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**Path Dependency or Route Flexibility
in Demand Responsive Transport?**

The Case Study of TWIST project

by

Ferenc ERDŐSI – Zoltán GÁL – Christoph GIPP – Viktor VARJÚ

Editor

Viktor VARJÚ

Series editor

Zoltán GÁL

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Authors

Ferenc ERDŐSI, scientific advisor, Centre for Regional Studies of HAS, Pécs.

Zoltán GÁL, senior research fellow, Centre for Regional Studies of HAS, Pécs.

Christoph GIPP, scientific research fellow – project manager, Berlin University of Technology, Institute of Land and Sea Transport Systems.

Viktor VARJÚ, junior research fellow, Centre for Regional Studies of HAS, Pécs.

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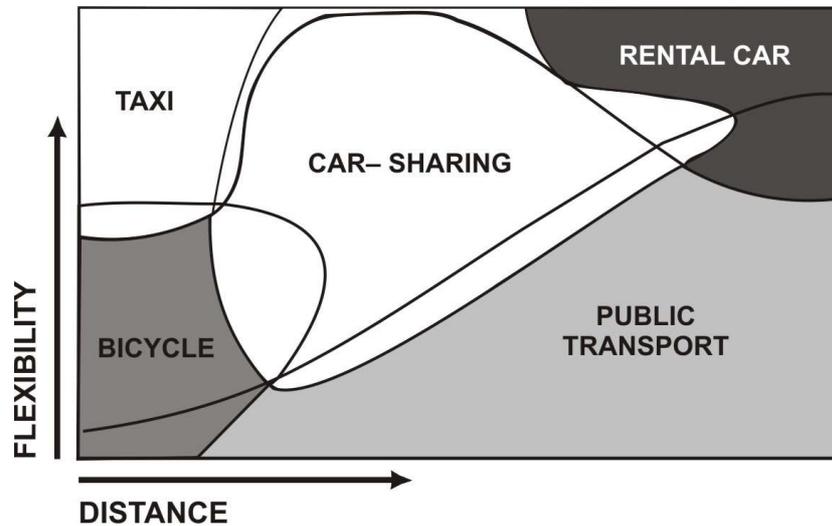
1 Introduction

The rising of mobility claims resulted not just in the increase of private car use but also called for solution in the field of public transport. Public transportation act upon the needs – e.g. it is frequented in day time – but much higher flexibility is needed. First experimentations began in the field of Flexible Transport System (FTS) – or in other name Demand Responsive Transport (DRT) – in 1980's. A turning point could be the years of 2000 when informatics and the telemetric based control systems came to the front and became widespread in transportation as well.

Demand Responsive Transport services provide transport “on demand” from passengers using fleets of vehicles scheduled to pick up and drop off people in accordance with their needs. DRT is an intermediate form of transport, somewhere between bus and taxi (*Figure 1*) which covers a wide range of transport services ranging from less formal community transport through to area-wide service networks (*Mageean–Nelson, 2003, 255. p.*).

Figure 1

Relationship of car sharing with other modes of local transport



Source: European Parliament, STOA, Briefing Note No 4/2001. p. 1–8.

TWIST¹ (Transport with a Social Target) is a European part-financed project by INTERREG III B – CADSES. It oriented towards the promotion of the mobility in underprivileged areas by experimenting a Demand Responsive System. Various European Countries (Italy, Germany, Greece, Hungary) participated in the project and implemented (excluded Hungary) the pilot system.

The project of TWIST is inspired by the cohesion policies of the EU which aim for territorial integration of countries or regions of countries which are structurally less developed. Areas participating show a lack of balance in infrastructural and transport services in mountain, rural and suburban areas.

The implementation of a DRT system aimed to reduce the social and economic gap between inland and urban areas, and aimed to set up an appropriate model to solve the problems in areas with similar background.

The social characteristics of the territories involved in the TWIST project have the main objectives of offering the possibility for greater mobility to the weakest part of the population, such as the elderly or disabled people, women, children and others who have no own cars.

2 Legal background

2.1 The Role of the DRT in the Transport Policy of the EU

Similarly to other sectoral policies transport policy is designated for implementing the objectives of the European Union defined as follows:

- Improving Europe’s competitiveness against the world’s other economic centres (North-America, East-Asia);
- The harmonic and continuous development of the economy within the Community adjusting to the environment and without being hindered by serious inflation;
- A high level convergence of economic performances/services, i.e. balancing between regional and inter-sectoral economic processes;
- The improvement of living standards and living conditions;
- Economic and social cohesion;
- Increasing the solidarity between member states;
- High employment level and building an extensive social care system.

Since Maastricht several Green and White Papers have been issued on the most important issues and segments of transport policy. Today due to the deepening crisis of global ecology the EU’s policies are attaching a growing importance to sustainability (both from traffic and environmental aspects) and various directives are issued for an environmental friendly transport.

¹ www.twistproject.org

2.1.1 Sustainability as a Key Issue

In the past the environmental problems of transport were handled by creating community legal rules for a certain issue of partial importance. The accelerating decrease of the quality of environment (especially the greenhouse effect) made necessary the multidimensional approach of the problem. The demand of a system-wide approach to environmental issues and regarding environmental aspects as primary aspects was formulated even in the 1990 Dublin Declaration before the Rio Conference. The European Community has declared its commitment for environment oriented development even in its 5th Environmental Action Plan. Article 130 of Maastricht Treaty has obliged the Community with enforcing environmental aspects in the elaboration and implementation of the Community's sectoral policies.

The EU considers sustainability as a superior principle to which community policy (including environmental and transport policy) should comply with. This requirement has been formulated on EU level even in the 1997 Amsterdam Treaty. As a consequence of the above-mentioned poor state of environment the sustainability of transport became a more and more worrying issue (primarily in the most densely populated and most heavily "motorised" areas of West-Europe in two aspects:

- In traffic aspects as more and more (financial environmental technical legal/regulator) conditions are missing for building such a transport infrastructure which capacities can keep pace with the demands of traffic but moreover;
- In environmental aspects as transport is one of the most heavily pollutant sectors it is damaging living (and partly built) environment in such a high degree that is threatening their sustainability.

Maintaining sustainable mobility is definitively a big challenge (*Table 1*).

Despite some scepticism the European Union is firmly devoted to the achievement of sustainable transport until the year of 2020. Sustainable transport, which is similar to the concept of "sustainable development" (*Figure 2*), needs some (rather unstable) compromise.

Various steps should be made for the achievement of sustainability. The majority of these actions is directly intervening into the mechanism of transport but others indirectly only.

There are two very different ways of stopping environmental pollution:

- Actions needing no reduction in mobility;
- Actions relying on a series of measurements for reducing mobility.

2.1.2 Traffic Extremities and their Handling Methods

According to the 2001 White Paper the transport in the European Union is threatened by a “stroke” in urban regions and by “paralysis” in peripheral areas. This is not an overstatement as the changing socio-economic structure of settlement networks and the restructuring of the spatial location of population and their implications on transport demands and the spatial distribution of traffic resulted in unfavourable changes in the past decades.

A growing rate of population, producer and other activities is located in urban agglomerations and concentrating in the proximity of interregional connection routes (high-speed trains, motorways, waterways) and sea ports and airports in favourable locations offering high capacity and quick transportation and cargo delivery facilities.

In these “core areas” and conurban territories traffic will increase to an unbearable level with constant traffic jams on main roads, motorways and the speed of traffic will slow down enormously. Due to the heavily built in areas the building of new roads for increasing the existing capacities will almost be impossible and if so their favourable impacts will weakly be felt because of their traffic increasing effects.

Table 1

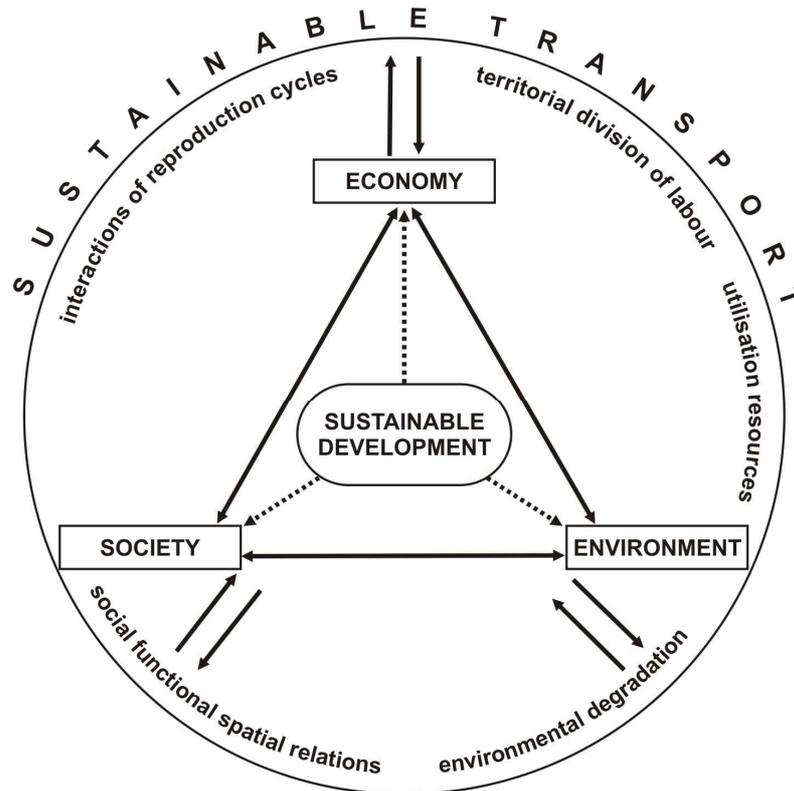
The proposed guidelines of sustainable transport

Guidelines	Description
Accessibility	Anyone should have reasonable access to places, goods and services
Justice	Transport should meet the demands of various social groups and generations
Health and security	Transport systems should be planned and operated making no harms for health and personal security
Education and involvement	People and communities should completely involved into transport related decision processes
Integrated planning	Various experts from different areas – environmental protection, health, energy management and urban planning should be involved into transport planning
The use of land and resources	Transport system should efficiently use available land and other natural resources while maintaining the diversity of the living world and biology
Environmental integration	Transport should make no harms for public health, global climate and essential ecologic processes
Economic welfare	Taxation and economic policy should contribute to the realization of fair and clean transport

Source: OECD Report, 1999.

