

## RECENT DEVELOPMENTS IN TELEMATICS-BASED DEMAND RESPONSIVE TRANSPORT SERVICES

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### Abstract

A number of new service concepts and technologies for Demand Responsive Transport Services (DRT) have recently been developed and demonstrated (e.g. as part of the DGXIII-funded SAMPO, SAMPLUS and INVETE projects and currently in the DG INFOSOC FAMS project). However, DRT services to date do not yet exploit their true potential and work is still required on the knowledge acquisition, analysis and dispatching functions of the intermediate transport solutions that are required in the pursuit of sustainable mobility, as well as the necessary supporting organisational frameworks required to deliver more effective and competitive transport solutions. The main body of the paper presents the findings of new research into the next generation of DRT services. In most cases flexible services, and in particular DRT services, are generally managed directly by a single operator (usually a transport company) as a unique and dedicated transport scheme with minimum or no level of integration with the other collective transport services available in the same area. Experience gained shows wide potential for improved operation of DRT concepts and models, in order to cover the overall spectrum of the intermediate and flexible services. This may be achieved by integrating the technological tools developed with emerging e-commerce and e-business services. The thesis is advanced that, starting from the single DRT services application, there is a considerable opportunity to evolve towards the concept of the Agency for Flexible Mobility Services through a scaling up of the current technologies and DRT models.

Keywords: Demand responsive transport; Telematics; Public transport

Topic Area: B1 Public Transport and Intermodality

### 1. Introduction

This paper introduces the FAMS project (Flexible Agency for Collective Demand Responsive Services) which has been funded by the European Commission's Information Society Technologies (IST) Research and Technological Development Programme within the Fifth Framework. FAMS is a "take-up action" for the realisation of a metropolitan Agency for flexible services management. FAMS is building on the experience gained in previous European projects (e.g. SAMPO, SAMPLUS, INVETE etc.) with respect to technologies, models, management processes etc. The overall objective of FAMS is the adaptation and integration of the core components of the DRT service management process (booking, service and journey planning etc.) with e-business/e-work services. This is expected to enhance the co-operation among the operators that offer flexible services in the same area and to improve the overall access to mobility services by the citizens and/or the associations involved.

FAMS embraces the shift from the Management Centre approach to DRT towards the Agency concept. This is achieved through the development of web-based modules and technologies (B2B and B2C services) allowing the operational co-ordination of the overall available resources, the integration of the service access possibilities by the users and the

sharing of the information base. Essentially, apart from the particular characteristics of the territory, the service, the users and the operators (number of operators, location of depots, type of fleet involved, type of services operated, booking systems in use etc.), the Agency should allow the management of the entire “production” process of the transport service. This process – from the booking of the users to the service/journey planning, monitoring and operational control etc. – should occur as a single entity (i.e. as a single operator with a single fleet and a single booking system), thus optimising the resources involved and providing an effective response to the mobility needs of the different user categories in the areas of weak demand.

Following a brief introduction to Demand Responsive Transport (DRT) services the paper provides details of the FAMS trials being implemented in two sites, in Italy and UK. Two transport operators / authorities - ATAF in Italy, Angus Transport Forum in the UK - are implementing the Flexible Agency concept in Florence and the Angus Region, respectively. Different transport service providers are collaborating with the Agency in the two local implementations of the FAMS concept. Each site represents different environmental contexts (urban/metropolitan area in Tuscany and a rural area with a very low level of transport services in Angus) and different facets (three main fleets in Tuscany, provided by major transport operators; different small fleets provided by various small transport enterprises and Associations in Angus). Both are complementary for the application of IT support systems to the Flexible Agency for intermediate, demand responsive transport. The sites are also different from the point of view of the IT facilities, practices and knowledge available about DRT and intermediate transport services.

## **2. The state-of-the art in DRT services: A brief review**

Conventional transport is ideal where there are defined corridors of movement, with clustered travel demand; here, it is economic and acceptable for many people to use such forms of transport. However, due to the changing habitation patterns and nature of activity such as work, there are many person trips to which conventional transport has become not suited. These include many local trips, areas of diffuse travel patterns, times of low demand, city-peripheral journeys, commuting etc. With the changing distribution of activities in cities to the outskirts, many person trips cannot now reasonably be made by conventional transport. In Europe over 50% of all trips are less than 5 km, and about 25% of trips are less than 2 km. Moreover, many of these trips are often not suited to conventional transport, so the car has often become the default mode of travel in most urban/metropolitan areas in Europe.

Demand Responsive Transport (DRT) Services provide transport “on demand” from passengers where fleets of vehicles are scheduled to pick up and drop off people in accordance with their needs. It is an intermediate form of transport, somewhere between bus and taxi and it covers a wide range of transport services ranging from the less formal community transport through to area-wide service networks. In recent years, the ability of DRT concepts to provide efficient, viable transport services has been greatly enhanced by the use of transport telematics.

