28 volunteers who sit on the management committee. The ability of community transport groups like Ring-a-Link to represent the needs of their area at low cost compared with traditional companies is one of their strengths. The service operates between the hours of 0730 and 1830 hours Monday to Friday using a 12 seat minibus.
  - *Main characteristics: rural area; restricted users; high tech; not for profit provider using minibus; fully flexible pick-up to hospital only.*

- **PORTUGAL, Almada -** *"FTS serving public service facilities and transport interfaces."* Located on the south bank of the Tagus River across from Lisbon, Almada is a city with 160,000 residents. Mostly due to this geographical situation, the transport sector accounts for 1/3 of the total energy consumption and CO2 emissions in Almada. As a result, environmental considerations are high on the political agenda when introducing new transport initiatives. The pilot FTS in Almada was introduced to the high density old town to provide a suitable link for the elderly residents to the market and local services as well as an interface at Almada/Cacilhas to the new tram line, buses and ferry services to Lisbon for other users. Due to the high density nature of the area, a mainly fixed route service was introduced with flexible deviations on request to selected points for elderly users such as private social institutions and day care centres. The fixed route section is indicated by a green line painted on the road and passengers can get in and out anywhere along this circuit. The service runs Mon-Fri (7am to 7pm) and Sat (8am to 1pm) and is operated by two electric vehicles which emit zero CO2 pollution locally in the old town. Although these vehicles are relatively expensive to purchase a 50% grant was received from the Portuguese government. The pre-booked trips are limited to specific groups and locations and so are relatively few in number and are handled using the existing facilities and staff of the Municipal Parking and Circulation Company, which runs the service, so there is no need for additional booking systems or software.
  - *Main characteristics: urban high density; open to all; connecting old town to centre and PT interchange; two new electric buses; fixed route with restricted deviations; shared booking resource.*

Cross site evaluation

As can be seen the 7 pilot sites have different characteristics and needs, thus allowing the investigation of flexible transport solutions across a range of operational environments. Within the project a comparative evaluation of the performance of each pilot was conducted in order to identify those that are performing well and highlight those in which improvements could be made. One of the main objectives of such a cross-site evaluation was to develop guidance based on an empirical evidence framework to inform politicians and decision makers, contemplating introducing FTS, on the best approach and likely subsidy requirements of introducing a FTS for their circumstances.

Table 1 presents a summary of the key performance indicator results collected during the evaluation for all sites. It is necessary to recognise that not all FTS can be compared on a like-for-like basis using these performance indicators due to the sites having differing specific goals and objectives (as outlined in the pilot descriptions above). This explains some of the variations in performance data (listed in Table 1) between sites.

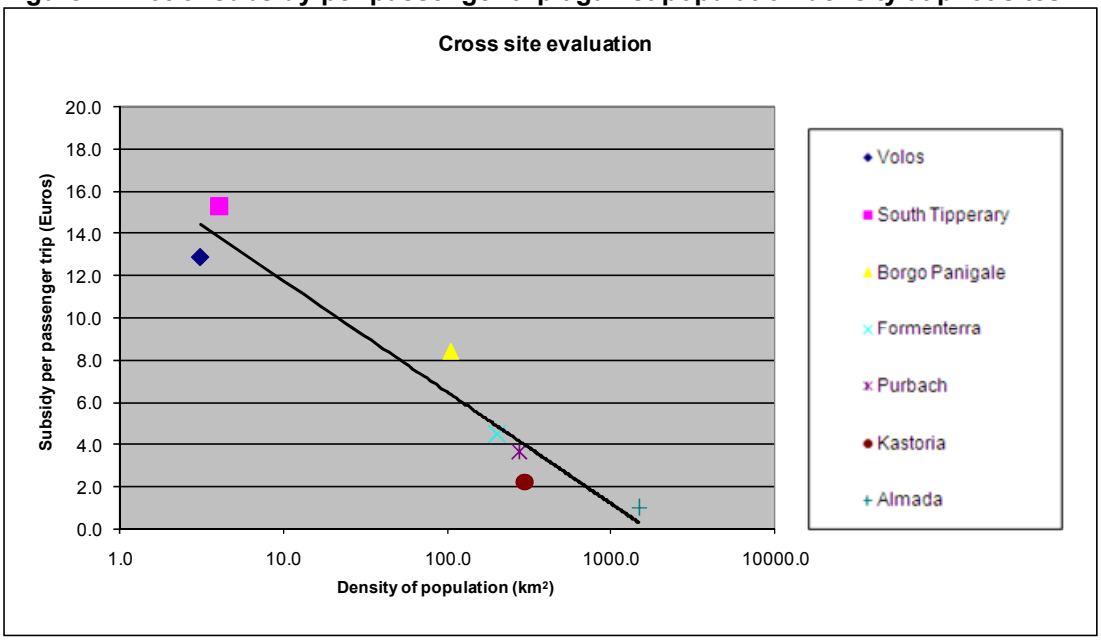
It is also the case that the sites themselves display very different geographic and demographic characteristics: some operate in very low density dispersed rural areas such as the largely farming communities of South Tipperary; at the other end of the scale there are some sites located within high density urban areas such as Almada (the density of population here is over 350 times greater than in South Tipperary).