Figure 2

Basic conditions three essential components of sustainable transport as part of sustainable development



Source: Erdösi, 2004.

In “traffic overloaded” agglomeration and conurbation areas transport policy is targeted at creating a global perspective of a European level of public spaces of sustainable mobility. This task can be solved upon the principle of subsidiarity as the European Union on European level is planning to connect states (capital cities and big economic centres) with Trans-European and Pan-European networks. These networks are based on high-performance transport routes collected/batched into corridors on the basis of multimodality emphasizing on joint services in goods transportation modes by creating economic synergies in delivery services and reducing environmental loads at the same time. Railway routes are considered as the main tracks of corridors alternatively supplemented by environment-friendly waterways as well.

Tackling local/micro regional transport/traffic problems belongs to the tasks of municipalities. The main objective on this level is stopping further traffic increases (or at least slowing it to a minimal level) and decreasing traffic volume to as low level as possible. This can be achieved by technical developments (by the extension of network, by influencing traffic by telematic devices and by building new parking places etc.).

By applying partial traffic rationalisation/organisation, restriction measures (total prohibition of cart traffic or its limitation to certain periods or hours of the day).

Beyond these measures different direct and indirect methods are applied for educating people for environment-friendly transport i.e. using cars in absolute necessity only and using public transport or cycle or walk instead of a car.

Recently several attempts have been made to reduce the high pollution of transport in urban/agglomeration areas (car, bus) (which can amount up to 70–80% of total air pollution (after de-industrialization in countries of advanced economic development industry fell back to the second or third place in the ranking of the main pollutant agents!) such as hiring electric cars, a better utilization of the capacities of personal cars, forming associations of transport, using school buses, establishing city mobility centres, introducing ecological awareness programmes and above all introducing demand responsive transport systems on local level.

Of them minibus ‘jitney service’ has been proved the most promising initiation everywhere from Ukraine to the Atlantic area. In this case a small group of passengers forms a team for the common use of a minibus for their daily travel purposes and share the costs of their trips.

This form of travel mode is known as car sharing. In some cases this may partially be funded by the local community’s budget but it is not customary.

The competitiveness of car sharing which is the most popular in Germany (Hamburg, Cottbus, Rostock, Berlin etc.) and Switzerland, several cars are shared in this way, could be improved if a special lane were assigned to these ‘tele-cars’ and their travel services were rationalized by mobility management services. The most serious problems of transport arise in big cities where people in move have great difficulties in getting a clear insight into the multiple actors and complex system of urban transport offering a large scale and diversity of services and the modes of personal transport in different urban quarters and streets. The orientation is also difficult under these complex circumstances choosing the right time, place and means of transport. At a certain development level metropolises can afford to establish a new institution of transport management. The transport management centre’s task is optimizing the supply side of transport and traffic flow in a network by the utilization of transport telematics, information and management systems for a better use of existing capacities.

This function can be extended by a mobility management system servicing potential passengers. This is definitely a demand oriented service providing detailed and comprehensive (computerised) information for channelling the majority of mobility requests into public and target group oriented transportation modes.

The other side of transportation extremities is servicing the transport demand of sparsely populated rural areas in an appropriate form.

Until 1990, the date of the collapse of the socialist system, the problems of servicing these areas by means of public transport was raised within the framework of market economy in West-Europe, as the utilisation of the conventional means of transport (train, bus, ship and air services) was very low, some per cent only, and the big difference between high costs and low revenues resulted in heavy losses and the system of public transport in rural areas became economically unsustainable. At first these heavy losses were counterbalanced by drastically reducing the frequency of services, by simplifying the transport modes and by increasing the subsidization of the state. In the sparsely populated, boreal climate areas of Northern-Europe this problem has been tackled by using a mixed transport system (the transportation of school-children to schools and seriously ill patients to hospitals is a joint task of the state and local municipality but in general personal transportation services are provided by flexible systems. A similar system has been introduced in the internal regions of Spain as well.

2.2 Technical rules – The EU Bus Directive

At European level, the rules and regulations regarding freedom from barriers are concretised in, for example, the EU Bus Directive (Directive 2001/85/EC of the European Parliament and of the Council of 20 November 2001 relating to special provisions for vehicles used for the carriage of passengers comprising more than eight seats in addition to the driver's seat, and amending Directives 70/156/EEC and 97/27/EC).

“While the principal aim of this Directive is to guarantee the safety of passengers, it is also necessary to provide technical prescriptions to allow accessibility for persons of reduced mobility to the vehicles covered by the Directive, in accordance with the Community transport and social policies. Every effort must be made to improve access to these vehicles. To this end, accessibility for persons of reduced mobility can be achieved either by technical solutions applied to the vehicle, as covered by this Directive, or by combining them with appropriate local infrastructure to guarantee access for wheelchair users” (reason No. 11, Directive 2001/85/EC).

For the technical implementation detailed “Requirements for Technical Devices Facilitating Access for People of Reduced Mobility” are included in Annex VII.

One of the purposes of the EU Bus Directive is to improve the accessibility to the transport vehicles for all groups of passengers. Article III of the directive asks that access to all buses used in the urban transport should be guaranteed for all people with reduced mobility and wheelchair users. The accessibility must be ensured for Class I urban buses for more than 22 passengers. For smaller urban buses (Class A, 8 to 22 passengers) and regional regular buses (Class II), each member state of the European Union can find a different solution to ensure the accessibility. If vehicles other than those of Class I are equipped with devices for people with reduced mobility and/or wheelchair users, they shall comply with the relevant requirements of Annex VII of the EU Bus Directive (*Table 2*).

Table 2

Classes of vehicles regarding the EU Bus Directive

Class I	Class II	Class III	Class A	Class B
Capacity exceeding 22 passengers			Capacity lower than 22 passengers	
Vehicles constructed with areas for standing passengers, to allow frequent passenger movement.	Vehicles constructed principally for the carriage of seated passengers, and designed to allow the carriage of standing passengers in the gangway.	Vehicles constructed exclusively for the carriage of seated passengers.	Vehicles designed to carry standing passengers; a vehicle of this Class has seats and shall have provision for standing passengers.	Vehicles not designed to carry standing passengers; a vehicle of this Class has no provision for standing passengers.

Source: Directive 2001/85/EC of the European Parliament and of the Council of 20 November 2001, Edited by Gipp.

2.3 Specific national regulations

Our standpoint is that problems begin with national legislation. As we could realise during the implementation usually the possibility and the identification of flexible transport did not exist on national level. Fortunately in several countries (Germany, Italy) the need and the idea of demand responsive solution appeared on regional or local level. But as experience suggests us we have problems in eastern part of Europe (e.g. in Hungarian legislation).

As you can see below the German legal background in order to the real and flexible mobility is much chiselled than the Hungarian one. The convergence is justified not just economically between the western and eastern part of Europe but legislatively – especially in real mobility – as well.

2.3.1 German Rules

With the provision of the German Basic Constitutional Law “No person shall be disadvantaged because of disability” (Article 3 (3) GG) the authors of the constitution of the Federal republic of Germany stated clearly that “disadvantageous and exclusionary provisions and discriminatory conditions in the everyday lives of disabled people are socially unacceptable” (official explanatory).

The following federal laws are important for complying with the ban on discrimination in Article 3 (3) of the Basic Law:

- “Code of Social Law – Book IX (SGB IX): Rehabilitation and participation of disabled people” of 19 June 2001
- “Act on the Equal Treatment of Disabled People and on the Amendment of Other Acts” of 27 April 2002, Article 1 of which constitutes the Equal Treatment for the Disabled Act (Behindertengleichstellungsgesetz, BGG)

The Equal Treatment for the Disabled Act (BGG)

The priority goal of the act is to create a comprehensively interpreted freedom from barriers that for disabled people includes the elimination of both spatial barriers and communication barriers.

“The term barrier-free is used to describe structural and other facilities, modes of transport, technical consumer items, data processing systems, acoustic and visual sources of information and means of communication, as well as other structured areas of life if they can be accessed and used by disabled people in the generally normal manner, without particular difficulty and in principle without requiring the assistance of others” (Definition of freedom from barriers in the Article 4 BGG).