Demand Responsive and Flexible Transport services have been available as a concept since the early 1970's when initiatives were implemented in the UK and USA, as well as in other countries (see Ashford, Bell, 1978). In the UK the ‘dial-a-ride’ concept and the ‘Postbus’ were implemented in many rural communities. Although they achieved their main operational aims, they were restricted by the need to book very much in advance due to communications limitations. Still, the experiences identified the expectations of the potential users and of the operators, and showed some of the difficulties which could be expected if such services were provided on a larger scale.

Since then, systems have been implemented in Europe, USA, Canada and Australia. Examples in rural areas include Minicar in Midi-Pyrenees (FR), Kerteminde (DK), Borgerbussen in FASTERHOLT (DK), De Lijn (BE) and Ozark (USA). Examples in low-demand situations in urban areas include Ruf-Bus in Hannover (DE), TelBus in Bastogne (BE), Flexroute in Gothenburg (SE), Multibus in Schlakwijk (NL), Dial-a-Bus and Transit Taxi in Adelaide, Australia. All of these systems typically include a strong marketing effort and good involvement of the users, but they have still been limited in their ability to form a strong part of the overall transport supply.

The emergence of Advanced Transport Telematics (ATT) tools, as well as the availability of mobile communications has allowed new service options to be developed. These are capable of handling substantial networks of services, managing the booking and reservations, allow the user to make bookings almost in real-time and can have real-time operational control. By meeting the users' requirements, there is now the possibility to improve the viability of the services and to provide the operator with the needed return on investments (see Ambrosino et al., 2004).

Projects such as SAMPO and SAMPLUS have developed and demonstrated the fundamental tools for Travel Dispatch Centres and booking and reservation (Mageean, Nelson, 2003); INVETE has advanced the in-vehicle terminals along with their support and communications (Scholliers et al., 2004); FAMS (which is introduced in the next section) has moved from the stand-alone DRT to supporting a Flexible Agency based on B2B and B2C principles; while eDRUL has migrated these concepts to the logistics domain. There is a wide range of active sites based on ITS-supported DRT including Florence (IT), Kuopio and Tuusula Regions (FI), Ost-Flanders and Hasselt (BE), Angus and Northumberland (UK).

In the City and Region of Tomorrow, the move away from conventional public transport is likely to increase further. The nature of work and access to services will change for many citizens through the increase of teleworking and e-commerce. This will reduce the commuting levels further as well as reduce the number of trips for administrative, business and shopping purposes. On the other hand, there will be more activity at the neighbourhood level (particularly through increases in teleworking) and changes in both the daytime population mix and the level of facilities, for both passengers and logistics, and services available locally will create and increase a demand for more local travel services. The fact that the population is ageing will only accelerate this trend.

### **3. FAMS: From standalone to multiple service provision**

FAMS is an EU funded Take-Up Action (2 years from March 2002). It followed the successful SAMPO/SAMPLUS projects, which tested and demonstrated standalone DRT applications. The objective was to develop a Flexible Agency for Collective Demand Responsive Mobility Services, showing whether a broader type of brokerage works in practice. Trials have taken place in Florence, Italy and Angus, UK.

The FAMS project identified five layers that describe an increasing complexity in the provision of DRT services (Figure 1). The basic layer caters for one service provider at one "Agency" [known as the Travel Dispatch Centre (TDC)]; booking and assignment is made manually at least one day prior to travel. The standalone layer introduces ITS support, enabling on-day, non-manual booking and assignment. The expanded and mature Agency (third and fourth layers) take this a step further by managing the routes operated by more than one service provider. FAMS is placed at the third layer. The fifth layer, interacting Agencies, enables optimisation of modes and services between Agencies.

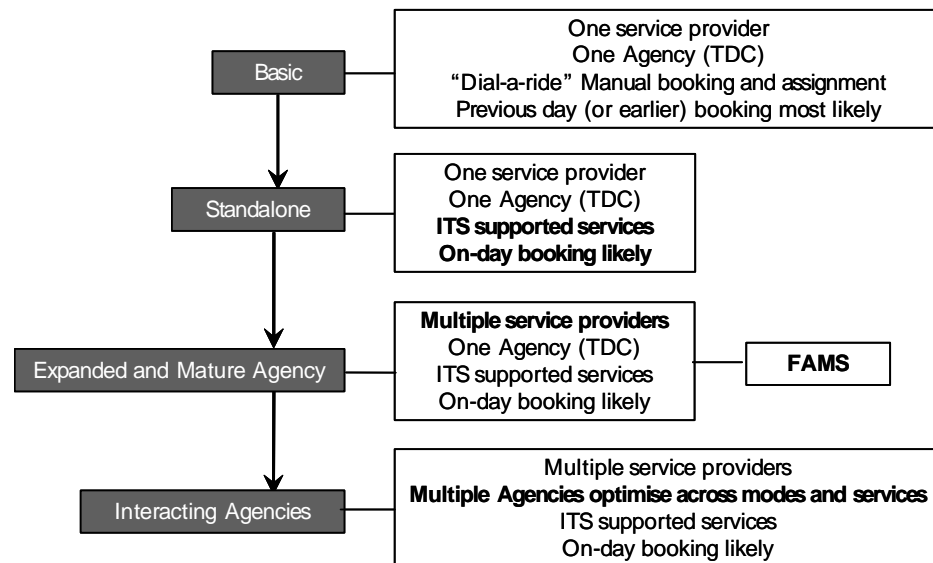


Figure 1: A Layered Approach to Developing the Provision of DRT Services

Figure 2 provides an outline of the reference model underlying the approach of the Flexible Services Agency designed within the FAMS project.