Table 1: Summary of Performance Indicator results for all FLIPPER pilot sites

	Density (persons/ km^2)	Subsidy per passenger trip (€)	Subsidy per vehicle hour (€)	Subsidy per veh-km (€)	Subsidy per pass-km (€)	Ratio of fare revenue to operating cost	Passenger trips per vehicle hour	kg CO_2 per passenger km
Volos	3.1	12.86	31.23	2.90	2.87	0.13	2.43	0.18
South Tipperary	4.1	15.22	17.66	0.60	1.01	0.13	1.16	0.41
Borgo Panigale	104.6	8.41	9.10	1.68	1.68	0.09	1.08	0.15
Formenterra	204.1	4.42	10.55	0.49	0.59	0.27	2.38	0.19
Purbach	271.7	3.66	18.50	1.15	1.15	0.18	5.05	0.33
Kastoria	298.2	2.22	9.53	0.96	0.89	0.51	0.55	0.14
Almada	1475.2	0.95	15.63	0.95	0.47	0.22	16.51	0.14

The subsidy required per passenger trip is often viewed as the most useful measure of performance of supported bus services. However, it is clear from Table 1 that cross site comparisons of performance indicator results can be unfair and misleading unless account is made for the vastly different populations which a service can provide transport to. To examine the relationship between performance and population density more thoroughly a plot of subsidy per passenger trip versus density (using a Log scale for clarity) is displayed in Figure 1.

Figure 1: Plot of subsidy per passenger trip against population density at pilot sites



From the services displayed in the plots of Figure 1 it is evident that there is a clear relationship between density and the 'subsidy per passenger trip' performance indicator. As density increases the subsidy per passenger trip decreases. The trend line shown in black

on the plot is a logarithmic trend which allows us to make cross site comparisons taking account of the density of population served by the pilot study application. The further a site is plotted above the trend line the poorer performing the service taking account of the population density of the area it serves while the further below the trend line the better performing the service.

It can be seen from Figure 1 that the Kastoria service appears to be the best performing when looking at subsidy per passenger trip while taking account of population density (i.e. furthest below the trend line). This is a service designed using taxis on a pay as you use basis. Operators retain the fares paid but no retainer or penalty fee is paid when there is no or little demand for the service. A comprehensive distance based fare structure has been developed to ensure the sustainability of the service. The minimum fare per passenger trip is €2 and can be as high as €7 for the longest journeys.

For supported conventional bus services in the UK a per passenger trip subsidy of around £2.50 (€2.90) is often considered as providing acceptable value for money. This can rise to £4 (€4.60) in rural areas. Per passenger trip subsidies above these levels often result in services being withdrawn. However, in deep rural areas these subsidy levels cannot be achieved. Basing funding decisions on such generic thresholds is often inappropriate for low density areas. It may be a better approach to judge the effectiveness of supported services using a population density adjusted value of subsidy per passenger trip as suggested by the trend line in Figure 1.

Service guidance based on evaluation data

If we are to consider recommendations for FTS design then the above performance indicator analysis provides some useful findings. Much of the guidance to date on FTS service design states that degree of flexibility and choice and size of vehicle depends on level of demand (and availability of suitable operator/vehicle). However, from our analysis we see from the Kastoria pilot service that taxis appear to be a good option for low demand services. The South Tipperary service, which is also low demand appears to provide a fairly good option using a bus, suggesting that the guidance as it stands is too vague.

One of the biggest differences between these two services is the average trip length, with Kastoria trips averaging 2.5km and the South Tipperary trips averaging 15km. Table 2 presents the trips per vehicle hour and the average trip distances along with the vehicle choices for the pilot sites.