The demand to participate equally in all areas of life and to have a self-determined lifestyle is specifically taken into account through the condition “in principle accessible and usable without the assistance of others”. Freedom from barriers is a target for structuring areas of life. The specification is carried out through DIN standards, general technical standards and programmes, plans and agreements. Providing the most extensive freedom from barriers is set out as an objective in the relevant specialist laws. The legal requirement that “publicly accessible transport facilities and means of conveyance in public transport must be designed barrier-free as provided for the pertinent legislation enhanced by

the federal government” (Article 8 paragraph 2 BGG) is important for the public transport.

The Passenger Transport Act (PBefG) and the public transport plan

When developing a new public transport plan principals (e.g. the town, county or region) have to satisfy the requirements of mobility-restricted passengers. The following provision was inserted into the Passenger Transport Act on 1 May 2002: “The public transport plan must take account of the interests of disabled people and other people with mobility impairments for the purpose of achieving the maximum freedom from barriers in using public transport; the public transport plan shall contain statements on time requirements and necessary measures. As the plan is being drawn up, any existing representatives of the disabled or advisory councils for the disabled of the principal shall be consulted” (Article 8, paragraph 3, clauses 3 and 4 PBefG).

The operators are obliged to specify the measures that will be used to put into practice the statements on freedom from barriers. “In all cases the application for approval shall contain [...] a description of the measures for achieving maximum barrier-free use of the transport for which the application is submitted, in accordance with the statements set out in the public transport plan [...]” (Article 12, paragraph 1, No. 1(c) PBefG). The public transport plan is an undertaking on the part of the principles.

Ordinance on the Operation of Motor Vehicle Companies in Passenger Transport (BOKraft)

The Ordinance on the Operation of Motor Vehicle Companies in Passenger Transport (BOKraft) applies to companies that carry passengers using motor vehicles or trolley-buses. The needs of mobility restricted passengers are only regarded in Article 34 BOKraft: “The operator shall provide seating for the seriously disabled, people with impaired mobility, elderly or frail people, expectant mothers and passengers with small children [...]”.

The Building Codes of the Federal States

Also the building codes of the federal states contemplate the requirements of barrier-free construction, such as step-free accessibility, door widths, ramps and movement areas. Partly they are created by ordinances, initial enactments or guidelines. The introduction of special DIN standards (e.g. DIN 18024 Part 1: “Barrier-free built environment: Streets, squares, paths, public transport, recreation areas and playgrounds”) applicable to building supervision is important for the implementation of the requirements of mobility-restricted people.

2.3.2 Hungarian Legal Background

As Hungary concerned National regulation nr. 33/2004. adopted the nr.1191/69 EU regulation in 2004 in the field of public passenger transportation. Hungarian Bus Transport being a regulated (not fully liberalised) market, regulation protects companies, already in the markets, from the new entrants. Until 2012 only 5–35%-of services can be provided by new entrants as subcontractors (there are no examples of this due to the unprofitability of public bus transportation service).

National regulation nr. 33/2004. defines different fields of passenger transport (rail bus) and differentiates between local and inter-locational transport. National regulation regulates the composition of nationwide timetable and (price) discount decree. There is a nationwide tariffs union of the 24 bus companies responsible for Inter-locational Bus Transport. Bus companies make “public service provision” contract with the Ministry of Economy & Transport for inter-locational transport service provision, while companies in larger town responsible for local transport make contract with local self-governments (municipalities). There is no specified territorial scope of DRT and bus companies (24 large ones), usually operate on county level.

Because of the causes mentioned above, big bus transport companies have monopoly rights for servicing their area until year 2013. There is an alternative plan for the entry of private transport service providers into the market but it is not operational. The major problem here is that Hungarian laws have maximised the servicing rate of private sector in coach transport services in 35%. This was not an attractive perspective for the actors of market as it gives no opportunities for gaining profits and according to this concept coach services do rather fall under the ‘category’ of regulated market than free market. On the other hand, today in Hungary the number of coach services is decreasing.

A plan has already been made for the ‘privatisation’ of coach services which tried to reform the present anomalies of coach transport. According to this concept the operation (and ownership) of Baranya County Coach Company should have been transferred to the county seat’s (Pécs) local government free of charge but this experiment has failed. The monopoly of Volán Coach Transport Company in county coach services prevents the extension of the bus services of the public transport company of Pécs into the agglomeration zone.

Another important difficulty appeared during the research. Nowadays in Hungary municipalities or micro regions have minibuses using them for school bus or other social purposes. These buses are not in use all day therefore it can be a solution to use them – operating by local self-governments and cooperating with public transport provider – as a flexible solution answering the demands in off-peak time. But Hungarian legislation does not allow micro regions or

municipalities to use these buses for satisfying other claims. In this case municipalities have to buy or lend new buses to response these demands. As it can be seen this part of legislation needs renewing.

3 DRT Services in Europe

Various rural areas all over Europe can be characterized by a lack of public mobility services. Declining population number, structural changes and the increasing use of private cars cause serious problems to guarantee mobility access for the population.

Several groups can be identified which do not have a private car access: elderly people, mothers with small children and young people under the age of 18 without a driving licence. Public transport services are a basic requirement to ensure a minimum of mobility to these population groups. To ensure the accessibility of rural areas authorities and operators have to find a way to provide a good quality public transport which is affordable and accessible also in areas and times of low demand.

The several European countries can be characterized by different market structures in public transportation, different legal frameworks (e.g. for licensing and bidding processes) and different levels of co-ordination between the authorities, operators and customers. Therefore innovation processes in rural public transport also require different mobility solutions. The integration of school transportation into the public transport network is for example an innovation in Spanish rural areas whereas it is a common practice in Germany.

The key word for mobility solutions in rural areas of low demand is Demand Responsive Transport (DRT).

3.1 Evolution of DRT Services

The first efforts to DRT were made in the 1980s (e.g. in Germany and UK) with dial-a-bus services. In most cases these projects were not successful and the services terminated after a few years. Reasons for the failures are different: lack of flexibility, economic fears of the operators, difficulties caused by insufficient legal basis, incalculable costs, lack of engagement of local actors, competition with taxi business, complicated access via telephone etc.

Many DRT dial-a-bus services were supposed to be a taxi service for the old and the poor which resulted in a low consumer acceptance. Nevertheless, there could be gained much experience.

Over the last decade DRT and dial-a-bus services have grown in popularity. Technological innovation enabled the implementation of new telematics-based systems. This improvement offered, amongst others, new possibilities regarding fleet dispatching. To strive for an increased collaboration between the transportation companies and the taxi business should be the aim of all new projects in the DRT sector. The management of dial-a-ride services should be located at transportation companies; the operation should be integrated in taxi business or as well in public transport companies. Currently it is possible for taxi or rental car companies to execute operation as a subcontractor.

Furthermore it is important to communicate towards the residents of an area served by a DRT service that dial-a-bus services can be used by everyone.

3.2 Options for DRT Organisation and Operation

Demand responsive transport services can be arranged in various operating modes.

- Flexibility in time implies a service operation only after a pre-trip reservation which normally has to be accomplished 30 to 90 minutes in advance. Although there may exist a defined timetable, the vehicles operate only on request to avoid deadhead trips. Several DRT services operate without any predefined timetable.
- Modal flexibility can be defined by the possibility to use different vehicle sizes (standard buses, mini-buses, vans, taxi).
- The route and the stops on a DRT service can be fixed, so that they could be served in any case. Spatial flexibility means the substitution of predefined routes in favour of a corridor or an area around the basic route. Both bus stops and points anywhere in the region indicated by an address can be beginning and end of a trip.
- Temporal, modal and areal flexibility can be combined with each other.

Within public transport network, DRT services can have different tasks.

Autonomous DRT services are operated without any relation to other public transport services. The local spatiotemporal requirements, like opening hours or the location of the community or the health services, determine the service.

Unlike the stand-alone DRT service, almost all of the costumers of DRT feeder service use it as a feeder service to a fix scheduled services. It is the connecting stop that mostly determines the operation of the feeder service as it has a predefined passing time and is always served. This kind of service is often installed for saving travelling time on fix scheduled service by avoiding deviations.

Both models above show extreme situations. In most cases DRT services will offer the possibility to reach the local centre, with its local facilities and the connection point to other public transport services.

The service concepts can mainly be differentiated by their spatiotemporal flexibility. With regard to the spatial flexibility (*Heinze, 1982*) describes different levels of flexibility of the so called “Paratransit” which includes also our common DRT systems:

- Door-to-door: The area coverage is only restricted by the existing road network. Examples are taxi or accordant forms of demand responsive bus systems;
- Many-to-many: No door-to-door relations are offered, but there are a lot of possible stops. Especially realised in demand responsive bus systems;
- Many-to-few: Connection of a centre or connection point with an area;
- Route-deviation-systems: There are fixed routes, but without fixed stops. If necessary it could be deviate to a certain extent;
- Point-deviation-systems: Demand responsible operation of fixed stops by flexible route choice;
- Fixed route with stop on demand: Conventional scheduled service with inclusion of spatially fixed stops on demand;
- Fixed routes with fixed stops: Conventional scheduled services with no spatial flexibility.