The general supporting infrastructure of the FAMS Agency includes the following main technological and telematic components:

- a common FAMS Service Centre (TDC) sharing a number of services for planning, managing and monitoring the different type of flexible services;
- the e-Business services between the Agency's DRT management service components and the different actors involved in the DRT process chain, both operators and users:
  - Business-to-Business (B2B) services, allowing interaction and teamwork among the different transport service providers co-operating through the Agency;
  - Business-to-Consumer (B2C) services, supporting access to information and services of different associations, user groups, communities, etc;
- a communication network among the TDC and the vehicles operating the services, based on cellular technology – GSM and GPRS.

The flexibility of the Agency covers not only the different needs of transport demand but also the different operational models and service provision schemes supported by the technical infrastructure. Based on this target infrastructure, the objective of FAMS is to trial, evaluate and gather best practice evidence in terms of:

- co-ordinated fleet management of vehicles belonging to different operators/co-operatives and associations;
- balancing of the service offered by the different actors involved;
- real-time service monitoring via the GPRS network;
- service access diversification (direct on-line access, different booking modalities: internet-based, by telephone etc.);
- controlled and co-ordinated expansion of the service in terms of vehicles and/or providers; and
- guaranteed efficiency and management transparency for the operators.

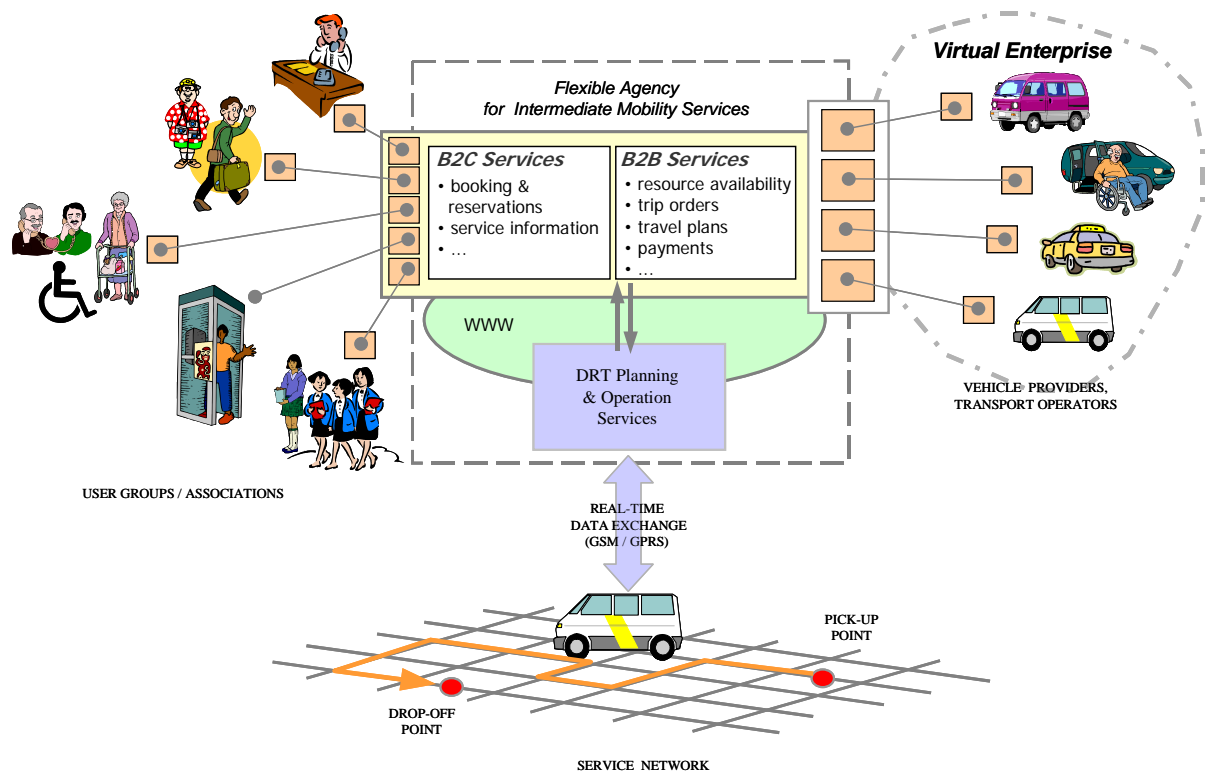


Figure 2: Overall structure of the Flexible Mobility Agency

#### 4. The Angus demonstration site

Angus has a population 112,000 people and it is situated in the north-eastern part of Scotland. It lies to the northeast of Edinburgh on the Firth of Tay. In an area of 2,200 square kilometres, mountains, glens, rivers, rugged cliffs, seaside towns, market burghs, turreted castles and ancient relics stand side by side. The coastal belt is well served by public transport services to and from Dundee, Arbroath, Forfar (the county town) and Montrose and onward north to Aberdeen and southwest to Edinburgh. The northern boundary of this coastal strip is marked by the settlements of Alyth (which is in the county of Perth and Kinross to the west of Angus), Kirriemuir and Brechin. These settlements have good transport links on the coastal side but