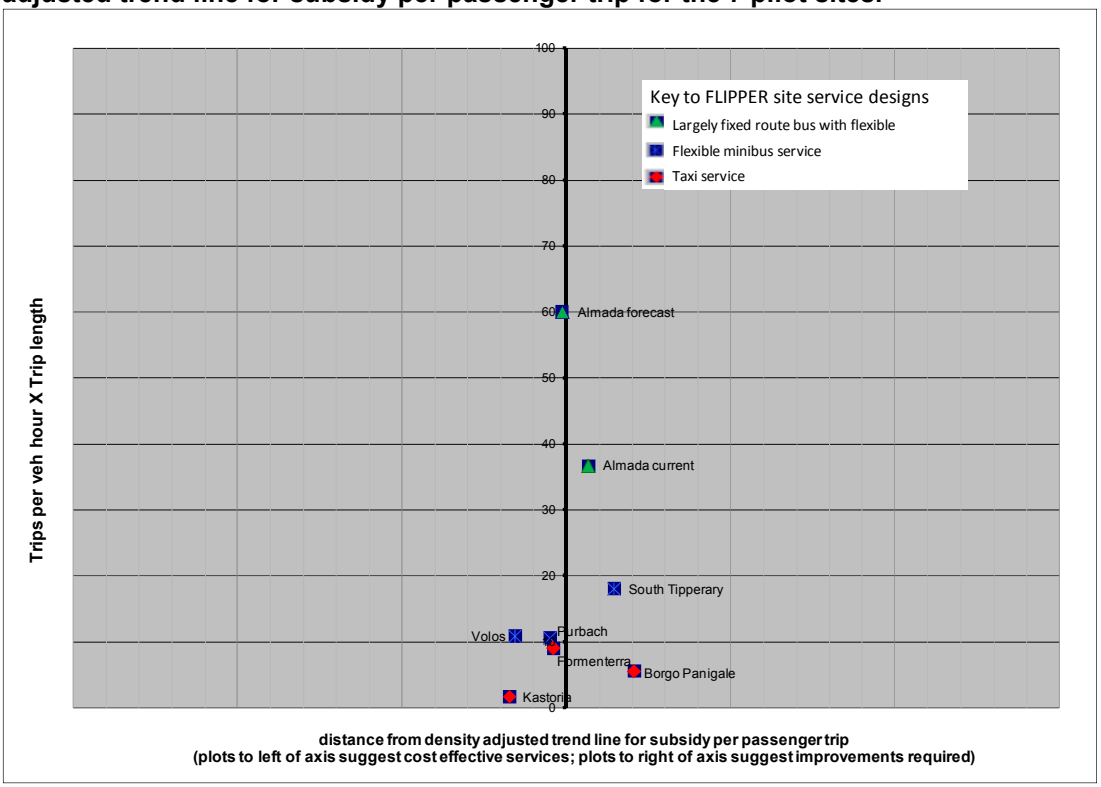
Table 2: Trips per vehicle hour and the average trip distances for FLIPPER pilot sites

	Passenger trips per veh hour	Av trip length	Trips per veh hour x Trip length	Vehicle type
Kastoria	0.55	2.5	1.4	Taxis
Borgo Panigale	1.1	5	5.5	Taxis
Formenterra	1.2	7.5	9.0	Taxis
Purbach	5.05	2.1	10.6	1 x Minibus (flexible route)
Volos	2.4	4.5	10.8	1 x Minibus (flexible route)
South Tipperary	1.2	15	18.0	1 x Minibus (flexible route with intermediate fixed stops)
Almada	16.5	2.2	36.3	2 x Minibus (fixed route with limited flexible deviations)

From Table 2 we start to see a pattern emerging between the type of vehicle which has been used and the product of the demand (passenger trips per vehicle hour) multiplied by the average trip distance.

Figure 2 plots the ‘trips per veh hour x trip length’ against distance from the density adjusted trend line for subsidy per passenger trip for the 7 pilot sites.

Figure 2: Plot of 'trips per veh hour x trip length' against distance from the density adjusted trend line for subsidy per passenger trip for the 7 pilot sites.



Referring to Figure 2, plots which are to the right of the vertical axis relate to services which fall above the density adjusted trend line for subsidy per passenger trip (see Figure 1). These are services where some improvement in service design should be sought to lower the subsidy per passenger trip. In all cases a small improvement should be sufficient to bring the services in line with the trend.