The temporal flexibility is also categorised in different levels:

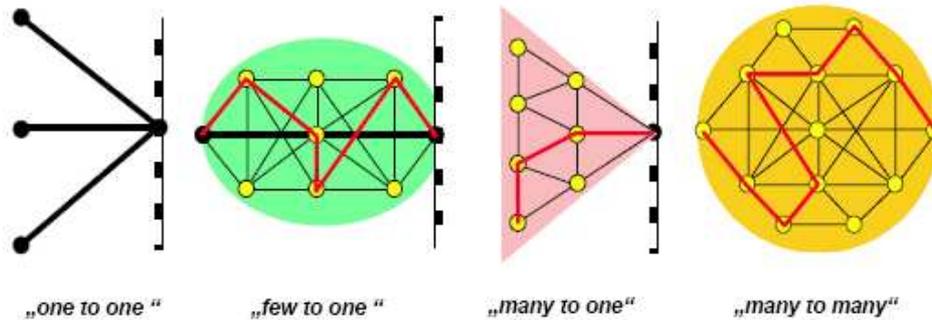
- Immediate-request: Dynamic scheduling allows a fixed service according to the wishes of the demanding users;
- Advanced-request: In this form a booking with fixed time limit is necessary;
- Advanced-standing-request: A returning trip has to be booked once;
- Temporal discrete service at fixed times: Service according to a conventional schedule.

Kirchhoff, 1987 and *2004* describes three operation concepts, which differentiate in their spatiotemporal structure (*Figure 3*):

- Conventional service on fixed lines “one to one”;
- Flexible service within a corridor including route deviations and route expansions “few to one”;
- Sector operation “many to one”.
- Area-wide service “many to many”.

Figure 3

Flexible Concepts in Public Transport Operation



Source: Kirchhoff, 2004.

For further descriptions of DRT operation concepts see *Engels and Ambrosino (2004)*, *Mehlert (2001)* and *Wilhelm (2002)*. The conventional scheduled service means an inflexible service topology with a fixed timetable on fixed routes. This leads to a high temporal and spatial aggregation of the demand and the single trip is made irrespective of the actual demand. Single lines are often linked to synchronised timetables. The advantages of this system could be seen in the high transport performance per vehicle and driver, low operational requirements and the good accessibility and for the passenger (see *Wilhelm, 2002*).

In contrast to fixed services, DRT services like route deviations, sector operation and area-wide operation will only serve all or a part of the stops, if passengers want to enter or exit the vehicle. This requires the announcement of the planned trip by the passenger and thereon the disposition of the route. Wilhelm stresses the importance of a relatively limited demand and accordingly a limited number of stops, which have to be served. If the number of stops becomes too big, the attractiveness for the passenger will reduce, due to long travel times.

In the flexible service in a corridor there are fixed, highly frequented stops at central places and demand responsive served stops in smaller villages. Trips follow a temporal in the direction fixed schedule. But the exact route will be determined by the passengers' trip announcements which can cause deviations of the journey times. The minimal route between the fixed stops will always be served.

The line expansion includes a conventional scheduled line, which is supplemented by demand responsive served stops. The DRT-section of the line could

have the form of a demand responsive scheduled service or an area-wide service.

The route deviation is characterised by a regular scheduled service on a fixed line which is supplemented by demand responsive served stops along the main route.

For flexible service in a corridor there are one or more fixed stops with fixed passing times. Demand responsive served stops are installed in the corridor between them. The route between fixed stops is determined flexible by the passengers' trip plans. For further structuring defining passing times for single DRT-stops could be useful.

The sector operation neither has fixed routes. Mostly there is one fixed stop with a fixed servicing time. The remaining stops are demand responsively served. The routes are defined by the passengers' trip plans. This could lead to highly varying servicing times. Like by all other forms of the flexible service in a corridor the trips are orientated to fixed time frames and follow fixed point.

In respect to the levels of flexibility, the area-wide service has to be seen in the fields door-to-door and many-to-many. The routes and times of service are only determined by the passengers' trip plans.

Demand responsive fix scheduled service means a service on fixed routes to fixed times which will only be operated if an announcement is made. Departure and arrival stop have to be known, which allows a partially operation of the line.

However, there are a lot of hybrids among these four DRT models; e. g. also in the flexible service in a corridor a stop-to-door service is possible.

3.3 European DRT in Scientific Research and in Practical Operation

Beside the objective to gather the social impact of DRT services and flexible mobility solutions for the population in mountainous and rural areas the TWIST project is a key project which profits from a number of further research activities and existing DRT experiences. The following examples give an overview on European and national research projects and DRT services in operation.

3.3.1 *Sampo/Samplus*

The aim of the EU project Sampo (1996–97) and its continuation Samplus (1998–2000) was the development and testing of systems for the DRT management. It was settled in the more general Telematics Applications Program (TAP) of the EU. Different rural and urban regions in Belgium, Finland, Sweden, Ireland, Italy and Great Britain were involved. Also different service to-

pologies and offers, e.g. special offers for disabled and elder people, were tested (*Table 3*). For a detailed description of the project see (*Ambrosino et al, 2004*).

Table 3
DRT concepts within the Sampo/Samplus projects

City/Town/Region	Country	Application/Environment			
		DRT/rural	DRT/urban	Special user/ rural	Special user/ urban
Limbourg	BE	x			
W-Flanders/E-Flanders	BE	x			
Seinä joki	FI	x		x	x
Tuusula/Järvenpää/Kerava	FI	x		x	x
Kilkenny (FS)	IRL	x	x		
Cavan-Leitrim (FS)	IRL	x		x	
Florence/Campi Bisenzio	IT	x	x		x
Hägsbo (Gothenburg)	SE		x		x
Märsta (Stockholm)	SE		x		x
W-Sussex/Surrey (FS)	UK	x		x	

Key: BE – Belgium; FI – Finland; IRL – Ireland; IT – Italy; SE – Sweden, UK – United Kingdom.
Source: Edited by Gipp.

3.3.2 ARTS

Within the ARTS (Actions on the Integration of Rural Transport Services) project financed by the EU different public transport applications were tested in eight rural regions of the EU. The involved implementation areas in Austria, Ireland, Finland and Sweden introduced different DRT concepts whereas the implementation in Hungary, Greece and Spain focused on school transportation or fixed line services with innovative elements regarding the national legal frameworks. The remaining project in Wales implemented a passenger information system (*Table 4*).

3.3.3 Public Transport in Rural Areas (PNV-Region)

Within the research programme „Public Transport in Rural Areas (PNV-Region)” of the German Ministry of Education and Research (approx. 2000–2006) different projects prove the chances for flexible mobility services and technical concepts for its impacts to the German public transport market. DRT modes are a main aspect of the developed solutions especially in the following projects:

Amabile focuses on the legal aspects of DRT systems within Germany and develops specific requirements and procedures for placement and bidding processes. Another key issue of this project was the development of IT-based planning tools for DRT services. “aufdemland.mobil” introduced taxi bus systems as a form of DRT in the counties of Herford and Minden-Lübbecke with a line-orientation but service on demand.

Table 4

DRT concepts within the ARTS project

Town/Region	Country	Application/Environment			
		DRT/ rural	DRT/ urban	Special user/ rural	Special user/ urban
Lappävirta	FI	x			
Gotland	SE	x			
Klaus	AUS	x			
Conamara	IRL	x			

Key: AUS – Austria; FI – Finland; IRL – Ireland; SE – Sweden.

Source: Edited by Gipp.

The main objective of the research project IMPULS 2005 (Integrated Mobility Planning, Realisation, Management and Services for Regions 2005) was the development of concepts for a new „intra-community transport“ for the German federal state of Brandenburg and their implementation in the rural districts of Barnim, Oberhavel und Uckermark as well as research on legal impediments for the realisation of the developed transport models. The project IMPULS2005 developed basic modules for the flexible forms of public transport, e.g. for operational conditions, routing and the avoidance of intersections with scheduled services.

Within the project “mob2” the whole public transport network of the county of Grafschaft Bentheim was optimised by the introduction DRT services as an efficient and cost saving part of the integrated public transport network including school transportation. MultiBus as another important project within the PNVRegion programme was oriented towards practical implementation. The aim was to transport mail and goods with public passenger transport (DRT).

The following table gives an overview on the implemented DRT systems within PNVRegion. Some of them were very successful whereas other examples had to be modified to reach user acceptance and economic efficiency (*Table 5*).

Table 5

DRT concepts within the PNVRegion projects

Region	Country	Application/Environment			
		DRT / rural	DRT/ urban	Special user/ rural	Special user/ urban
DRT Gransee (IMPULS 2005)	GER	x		x	
DRT Eberswalde (IMPULS 2005)	GER	x		x	
DRT Gerswalde (IMPULS 2005)	GER	x		x	
DRT Gartz/Oder (IMPULS 2005)	GER	x		x	
DRT Angermünde (IMPULS 2005)	GER	x		x	
Taxibusses Herford/ Minden- Lübbecke (aufdemland.mobil)	GER	x	x	x	x
DRT Grafschaft Bentheim (mob ²)	GER	x		x	
DRT Selfkant, Waldfeucht, Gangelt (MultiBus)	GER	x		x	

Key: GER – Germany.

Source: Edited by Gipp.

3.3.4 The UK Case

Since public transport deregulation in the UK the provision of solutions to transport demand in areas of dispersed demand has been met by local authorities' attempts to "fill the gaps" in the commercial public transport network, whilst the voluntary sector has addressed the needs of more specialised travel. Over the last five years more innovative solutions have been enabled by the development of Intelligent Transport Systems (ITS), which allow more flexible transport services in terms of time and space (*Brake–Nelson, 2007, 262 p.*).