landward towards the Glens the public transport provision ranges from adequate to poor and even non-existent, particularly at the heads of the Glens. Angus is no different from other rural areas in Scotland and Europe. The issues of rural depopulation, sustainability, access to employment, health, education, training, child care are all perceived as a major problem unless people have access to a car. Where public transport services exist these are based around school transport provision and a weekly shoppers bus. Post Buses operate in Glen Isla, Glen Prosen and Glen Clova.

The FAMS take-up and trial site in Angus is new to DRT applications, although local plans existed to introduce DRT and the Flexible Agency at the site. The site covers the rural Angus area surrounding Alyth, Kirriemuir and Brechin and has allowed evaluation of transferability issues, both on the technical and organisational level. Figure 3 below shows the FAMS site in Angus. The main actor of the Angus site is the Angus Transport Forum (ATF). It has a membership of over 60 organisations, comprising of voluntary organisations, Community Councils, transport providers and residents of the area.

The Angus pilot sought to maximise the use of existing public/collective transport resources in the area to produce flexible, user-friendly integrated services and to provide a



sustainable means of delivering transport provision utilising new technologies. This challenge required the dismantling of artificial barriers erected by the “it’s always been done like this” mindset which has led to the erosion of public transport services. This review of service delivery suggested that it needed to be designed to meet the needs of customers, not just the operators, by designing it from the bottom up in such a way that all public transport providers had the opportunity to participate in maximising the efficiency of services by using brokerage. This was placed in the difficult context of delivering public transport services to a low density, highly dispersed population, e.g. 1.2 persons per sq km in Glens Isla and Alyth.

Beginning in June 2003 the FAMS Agency in Angus was run from Stracathro Hospital in Brechin, by Angus Transport Forum (ATF) which has secured funding to continue after FAMS has finished. During the course of the project, the forum gained interest from over 60 organisations. The characteristics of the services offered through the Agency vary according to a range of factors:

- Registered or private hire
- Type of permitted user
- Degree of route flexibility
- Choice of vehicle
- Choice of operator