It is revealing that the services to the right of the axis are those which charge the lowest fare per km travelled. This suggests that these three services should consider the option of charging higher fares. For instance the Almada service charges the lowest fares with an average of only 0.26 Euros per trip. This is very low, even accounting for the relatively short distances travelled (average 2.2km). In the case of the South Tipperary service, because it is serving a hospital the vast majority of passengers are entitled to National Government RTP (rural travel programme) subsidy of 2.30 Euro per trip (for persons over 65, disabled or for socially necessary travel). As a result Ring-a-Link charge no fare for these passengers. However, due to the long average distances travelled (over 15km) and the door-to-door nature of the service it may be advisable, and perhaps not unreasonable, to also charge a fare for these passengers in order to reduce the subsidies required. In the case of the Borgo Panigale service, despite using limousine taxis to provide the service the average fares charged are very low, 0.76 Euros per trip (0.15 Euros per km). The other pilot sites utilising taxis charge much higher fares: e.g., the average fare for a trip in Kastoria is 2.33 Euros while a trip of equivalent distance to that travelled in Borgo Panigale would be around 4 Euros. By increasing the fares charged by only 0.25 Euros/km at each of these three sites (assuming no loss of patronage) the services would move below the trend line in Figure 1 and hence to the left of the vertical axis in Figure 2.

Note that there is a plot for 'Almada forecast' in Figure 2. This is based on forecast patronage after a full year of service (the data obtained for the evaluation reflected actual passenger use after the initial 6 months of operation of the service and this is expected to grow further).

Given that the pilot services appear to be performing reasonably well we suggest that the choices of vehicle type and operator made in the planning stages have been appropriate. From this assessment we have derived the generic service guidance presented in Table 3.

Table 3: Service design recommendations for choice of vehicle and degree of flexibility

Trips per veh-hour x Trip length	*Vehicle Choice and Degree of flexibility*
less than 10	taxi
between 10 and 20	taxi(s) or a flexible minibus could be used – the choice will depend on availability and relative costs locally
between 20 and 50	flexible minibus should be provided with lower degree of flexibility at the higher end of the range
greater than 50	largely fixed route bus service should be provided with limited deviations

Application of the guidance

To illustrate how this guidance can be applied by local authority planners we consider the data collected from the FLIPPER feasibility sites. Table 4 presents the trips per vehicle hour and the average trip distances along with the vehicle choices for the feasibility studies. Figure 3 then plots the product of the demand multiplied by the average trip distance for both pilot applications and feasibility studies. These have been plotted with distance from the density adjusted trend line for subsidy per passenger trip on the horizontal axis. Superimposed on the diagram are the service guidance recommendations for vehicle type and service flexibility. From this we can see that the Livorno service is performing very poorly (well to the right of the vertical axis). We can also see that this service proposes to use a minibus when it clearly falls in the category of taxi use based on our service design recommendations. There is a clear indication that this service is proposing to use an unsuitable vehicle and the recommendation is that this service should be implemented using taxis rather than a minibus.