The areas of Great Britain are densely populated with favourable terrain (a mixture of plains, hills and low mountains) and with dense and well built road system. The rate of personal cars is high. However, since the privatization of inter-settlement/rural bus services private bus companies have terminated several bus services in rural small villages as the maintenance of heavily segmented outlying village lines with low number of passengers was an extremely loss-making business for bus operators. For this reason since the 1990s in several counties experiments have been made with more or less success for the introduction of demand responsive transport (DRT) systems. DRT in Britain has not been introduced in a homogenous system but varies according to the different variations in technical solutions and traffic organisation.

British planners state that against those who consider fixed route public transport services as a kind of demand responsive (supposing that the operator's

historical knowledge of customer demands influences the route taken and the type of vehicle used) they interpret the term of demand responsive transport services as real “flexible route” services adjusted to concrete passenger demands. In this case the concrete travel demand can change the fixed route in time and space during each travel. (*Brake–Nelson–Wright, 2004*).

3.3.5 Further DRT Experience

The “Taxitub” system of Saint-Brieuc (France) is a kind of DRT service but possesses all the characteristics of regular line services (fixed routes and stops; timetable). The lines are only activated by user’s request. Requests can be made at least 45 minutes before and a maximum of 10 days before departure. The request of a Taxitub ride can be made via telephone push buttons (departure time, number of passengers, departure stop, arrival stop, etc.). Between 1992 and 2001 the number of routes increased from 23 to 45 virtual lines. Together with that the number of passengers raised from 8.400 to about 11.000 passengers per year (see *Epe, 2006*).

Other experiences could show the successful implementation of DRT like Treintaxi (The Netherlands), PubliCar (Switzerland) or Anrufbus Leer (DRT System Leer/Germany). Beside that many systems failed in order to various above mentioned structural problems (see chapter Evolution of DRT systems).

The MASCARA project aims to become a vehicle for the promotion and widespread implementation of site-specific Collective Demand Responsive Transport Services (DRTS) as a key component of social cohesion, sustainable and competitive development in European Regions. The MASCARA partnership includes 7 Transport Operators / Authorities / Universities from 7 European Regions representing different transport /mobility environments, ranging from large metropolitan areas to small towns in more rural areas. This provides an ideal context for investigating DRT mobility solutions and achieving useful tangible, results regarding mobility service accessibility. The Evaluation Plan received inputs from all sites describing the local area, local user groups, population densities, demographics, commercial/educational activities and transportation routes for existing and proposed modes. This will ensure that the evaluation yields “an action plan to conduct sustainability analysis of potential DRT services” and leads to “guidelines to enable local authorities and PT operators to set their DRT services and links with companies providing the market with technologies, organisational and support services”. A number of different drafts of the Evaluation Methodology were produced by Porto and refined by all partners. All partners actively participated and exchanged information on training courses and project meetings (see *Cork City Council*).

In nine municipalities of the Mountain Community of Montefeltro, this Demand Responsive Transport service satisfies the need for mobility in territories characterised by weak demand, making regularly scheduled line service economically inefficient. At each stop covered by the service, a map of all the other stops in the municipality serviced on a demand responsive basis can be viewed. Reservations are made by telephone for daily, weekly or monthly rides, as long as they are received at least one day prior to the date on which the service is requested (see *Comune di Tavoleto*).

A Demand Responsive Transport service established under the project entitled AGATA (Agence de multiservices basée sur des Télécentres pour la gestion intégrée de la mobilité et de l'accessibilité aux services de transport), part of the European Regional Cooperation Program INTERREG III B – MEDOCC. To benefit from the PRONTOBUS service, users must be registered. Once the service has been activated, users will be able to make reservations by means of a toll-free number or the on-line reservation section of the service's portal, specifying: the zone in which the service is requested, the stops for pick-up and drop-off, the requested times of pick-up and drop-off and the number of seats onboard the bus. Registered users may reserve one or more rides a day, round-trip if necessary. If the ride is required habitually, they can reserve the service for a given period of time, even reserving rides scheduled for different times and destinations on different days (see *AGATA*).

3.4 Summary of the Earlier DRT Systems

The description of various European experiences with DRT and flexible public transport services shows that many different areas try to solve transport problems and to cover low demands. In the context TWIST enables us to learn from all of this case studies and practical examples. It is a crucial advantage for TWIST that we are able to gather specific solutions for the different implementation areas together with the chance to avoid serious failure reasons. TWIST will cover some additional benefits for rural transport operation and cost efficiency of services because many problems remained unsolved in the past projects.

Experience from across Europe suggests that for financial and scheduling reasons, DRT services do not aim to be the dominant public transport supplier in a market, but are regarded as a vital supplier of services where conventional solutions are untenable, for example low demand areas, special transport services and where social exclusion is evident with low number of potential patronage (where the conventional means of public transport are insufficient). Elderly people, young passengers, disabled social groups and individuals with-

out cars may have extreme significance in servicing transport demands within the framework of DRT systems.

Past DRT experience have shown that the more regulated the economic/legal environment, the less conflict there is between DRT and other public transport modes.

It seems in terms of technologies for DRT services, the level of telematics support available at the local level is critical. In any situation, major investment into TDCs and telematic networks can only normally be justified if high patronage can be confidently predicted. Fortunately, regarding mobile phone and other ICT technologies, the telematics solutions for DRT are highly transferable to rural and urban areas making the access to telecommunication services easier and cheaper.

Intermodality needs an adequate environment. Some fixed stops are needed by all means for interconnections. Services need a fixed starting time and a definite starting point for departure. Completely circular schemed flexible routes very rarely prove to be viable in the long run.

4 The Experimentation Areas

4.1 Region Abruzzo²

4.1.1 Description of the Area

The Mountain Community Medio Sangro Zone “R” in the Province of Chieti, with offices at the Municipality of Quadri, has been identified as the area for implementation in the Abruzzo Region. The total area of the Mountain Community amounts to 157.73 square kilometres, the equivalent of 6.10% of the territory of the Province of Chieti, with a density of 36.38 inhabitants per square kilometre, a value decidedly inferior to the provincial average of 148 inhabitants per square kilometre. The majority of the population, amounting to 5,783 inhabitants, equivalent to 70.08%, reside in a zone at an altitude of between 500 and 1,000 m above sea level. The remaining 29.92% residing at between 1000 and 1500 m above sea level are distributed not only in urban centres, but also in residential settlements and houses dispersed across the communal territory. The orography of the Mountain Community territory is uneven with aspects connected to the presence of waterways and a section with a higher drop down to the Sangro River, which characterises the territory.

² *D’Orazio, 2006*

Regarding the economic aspects of the community, the activities of service-producing sectors relative to commerce, receptivity and catering have registered the highest number of personnel. Tourism is one of the opportunities for local economic development together with promotion of the natural and historical elements of this part of the Medio Sangro, which has already stimulated the preliminary development of tourist-receptive activities. The industrial index is very low (from 1970 to 1996, on average of only 3% of the resident population in the nine municipal areas was employed in industry) confirming dependence on industrialisation in the lower valleys of the Sangro. The construction sector however historically results in the highest number of local units and employees. Since the fifties the primary activities of agriculture and zoo technology have lost importance in the economy of the Communities of the Medio Sangro, with a profound transformation coinciding with the phenomenon of immigration.

Apart from the company providing regional railway transport, local public transport is guaranteed by another three local public road transport companies, which ensure local and interregional transport to Molise. The single municipalities and the Mountain Community are provided with their own means to integrate said service with that of scholastic transport. The Mountain Community has features similar to those of all the mountain zones in the internal regions: scarcely populated, insufficient infrastructure and a scarce propensity for industrial development.

4.1.2 Experimentation

The Medio Sangro Mountain Community resents the features typical of an area with a weak demand for public transportation. The demographic dimensions of the area, which holds fewer than 6,000 inhabitants, the extremely limited population density (36.38 residents per km²) and the high ageing index (equal to 282%) mean that Demand Responsive Transport service can be effectively carried out by only four vehicles, one of which serves as spare, each seating sixteen passengers (or twelve, in the case of vehicles outfitted for disabled transport).

The four vehicles, equipped with interactive onboard terminals, are managed by means of a continuous connection with the operations control centre, located at the headquarters of the Mountain Community. The centre receives requests for the service from the users and confirms that the requests are compatible with the scheduled service plan by means of dedicated software (Telebus). Information is exchanged using GSM or GPRS (General Packet Radio Service) signals, while the location of the vehicle is tracked with GPS. The service is provided on both sides of the Sangro Valley, the area holding the destinations of interest to the residents of the Mountain Community.

The drawing of the graphic illustration for the TWIST transport network guarantees connections, both modal and inter-modal, between the municipalities inside the Mountain Community, as well as between the latter and the major destinations that attract flows of transport. The graphic illustration was drawn up on the basis of the geographic characteristics of the area of implementation, facilitating the placement of preset stops (pick-up points). The residential patterns of the local population, which tends to cluster (at a rate of nearly 90%) around urban centres and inhabited areas, rather than living in homes spread throughout the territory, makes the placement of the pick-up points almost obligatory. Within the group of pick-up points, a distinction can be made between those with set pick-up times and those where pick-ups are made at the request of the users (variable scheduling).