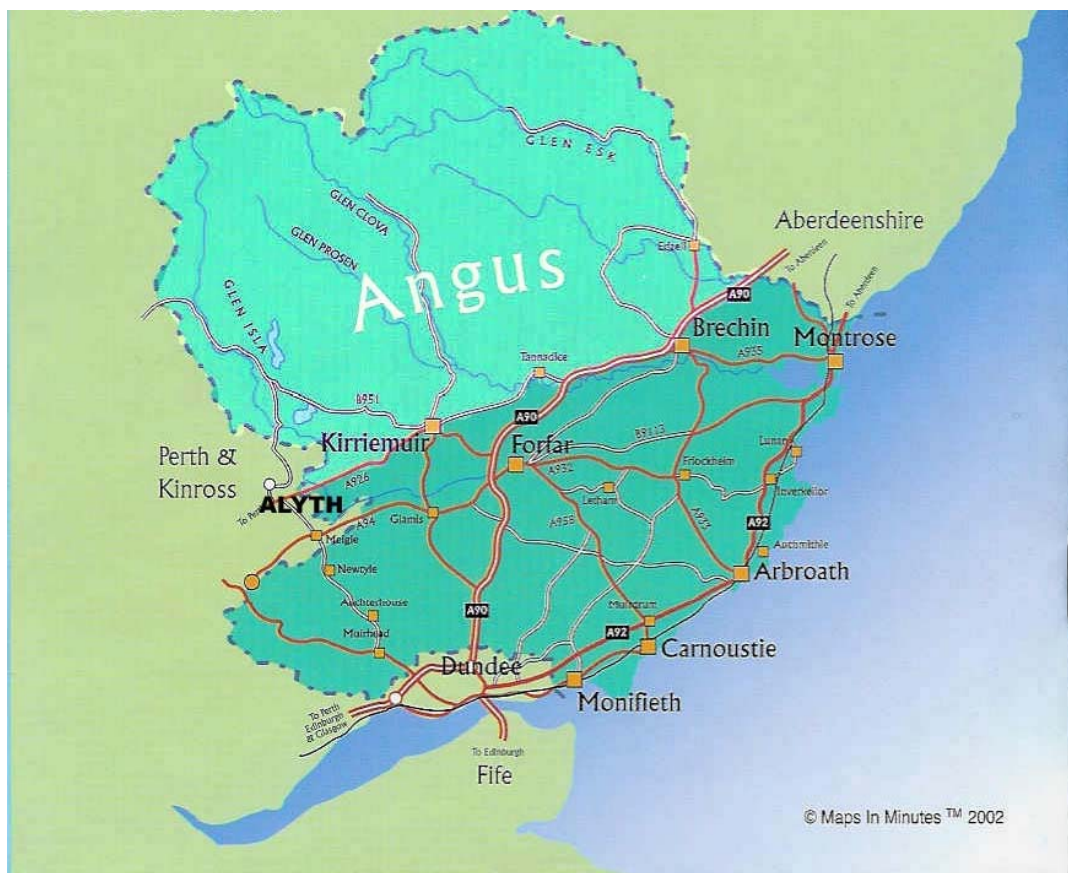


Figure 3: The Angus site

#### 4.1 Brokerage of public transport services in Angus

In the Glens of Clova, Isla and Esk, Angus Council registered semi-fixed routes that took advantage of the dead mileage on education contracts (Figure 4). Dead and live mileages are now available to all user categories. One transport provider is dedicated to each route, having won a competitive tender. Vehicle availability depends on the operator's fleet – usually one nominated vehicle per service. These services operate at peak times.

Outside peak times the same vehicles within the respective Glens are available for private hire for individuals to book door-to-door journeys. For all the Glens services fixed route information has been added to a database so that interchange can be made between flexible and fixed routes.

Proposed disabled and elderly services in Angus are designed to overcome problems such as the time taken to reach the hospital in Dundee using patient transport service (PTS) vehicles or by several changes of fixed route bus. The solution is to bring customers to hubs in Alyth, Kirriemuir and Brechin and then transfer to PTS. The feeder operator and vehicle is selected from participating transport providers and statutory bodies according to the price and their vehicle availability.

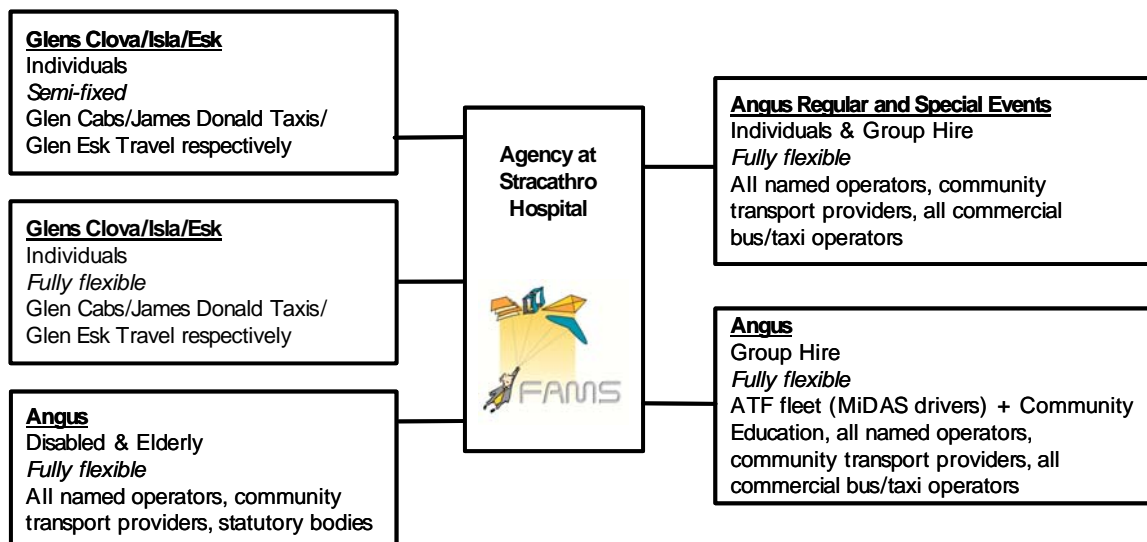


Figure 4: Brokerage of Public Transport Services in Angus

ATF established a Travel Club identifying interest in over 90 activities. This information is used to plan regular and special events. Door-to-door services are offered where no commercial services operate. Where it is possible to undertake the route or part of it by a commercial service, a door-to-service link is provided. DRT services for regular and special events are organised on a private hire basis. Routes are fully flexible. Customers – individuals and groups – can select the operator based on price and vehicle availability, e.g. a cheaper journey may be less convenient.

Group hire is available to organisations with Minibus Driver Awareness Scheme (MiDAS) accredited drivers. The vehicle fleet is owned by ATF; although Community Education, community transport, and commercial bus/taxi vehicles are also available. Once hired the route is determined by the group.