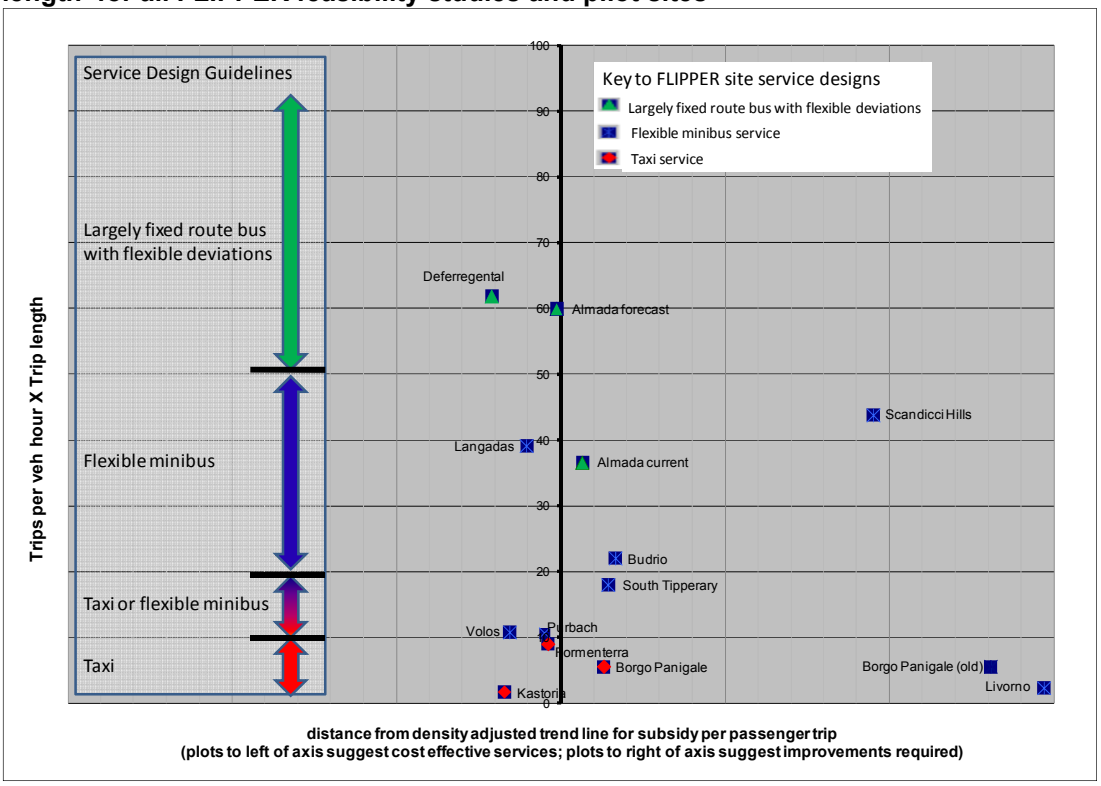
In Borgo Panigale the service was initially provided using a commercial bus operator and a 14 seat minibus - identified by the 'Borgo Panigale (old)' plot in Figure 3. However costs were becoming prohibitive and on assessing the service performance it was revealed that the minibus was only driving for 20% of the service time, while the remaining 80% of the time was spent waiting for journey requests. With this in mind it was decided to introduce a taxi based FTS to replace the minibus based service. The total operating cost of using taxis is now less than half that of using a single minibus. The service design guidance suggested in this paper would have identified immediately that a minibus was unsuitable for the level of demand and average trip distances experienced in Borgo Panigale. As Figure 3 illustrates this service clearly falls in the taxi provider category.

Although the other services appear to be using suitably sized vehicles the Scandicci Hills service is demonstrating poor performance. It is recommended that this service reassesses its costs and revenues to try and reduce the subsidy required. It may be that this service could consider redesign utilising two rather than three vehicles, or perhaps could consider the use of volunteers.

Table 4: Trips per vehicle hour and the average trip distances for feasibility studies

	Passenger trips per veh hour	Av trip length	Trips per veh hour x Trip length	Vehicle type
Livorno	3.8	0.6	2.3	1 x Minibus (flexible route)
Borgo Panigale (old)	1.1	5	5.5	1 x Minibus (flexible route)
Budrio	2.8	8	22.0	1 x Minibus (flexible route)
Langadas	3.1	12.5	39.1	2 x Minibus (flexible route)
Scandicci Hills	5.5	8	43.8	3 x Minibus (flexible route)
Deferregental	5.0	12.5	61.9	1 x Minibus (fixed route with limited flexible deviations)

Figure 3: Service design guidelines overlaid on plots of 'trips per veh hour x trip length' for all FLIPPER feasibility studies and pilot sites



The service design guidance proposed in this paper shows promise as a useful tool for planners of FTS, however substantial validation with more numerous real life service data is still required – from both long established 'successful' services as well as those that have been deemed failures and have been withdrawn.

It is also important to stress that although the service guidance developed above can be helpful to decision makers in directing them to the best option from a financial performance viewpoint, there may be overriding practical limitations which dictate the ultimate choices made. These include availability of existing resources, local group demands influencing vehicle size (e.g. for education trips), and specialist requirements for certain passengers. For instance the service in Purbach is on the boundary between choosing a flexible minibus and a taxi. This choice to use a minibus for this service and not taxis was because there are no registered taxi providers in the town of Purbach. In Volos, the guidance again suggests taxis may be the most cost effective option, however, the specialist nature of the clients carried by

this service demands a vehicle with multiple secure wheelchair spaces which taxis could not provide.

Conclusions

The current economic crisis is forcing governments to look at new ways of working to reduce costs. The FLIPPER cross-site analysis provides decision makers with evidence based service guidance for different environments derived from analysis of economic performance of the FLIPPER pilot site applications. A major conclusion from the analysis is that the product of the demand multiplied by the average trip distance provides a very strong indicator as to the type of vehicle which should be used and the level of flexibility which should be offered. It is hoped that this will prove to be a valuable aid in helping decide on the most suitable and cost effective FTS solutions in both urban and rural environments across Europe.

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