The project is being enacted under a partnership between the Mountain Community and the manager of the Local Public Transportation Service: while the proper operation of the Call Center is overseen by the Mountain Community, which has hired specially trained personnel for the task, the transportation of the users is the responsibility of the local manager of the TPL “Autolinee Casciato S.r.l.”. The drivers of the vehicles, hired for the experimentation periods, have been trained in the use of the onboard terminals, in order to guarantee continuous and effective connection with the operations control centre.

As a preliminary approach, the service follows a pre-set route along which “latent stops” are made exclusively at the request of users. This means that certain lines consisting only of stops made upon request are operated only when there are requests for the service. Permanent service is provided on certain days of the week along set lines that present a constant level of demand. The service operates from 6:36 am to 5:00 pm on weekdays, and from 6:36 Am to 9:05 pm on Saturdays and days preceding holidays. Extensive publicity has been given to the program in schools and public offices (posters and pocket-size schedules), while the reservation services in operation include the toll-free number 800–138–078, which is answered by an operator at the Call Center of the Mountain Community.

4.2 Region Apulia³

4.2.1 Description of the Area

The area bordering Molise and Campania is delimited to the Northwest by the Fortore River, to the South by the Salsola Torrent and to the East by the Tavoliere Plain. The Mountain Communities of the Northern Apennine Dauno

³ D’Argento, 2006.

include thirteen municipalities (Alberone, Biccari, Carlantino; Casalnuovo, Monterotaro, Castelnuovo della Daunia, Casalvecchio di Puglia, Celenza Valsortore, Motte Montecorvino, Pietra Montecorvino, Roseto Valfortore, San Marco la Catola, Valfortore Appula and Volturino) comprising a total population of 22,713 inhabitants. The surface area amounts to 675.95 km², of which 537.78 km² are classified as mountainous territory, explaining the data relative to the population density, which is the lowest in the region (equivalent to 33.60%). With reference to the demographic situation, the present situation of depopulation is aggravated by an increase in the index of the old-aged population (205.4% is the average data of the Sub-Apennine), which directly reflects on the occupational situation as well as the educational level of the population.

Continuous depopulation creates serious problems for attracting capital and motivating investment and thus scarce entrepreneurial initiative caused by the low relational density and reduced demand together with a minimal degree of management and financing for the structures is offered. Data relative to the average level of education of the population highlights a low index of high school education and still a large degree of illiteracy, nurturing an evident divergence between employment expectations and the opportunities offered by the system (the unemployment rate in 2001 was 18.1% with peaks of 29 and 27% in some municipal areas).

The road infrastructure is decidedly inadequate with a lack of both medium and high-speed roads and those present are all two-lane roads with single lanes in each direction. Furthermore due to the morphological configuration of the territory these roads are curved rendering it impossible to exceed an average speed of 45km/h. Mobility is almost exclusively through private vehicles directed toward external centres characterised by greater development. Local public transport seems incapable of satisfying the requirements of the residents and the tourist demand. The zone is currently served by a bus connecting a few municipalities with each other and the nearest urban centres, these journeys are concentrated in particular during the hours of commuter transport. In this context the socio-economic and road situation is destined to be further aggravated by the absence of any integrated social capital support for the productive resources and territorial infrastructure. It seems necessary therefore to improve the infrastructure with a transport service capable of linking the entire territory.

4.2.2 Experimentation

The experimentation of the TWIST project in the Apulia Region began in the Northern Daunia zone of the Apennines, one of the region's most disadvantaged areas in socioeconomic terms. Characterised by the presence of primarily mountainous zones within a total surface area of approximately 676 km², the area holds nothing but small-scale towns (from 1,000 to 3,000 inhabitants per municipality), in addition to which the ageing index is high, as the bulk of the population is over 65 years old.

The roadway infrastructures are extremely scarce, all consisting of a single roadbed, with one lane of travel in each direction. The highly TWISTing paths taken by the roads, as well as the sharp changes in altitude, keep the average travelling speed below 45 km/h. What is more, the area is currently serviced exclusively by buses providing connections between only some of the towns and the larger nearby urban centres, with the bulk of the runs occurring during the day-parts in which commuters travel to school or work.

The area originally selected for implementation of the project held all thirteen of the towns that make up the Northern Daunia Mountain Community, whose demand for internal transportation is low, on account of the absence of sites of attraction, apart from an advanced spa centre found in the town of Castelnuovo della Daunia. It was thus decided to reduce the number of towns serviced by TWIST to ten, though these municipalities were provided with a connection to the town of Lucera, which turns out to be the urban centre of greatest interest, as well as the one nearest the area of experimentation. In addition, it holds Local Healthcare Board FG/3 (covering all the towns in the experimental area), plus a hospital and the INPS pension institute office for the zone.

At present, therefore, the experimentation is being carried out in the towns of: Carlantino, Celenza Valfortore, San Marco la Catola, Volturara Appula, Volturino, Motta Montecorvino, Pietramontecorvino, Castelnuovo della Daunia, Casalvecchio di Puglia and Casalnuovo Monterotaro. The transportation service runs on a "call-in" basis, with flexible routes and schedules tailored to meet the needs of the users. A short model bus has been selected for the service, with a seating room for nine and the features necessary for disabled passengers. The service is in operation from Monday to Friday, during the hours of 9:09 am to 3:40 pm. Reservations can be made by calling the toll-free number 800-904770, which is answered by an operator who collects the requests, organises the route and communicates confirmation of the service to the users who have made reservations.

The Call Centre is in operation from 1:30 pm to 6:00 pm daily, with the exception of Saturdays and Sundays. The distances between the different towns, together with the low average travelling speed, made it impossible to implement a service that meets the requests received in real time. Instead, an off-line sys-

tem was adopted, meaning one under which reservations must be made no less than 12 hours in advance of the actual performance of the service. The reservations received are processed by Pluservice's "Telebus" software, a program capable of determining the optimal route on the basis of input supplied by users and supplemented by subsequent input. All the calls received and the routes drawn up on a daily basis are registered and catalogued, with the result that they shall serve as a key source for analysing the service at the end of the experimentation. On the other hand, the vehicles were not outfitted with onboard devices for communication with the Operations Centre, a feature held to be pointless, given that it is not possible to vary the route during the run. Promoted through the distribution of leaflets and the display of posters in the towns involved, as well as television commercials broadcast by the local station "Telenorba", the service began operation on 11 September 2006.

4.3 Region Marche⁴

4.3.1 Description of the Area

Alto Maceratese is characterised by the presence of several hamlets and tiny housing clusters, the majority being of a rural nature, disseminated across a scarcely inhabited territory. The area is represented by the Mountain Communities of Camerino, San Severino Marche (Alte Valli del Potenza and dell'Esino) and San Ginesio (Monti Azzuri). The Mountain Community of Camerino (749.13 km²) is a zone with a demographic decline caused by continuous depopulation from the area towards the urban centres and a progressive aging of the resident population. This area, although on the outskirts of the centre of provincial development, houses a first class cultural centre – the University of Camerino. The naturalistic, environmental and cultural patrimony of the territory is represented by the National Park of the Sibylline Mountains and the Natural Reserve of Abaddia di Fiastra. The Mountain Community of San Severino Marche, or "Alte Valli del Potenza and Esino" (623.14 km²), has entered a phase of demographic growth thanks to immigration resulting in a slow but progressive peopling of the principal urban centres.

The area, a barycentre in respect to the bordering centres of industrial development, is characterised by the presence of small and medium sized industry. In the Mountain Community of San Ginesio, or "Monti Azzurri" (504.83 km²) the resident population results as substantially unvaried over the years, but showing significant movement toward the industrial centres of Tolentino and the adjoining Belforte del Chienti. The economy of the area is characterised by the

⁴ Pongetti, 2006

presence of several agricultural firms and animal breeding farms, as well as receptive tourist structures, favoured by a rich naturalistic and environmental patrimony.

The road system and mobility in Alto Macerate is conditioned by a range of hills and mountains and a branched road network with long winding stretches and steep inclines even on provincial and state roads. Similarly the railway system lacks fast transversal connections with the Tyrrhenian side, heavily limiting access to the territory. Currently local public road transport is the principal source guaranteeing a service of mobility. In a situation of progressive abandonment of the rural zones, the resources destined to local public transport are often reduced to the supply of minimal services. In this context demand responsive transport represents a modification (and integration) of the present transport system, capable of offering better capillarity and usability of the public service.

4.3.2 Experimentation

Given the layout and the specific morphology of the Macerata hinterland, an area that includes the three Mountain Communities of Camerino, San Severino and San Ginesio, it is not always possible to provide TPL services that fully satisfy the needs of local residents. With its scattered habitation patterns and high rate of ageing, the territory presents the features of an area with a weak demand for public transport, explaining why it was selected for the TWIST pilot project.

The experimental TWIST Demand Responsive Transport service was started up by the Marches Region on 1 August 2006. The experimentation is being carried out with 4 vehicles that hold 19 passengers each, one of them outfitted for the transport of disabled people. The vehicles are equipped with interactive onboard terminals operated by software installed at the Operations Centre in Castelraimondo, plus devices onboard the buses, designed to dialogue with the Operations Centre through the “Telebus” system and its GPRS/UMTS technology.