## 5. The Florence demonstration site

In contrast to Angus Florence has a long tradition of experimenting with non-conventional, flexible transport solutions from the end of the eighties. Following some major initiatives – such as SAMPO and SAMPLUS – launched in the mid-nineties, DRT services proved to be a viable and successful scheme to address personalised mobility needs in several areas of Florence and for different user categories. Since then, several DRT services have been implemented and this led the local mobility authorities to think about new ways to co-ordinate the provision of different DRT schemes within the metropolitan area and to improve the service offer and accessibility to the different DRT user categories. FAMS offered the ideal context for development of the Flexible Agency for Demand Responsive Mobility Services concept and for its pilot application within local trials.

The City of Florence is an historical centre with a very old cultural and economical history, some 590,000 inhabitants and huge commuter/tourist flows during the whole year. The trial area of FAMS covers part of the Florence metropolitan centre and a peri-urban area called “La Piana Fiorentina”, a vast *plateau* located north-west of Florence and including the administrative boundaries of four of the nine towns surrounding Florence: Campi Bisenzio, Scandicci, Sesto Fiorentino, Calenzano. Altogether, the FAMS area includes characteristics and problems which are typical of different transport and mobility environments: pure urban districts and areas, peri-urban areas, small-size towns, rural areas.

In Florence, the FAMS concept was built upon and around the existing DRT services, with a view to gradually expanding, after successful implementation and evaluation of the trials, an Agency for co-ordination of all intermediate transport services in Florence Region. The baseline scenario and resources were set by the existing technologies of the major public transport service provider (ATAF) – i.e. the TDC and related infrastructures – as well as the available experience in the planning, operation and management of DRT and flexible services.

Through the FAMS organisational and business model, the Agency has been established as the unique reference interface and as a service centre for the users of intermediate transport in Florence, providing services for booking and reservation, user information and feedback, etc. Figure 5 below provides a summary of the intermediate transport services that have been initially co-ordinated by the FAMS Agency in Florence.

Figure 6 introduces the overall context of operation of the FAMS Flexible Agency in Florence which is implemented via a web-based portal. There are four main classes of users:

1) **End-users of flexible transport services**, covering the whole range of current and prospective end-users of DRT services in the Florence Region: citizens and generic transport users; disabled and elderly user groups; other user groups with specific transport requirements (e.g. students, workers, tourists, etc.); public agencies (e.g. public health organisations, social service organisations, etc.) and associations (e.g. voluntary associations, community groups, etc.) organising transport for particular user groups; *active destinations* for demand responsive transport (e.g. hotels, shopping centres, hospitals and clinics, airport, railway stations);

2) **Transport service providers**, including both public and private organisations which provide various forms of flexible, collective transport services, from DRT services for generic users (i.e. ATAF, SITA, Li-NEA, CAP) to disabled and elderly services (ATAF, Humanitas, Misericordia). These users of the FAMS Agency actually provide transport resources, infrastructure and services meeting the demand of the above user categories.



3) **Mobility Authorities.** This category represents the interface between flexible transport organisation/provision and the planning and management of mobility services at city level. Mobility authorities in the Florence Region include: the relevant transport and mobility departments of the Municipality of Florence, the Province of Florence, the Tuscany Region, the Mobility Manager of Piana Fiorentina. These authorities need to have access to the FAMS knowledge base of users' demand, transport service planning, management and operation data for the purpose of monitoring the implementation and updating the mobility policies in the application area.

4) **Flexible Agency operators.** These represent the operational users of the organisational and technical infrastructure implementing the Flexible Agency. Supplied by ATAF – which hosts the technical and organisational infrastructure of the FAMS Agency – FAMS operators ensure the effective implementation of all the processes and workflows related to customer communications, service booking and reservation, service management and operation.



Figure 5: DRT services for the FAMS trials in Florence Region

## 6. FAMS in Angus: outcomes of brokerage

As with any new concept there has been a mixed range of views to DRT at the Angus site. It is therefore essential that all sectors are involved in the design, evaluation and monitoring of services. Building trust in the concept and associated technologies cannot be achieved by imposing the idea in a commercial environment. The type, number, and size of the operators in an area may have a bearing on the receptiveness to innovation. The deregulated transport environment, as in Scotland, means that trials of new concepts can only succeed when the operators are willing to participate.

Technological capabilities are such that individual routes can be booked, scheduled and dispatched by the Intelligent Transport Systems (ITS) if required, e.g. flexibly routed services that are pre-booked close to the time of travel. Operator selection is based on cost,

transport providers being compared manually from a database. Vehicle selection is based on availability, transport providers are again compared manually from a database.