These instruments track the bus using satellite technology, transmitting the information directly to the Operations Centre:

- The Operations Centre immediately transfers the requests to the software.
- The software processes all the requests received, setting the route to be followed.
- The user is informed of the trip specifications.
- The software sends the data to the interface installed on the buses used for the service; the interface registers the data.
- The driver, based on the information received, carries out the service.

The TWIST service is offered from Monday to Saturday between 7:30 am and 12:30 pm, with 1 bus earmarked for the purpose, while, during the rest of the schedule, the 4 other fixed-route vehicles service branches of the fixed lines when necessary. Users wishing to call in a reservation for a ride can do so up to 20 minutes before departure (in this last case, the user's request is satisfied if the scheduled service plan makes it possible), procuring a ticket for a simple ride, based on the regional fee for kilometres travelled, by simply calling the toll-free number 800-037737. What is more, during other parts of the day, certain stops-upon request can be reserved, assuming operations on the fixed-service lines permit it.

The area selected for the experimentation includes a number of towns in the three mountain communities of the upper Macerata zone, with the primary objective being to provide connections between these zones and the towns which, because they offer various types of structures (hospitals, sports facilities etc.) are destinations frequently requested by users.

The service is carried out by Contram SpA, a local public transportation operator in the Upper Macerata zone, employing human resources that work inside the company, managing calls and software plus resources that work outside, such as the drivers. Contram has installed the Operations Centre in a branch office in Castelraimondo, where the operators, during set hours, answer calls and handle requests, reporting to the Transport Movement Office at the central headquarters in Camerino at the end of the day.

The TWIST initiative has been publicised among families in the towns covered through the sending of envelopes containing a letter from the Head of the Regional Transportation Bureau, a map of the service and a brochure on the operating procedures. The experimentation has been further highlighted with posters, the distribution of fliers and other information materials on the vehicles and in the towns involved, plus the publication of press releases in local media.

4.4 Region Molise⁵

4.4.1 Description of the Area

Molise is a predominantly mountainous region extending across 4,438 km², with a population of 320,601 inhabitants. The area identified for implementation consists of the municipal territories of Bonefro, Casacalenda, Castellino del Biferno, Colletorto, Larino, Montelongo, Monotorio nei Frentani, Morrone del

⁵ Storto, 2006

Sannio, Provvidenti, Ripabottoni, Rotello, San Giuliano di Puglia, Santa Croce di Magliano and Ururi, all falling within the so called Crater area, the area hit by seismic forces on the 31st October and 1st November 2002 and part of the Province of Campobasso. The area under study is internal and prevalently hilly covering a surface area of 569.73 km² with a pre-earthquake resident population of 27,663 inhabitants. The largest municipality is Larino with 7,078 inhabitants while the smallest is Provvidenti with a mere 166 resident inhabitants. It would be pleonastic to note that after the earthquakes hit this area the socio-economic component of many of these municipalities suffered notable upsets caused by the temporary transference of many family units to other municipalities or to new structures specially developed in more secure areas.

The road infrastructure is complexly characterised by routes which are not very smooth, winding and scarcely efficient, coupled by the absence of a transversal motorway offering a fast Tyrrhenian-Adriatic connection and a regional motorway accident rate which is equivalent to 1.76% of the complex national rate. The Molisan railway network consists of 250 km of track, for a large part obsolete with 33 km running on electricity and 17.5 km of double track. Only Ripabottoni, Cascalenda and Larino benefit from the rail service (Campobasso-Termoli line, obsolete and slow); for all the municipalities considered, road transport is prevalent. The TWIST DRT System serves the hospitals of Larino and Termoli which are currently lacking a public transport connection. An initiative that will respond to the lacking infrastructure and to a primary need of the aged, youth and disabled as well as all those who do not own a private vehicle.

4.4.2 Experimentation

The local implementation of the DRT system in Molise launched from 18 September in the territories of ten municipalities of the “Cratere” area hit by the seismic events of 31 October and 1 November 2002. This area is especially well suited to the experimentation, and doubly qualified in terms of the type of territories considered under the project, given that it is both a mountain zone with a low level of transport mobility and an area that was further weakened by the recent earthquake. The intention of the Regional Bureau of Transportation is to make the towns of the “Cratere” area the first to participate in experimentation of a new mode of public transportation designed for the weaker segments of the population, with the creation of an operating model that can be reprised in all the mountain and hinterland areas of Molise.

From Monday to Saturday, mini-buses leave these cities for the medical centre in Larino during the visiting hours for relatives. Given the social charac-

teristics of the territories involved, the experimentation has been aimed at the socially weaker population segments and those with a lower level of mobility, such as women, very young children and the elderly, with a particular focus on the latter, who experience the greatest difficulty of movement. The experimentation in the field was assigned to the CMM regional bus consortium, and specifically to the Silvestri and Calzolaro bus companies, which already operate routes in the territory selected for the experimentation.

The service was organised around 2 flexible, interchangeable routes that passed through the towns involved in the experimentation only when a call was received, in this way ensuring that the entire area was served while optimising the route taken to and from the medical centre in Larino. The system for requesting the service is activated by users through a Call Centre with an operator all its own, located at the office of the Silvestri company, which is found in one of the towns involved in the project, as is the telephone number and the company itself. By telephoning the Call Centre, up to roughly ten minutes before departure, the users can reserve a round-trip at the cost of a normal ticket for the same route: the Call-Centre operator confirms that the request is viable and enters it in the operating program, “communicating” it to the driver the minibus, which is connected to the Operations Centre by GPRS, in real time.

For the TWIST experimentation, it was decided to use an online computerised system under which calls are made to the Call Centre, which, in turn, communicates with the travelling vehicles in real time. This explains why the call can be made up to 10 minutes before the bus has the option of passing through the town from which the call originates. The service is managed by a MICROTPL/ROUTE type dedicated software that makes possible organisation of the services, the vehicles, the stopping points and the routes, plus the off-line management of reservations, with transmission of the lists of stops and user reservations, display of maps providing the geo-positioning of the vehicle for on-line requests for stops and a variety of statistical output. This service is supported by an advanced onboard hardware, as each vehicle is equipped with an onboard computer assisted by dedicated software, a system for tracking and communications with the Operations Centre, plus display of off-line and on-line information, together with a two-way GSM/GPRS-GPS radio, complete with software, antenna and wiring. All the computer equipment was prepared and supplied by the company MICRODATA s.r.l. of Campobasso.

It is necessary to note that a similar optimisation of the service makes it possible to reduce the total kilometres travelled, as compared to the traditional approach, by more than 50%, all the while guaranteeing the necessary coverage. In order to promote the service, and taking into consideration the limited expense of the territory and the difficulty involved in reaching the target, a very simple, direct communication was prepared for all users (delivered through fli-

ers and posters), together message, referred to as the “trust” communication, specifically aimed at the elderly and featuring figures with whom the elderly come into contact, and who enjoy their trust: physicians, pharmacists and parish priests. An overview of the communications initiatives carried out would include: the widespread distribution and posting of fliers and posters, both on the buses of the transport companies involved and in all locales normally frequented by possible users of the experimental service (parish halls, hospitals, local healthcare agencies, family doctors’ offices, pharmacies, bus terminals, intermediate stops, town halls, non-profit organisations, centres for the elderly and for social activities on the part of the target); encounters dedicated to the subject at town halls and parishes, in the company of the “trusted figures”, in order to set off word of mouth; assisted distribution of communications materials on the bus lines.

4.5 Region Ioannina⁶, Greece

4.5.1 Description of the Area

The Prefecture of Ioannina, identified the area for the implementation and realisation of the TWIST project, a mountainous region in the Northwest of Greece with natural resources and a cultural heritage preserved over time. The Prefecture is the third largest province in Greece, covering 50% of the Region of Epirus, one of the most disadvantaged regions in Europe. The surface area amounts to 4,990 km² and, according to the latest demographic survey, the population has grown to include 170,239 inhabitants. Mountainous like the entire region of Epirus, Ioannina lies at an average height of 510 m above sea level, while the average height of the territory is 520 m (above sea level). The territory is one of the poorest in Europe with an average income of € 10.300 per capita. The territorial contribution to the national gross domestic product is a mere 1.40%. The principal economic sectors are: agriculture (8.5%), industry (21.8%), services (69.7%).

The road infrastructure in relation to the population is 1,307 km per 100,000 inhabitants, while the average cost of local public transport is € 1.38 per km. Territorial mobility is principally characterised by local buses and KTEL long distance service buses. From 1952 the owners of the transport companies in the Greek regions operated individual lines covering the transport needs of the villages, cities and regions, under the auspices of the local authorities (State Licence). In 1973 by a governmental decree KTEL transformed the structure of its

⁶ Petropoulos, 2006.

organisation. KTEL SA is participating in the TWIST project with the general aim of having an influence on transport with a social target in the vast area of the Prefecture of Ioannina, acquiring and transferring know-how between the participating regions and providing a region which fully meets the project objectives with the TWIST model.

4.5.2 Experimentation

The area selected for the implementation of the TWIST project is the Prefecture of Ioannina, which covers over 50% of Epiro and is the third largest Prefecture in Greece. Its territory, among the most disadvantaged in Europe, fully meets the principal objectives of the project at which KTEL is participating with the aim of promoting public transport and increasing the social target on the entire area. KTEL has initiated implementation adapting its transport system directly within the catchment area. In September 2006 new pick-up points were introduced and presented to the public to satisfy the need for access to other means of long distance transport.