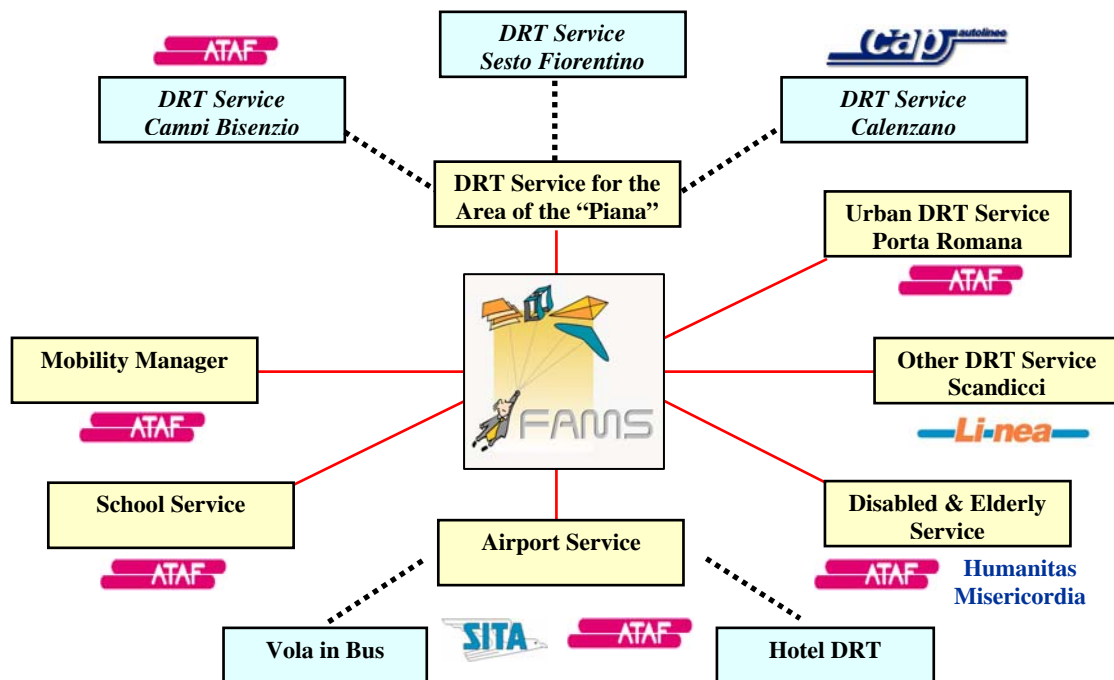


Figure 6: Context diagram of FAMS Agency in Florence

The most important technological barrier is the poor overall mobile phone network. Different areas are covered better by different networks, making it difficult to know which network to use. This results in failure to communicate with the vehicles in the Glens, and therefore it is not possible to take on-day bookings.

Public transport has been neglected for many years in the Glens so people have become used to making their own arrangements – or even leave the area. This results in people being suspicious of new services, questioning its permanence. The regular events have had some success, e.g. after school activities, Cinema Club, Disabled Ramblers. Special events are very successful but intermittent, e.g. Hill Walking Festival, Highland Games. Group hire is very successful being used by a wide range of groups. Implementation of the disabled and elderly service has been delayed, due to on-going discussion with PTS concerning working practices.

Each mode has different regulations that affect how responsive it can be. For example, concessionary fares are not available to some modes: given a choice a passenger may select a cheaper if less convenient mode. Bus deregulation does not encourage co-operation between transport providers, nor does it promote through ticketing, which ultimately discourages the use of public transport. Operators are suspicious about giving information to the FAMS Agency database; they also prefer the *status quo* of subsidised services which guarantees an income, whereas participation in full brokerage does not – although the opportunities for greater income exist.

## 7. FAMS in Florence: outcomes of brokerage

The findings in Florence differ somewhat from those of Angus. Whereas Angus is a green field site, Florence has been running DRT services for several years. This means that the findings are more related to technical issues than organising and running the services. The technological scenario built up to support DRT operations in Florence and the

operational experience gathered has provided the starting point to upgrade the existing TDC into a Flexible Agency, interconnecting the different public (ATAF) and private transport operators (SITA and Li-NEA) and co-ordinating, differentiating, optimising the overall intermediate services offer in the metropolitan area. The core DRT planning/operation facilities for the Agency is provided by the PersonalBus scheduling system. The extension has been possible mainly due to the introduction of the required B2B/B2C components to the interoperability through the different transport service providers.

Through the FAMS organisational and business model, the agency is becoming the unique reference (for service booking/reservation and management and optimisation of the resources based upon vehicle availability) interface at the Florence site for the users of intermediate transport, with the responsibility of co-ordinating the different operators and managing in real-time a set of flexible services. Results available to date suggest that different types of transport can achieve a number of business advantages:

- Personalised services for particular user categories such as disabled, elderly people and schoolchildren, tailored to each category's specific needs.
- Provision of information on service quality and planning.
- Special services connecting the main city attractions, the airport, the main railway terminals and the main hotels.
- Integration of e-Business solutions to allow the interaction of all the transport operators and easy access to services (information, booking and reservation.) to different user categories.
- Adequate interaction and co-operation between service providers (SITA, LI-NEA, Citizens Associations) and the service planning and dispatching TDC (ATAF).
- Transfer of operational and management expertise from the current DRT operated by ATAF in Florence to the new Agency

In addition to facilitating the development of wider service options for customers, the new integrated agency offers a true opportunity to co-ordinate at the Metropolitan level all the actors involved in the provision of services (public transport operators, municipalities, disabled associations), thereby improving the service offer to the users and optimising the overall financial resources utilisation for transport services. Some of the institutional and organisational issues related to co-ordination between the different service providers had been investigated in the Florence Metropolitan Area and agreements had been stipulated before the start of the Agency, in order to prepare for the new operational challenges currently undertaken within FAMS. The activities included trial operation which started in May 2003 (the minor delay at the Angus site was mainly due to the different level of complexity and state-of-the-art required for starting operations). Much effort has been made in order to meet the first feedback received from the operators after the training phase.

The real achievement of the FAMS Agency has been to gain experience about its operational requirements and on the main needs of the target categories (mainly the TDC operators for B2B aspects and passengers for B2C aspects). In this context, the suggestions that have arisen from the TDC operators are already significant because they have gained experience on portal usage, even though during the summer the amount of requests was quite low. Data collection for evaluation is on-going with observations from users/passengers being collected.

## **8. Conclusions and recommendations**

The experiences of the FAMS project have shown that the take-up and further development of telematics tools and applications can be done effectively, but only if it

takes into account the political, juridical, institutional and organisational frameworks. Often the main challenges, problems and barriers related to development of new kinds of flexible public transport concepts have not been technological. There are however institutional, juridical and operational issues and questions that have to be clarified by the potential new take-up sites before the full scale DRT system can be implemented. The take-up activities, new service concepts, DRT and related telematics applications and technologies have been accepted both in Italy and Scotland by dispatchers, operators and end-users.

### **8.1 Conclusions and recommendations for Angus**

The FAMS Agency and the DRT services in Angus did not exist before the project. As with any new concept there have been different views of DRT. Therefore it is essential that all sectors are involved in the design, evaluation and monitoring of services. Building trust in the concept and associated technologies cannot be achieved by imposing the idea in a commercial environment. Depending on the type, number, and size of the operators in any area, there may be a bearing on the receptiveness to innovation. The deregulated transport environment means that trials of new concepts can only succeed where/when the operators are willing to participate. There are some important issues that should be taken into account, when creating DRT services and flexible agencies in similar environments:

1. It is important to check the existing juridical and regulatory frameworks.
2. The operational environment must be defined (including all the existing modes).
3. The operators (and other stakeholders) should agree upon the services to be provided.
4. Information about the existing services should be available or provided by the transport operators.
5. Co-ordination of the existing services is important.
6. Subsidy systems should be clarified.
7. Joint ticketing agreements are of great importance.
8. The technological environment must be ready for the new service and the tools required need to be defined and developed
9. Information provision and training are essential

### **8.2 Conclusions and recommendations for Florence**

The findings in Florence differ somewhat from those of Angus. Since Florence has been running DRT services for several years conclusions and recommendations are more related to technical issues. The importance of the user/supplier partnering is the core aspect of the FAMS Agency, and will continue until the end of the trial operation and beyond.

It has been shown to be very important to use the suggestions and indications arising from TDC operators because they have gained experience by using the portal emphasising its general structure, layout and navigation facilities, together with some improvements to DRT reservation and trip refusal services. Error handling and security are also important aspects. The modifications implemented have been successful, enabling substantial bug fixing and user-adaptation for further testing and evaluation during operation. The operators feel that efficient booking management and user requests management are important. With regard to passengers quantitative data collection and analysis is on-going.

### **8.3 Overall conclusions**

In most cases to date flexible transport services, and in particular DRT services, are generally managed directly by a single operator (usually a transport company) as a unique and dedicated transport scheme with minimum or no level of integration with the other

collective transport services available in the same area. This paper has demonstrated that there is wide potential for improved operation of DRT concepts and models, in order to cover the overall spectrum of the intermediate and flexible services. This may be achieved by integrating the technological tools developed with emerging e-commerce and e-business services to create the Agency for Flexible Mobility Services.

The provision of brokerage for all public transport services requires the development of ITS systems that can broker between transport providers according to desired criteria. However, improved ITS alone will not guarantee better services, e.g. the mobile phone network needs to be substantially enhanced. There needs to be a reassessment of the regulatory barriers regarding the co-operation between transport providers, thereby enabling a level playing field concerning the prices that can be offered to customers. In particular, suspicions about the objectives and longevity of new services by both customers and transport providers need to be broken down.

## References

Ambrosino, G., Nelson, J.D., and Romanazzo, M. (Eds.), 2004. Demand Responsive Transport Services: Towards the Flexible Mobility Agency, ENEA, Rome.

Ashford, N., and Bell, W. (Eds.), 1978. Mobility for the elderly and handicapped, Loughborough University of Technology, Loughborough.

Mageean, J.F., and Nelson, J.D., 2003. The Evaluation of Demand Responsive Transport Services in Europe, *Journal of Transport Geography* 11 (4) 255-270.

Scholliers, J., Gorini, M., and Kaisto, I., 2004. In-vehicle technologies. In: Ambrosino, G., Nelson, J.D., and Romanazzo, M. (Eds.), Demand Responsive Transport Services: Towards the Flexible Mobility Agency, ENEA, Rome, pp. 111-125.