New routes have been activated and, although only available during specific hours, they cover an area that until now was rarely served. The beneficiaries are mainly inhabitants who utilize the bus to and from the Prefecture of Ioannina. Before implementation of the new transport service, passengers headed for Ioannina had to organise themselves beforehand in order to reach the nearest KTEL stop along the busiest Ioannina–Athens–Ioannina line. To date the service has enriched the line offering pick-up points in predefined localities at which the bus only passes on passenger request.

Until introduction of the service, passengers could only board at a KTEL stop fixed along the route. What has therefore been introduced is the possibility for passengers to board within fixed localities, but according to their particular needs by making a simple booking. The KTEL Ioannina–Athens–Ioannina line, which previously functioned in a standard mode, is now reserved for Demand Responsive Transport: the passenger who wishes to use the service needs to timeously inform the local KTEL, at which of the predefined areas they shall be waiting so that a bus on route is able to stop and fetch them. Currently no additional cost is imposed for the service.

The service is activated on the E951 line and includes all buses travelling Ioannina–Athens–Ioannina. The line E951 passes through Anatolia, Bizanzio, and the town of San Dimitri. As an extension to the DRT destined zones, KTEL has introduced a stop on the Rio-Antirio bridge notwithstanding the fact that this area is outside the implementation area of the project. This choice was based on the importance of serving an ample fascia of passengers. The lines

chosen for DRT implementation were based on a transport study undertaken by KTEL in 2005. A collection of requests made by frequent passengers also provided important data for defining the service timetable.

The service is active three times a day on the lines to and from Athens: during the morning, at midday and in the evening. With the aim of spreading the service, a publicity campaign utilizing hoardings and leaflets describing the service, was initially undertaken. The hoardings were put up at the KTEL pick-up points, while the leaflets were distributed directly among the passengers. The first phases to follow, without doubt, will be an increase in the number of areas included in the DRT service. These areas may vary along the route covered by the Ioannina-Arta, Ioannina-Preveza lines and those to other major cities in the Epiro region.

Furthermore KTEL presented a proposal to the National Secretariat of Information Technology, for the purchase of hardware to increase the level of technology in the company fleet in order to satisfy the needs of Demand Responsive Transport. This proposal was presented within a national competition for funding reflecting the increasing awareness of state authorities to the DRT network. The supply of the necessary technological equipment is programmed for the first quarter of 2007. This will enable KTEL to completely manage the DRT activities activated in the implementation area and supply services that are more appropriate and effectively respond to user needs.

4.6 Region Oberhavel, Germany

4.6.1 Description of the Area

The district of Oberhavel is located north of Berlin and covers an area of 1,796.75 km². About 50% of the area can be classified as a natural reserve and landscape patrimony. The total population is about 200,000 inhabitants with an average population density of 111 inhabitants per km². Industry in the Oberhavel district is of little relevance, with the greatest number of industrial buildings concentrated in an outlying area. In the Region of Oberhavel 40% of the workers are employed in the industrial sector, 24% in the service-producing sector and 12% in public administration. Only 4% still work in agriculture. Given the concentration of economic activities in the Southern outskirts and the principally rural characterisation of the North of Oberhavel, there is a consistent difference between the unemployment rate in the North and the South. Tourism is increasing, mainly in the rural zone of the region, a recreational area near Berlin.

Oberhavel is equipped with a 47 km motorway network, 316 km of federal road and 174 km of local and state roads. Due to the large distances within the district, the lack of a good public transport service and social problems that emerged from the drastic changes after the re-unification of Germany, Oberhavel, like many other areas in East Germany, is characterised by total motorisation. The transport company Oberhavel Verkehrsgesellschaft mbH (OVG) serves all the bus lines within the district. The passenger train system consists of peripheral trains in the suburban areas (every twenty minutes) and two express trains on the commuter line (RE-Regional Express), which cross the Oberhavel district from North to South. In addition five commuter train lines (RB – RegionalBahn) serve the area. Only the principal line offers a constant service between 6.00 in the morning and 8.00 at night. Reduced solutions are used to guarantee school transport. At the weekend, during the holidays and during the night, the bus service is heavily reduced to the principal routes. The drastic socio-economic changes, especially in the rural areas, together with the increase in the cost of public transport necessitate better and more flexible solutions to guarantee system efficacy. The introduction of demand responsive transport system will help to maintain and in some cases extend the current level of service toward an explicit social target: it will guarantee access to mobility to the aged, commuters, those without private vehicles, minors, low income groups, etc in periods and areas of low demand.

4.6.2 Experimentation

Like many other European and German regions the Oberhavel Implementation area has to solve serious problems of financing public transport services. This requires more flexible and cost efficient operation solutions intent on keeping and extending the current service level with an explicit social target. TWIST prevents a shortening of the routes and a reduction of rides. TWIST activities in the Oberhavel Area aim to guarantee mobility access to people without private car access, older people, commuters and minors in times and regions of low demand. A passenger census in three different periods enabled a specified analysis of transport demands and the identification of low demand areas. Only trips which were identified as economically critical in a prior evaluation process were analysed.

The demand structure analysis showed the usage of each trip within the existing public transport system. As a result it was possible to separate different implementation areas within the Oberhavel area and to find adequate alternatives to the current operation models.

The implemented forms to reach higher flexibility and cost efficiency – especially in low demand areas – can be performed by operation with small vehicles, the introduction of line oriented or dispersed DRT services and service provision by subcontractors.

All TWIST activities are fully integrated in the Berlin-Brandenburg public transport service e.g. corporate design, route numbers and integration in passenger information systems (printed and online timetable information) to ensure a good user acceptance.

The strategies to guarantee mobility access for the users are the transformation of line oriented services and the introduction of demand responsive operation on fixed lines, an operation with vans to reduce operational costs, the use of subcontractors to reduce personnel costs and optimisation of the connections to regional and suburban trains to and from Berlin. The booking of rides has to be made 90 min in advance. The operator (Oberhavel Verkehrsgesellschaft mbH) offers a 24 hour Call Centre with common telephone access for DRT booking and passenger information purposes. A prebooking is not required in the trips involved in “Southern Oberhavel” and the “Hohen Neuendorf Area”.

The service provision is supported by different software systems or databases. “IntraCity Rufbus” is a special solution for DRT management. All booking, routing and disposition activities are based on the already existing software solution IntraCity Rufbus. To save costs for additional technical services it was useful to integrate TWIST services into the existing technical environment. As an additional benefit it is possible to use „IntraCity Rufbus” for DRT controlling and evaluation within the TWIST project.

The interface between the Call Centre, the DRT management software and the passenger vehicle is performed by the existing Computerized Operational Control Centre of the operator. All large scale vehicles are equipped with GPS based units for communication and localization. The usage of small vehicles and the operation case “subcontractor” will be solved by the implementation of mobile units. The unit “ATRON 120 MR Mobile” will guarantee localization and communication with the Operational Control Centre and the DRT booking system. Additional benefits of the mobile communication unit are ticketing, printing and penalty management functions.

The start of the test phase in “Northern Oberhavel” was 11.12.2005. The following table shows the number of trips involved in the TWIST project classified by route numbers. The trips include a variation of the vehicle size to small units, the change of the operator towards the introduction of more subcontractors and the change to DRT-services.

In the “Southern Oberhavel” and “Hohen Neuendorf Area” the implementation includes the operation with vans to reduce operational costs, the use of subcontractors to reduce personnel costs and an optimisation of connections to

regional and suburban trains to and from Berlin. The main start of the test phase was 28.05.2006 but some rides on routes 801 and 816 already started on 11.12.2005. All trips of the “Hohen Neuendorf Area” started on 20.08.2006. The operator offers a 24 hour Call Centre with common telephone access for passenger information purposes. A pre-booking is not required in the trips involved in “Southern Oberhavel” and “Hohen Neuendorf Area”.

4.7 Region South Transdanubian, Hungary

4.7.1 Description of the Area

In Hungary TWIST focus orients on Southern Transdanubian area, a region comprising three micro regions: Szentlőrinc, Sellye and Pécsvárad. Due to legal problem until the end of the project no TWIST DRT services can be implemented. The region will define requirements that enable a future implementation with a focus onto the political structures and tasks for authorities and government.

South-Transdanubia is an area rich in natural resources which has been amply promoted during the reorganisation of the Hungarian economy. The agrobiological wealth of the area, arises from favourable soil and climatic conditions, which constitute a relevant basis for agricultural production. The area is however characterised by a poor economy and low level of exportation, principally toward east Europe. Thus economic change toward the service sector and general development of the infrastructure to reinforce the export potential must be considered by the regional development strategy as a multiple and decisive factor for growth. Although the territory is more industrialised than other suburban regions in Europe, the high number of agricultural workers and the scarce presence of industrial and service sectors is inevitably an index of backwardness. The poor transport and communication infrastructure (bad road and rail quality, lack of motorways, the scanty communication network and backwardness in data processing and transmission) are slowing down transformation and still further reducing the level of exportation activities. Production, the quality of products and services, and the number of personnel in the sector are low in this area and activities are principally linked to the city. The average population density in Southern Transdanubia (711 inhabitants) is significantly lower than the national average (1,259 inhabitants) and the area is characterised by a vast number of little villages, among which Baranya is that with the lowest population rate. The correlation between geography and transport within the region is determined by both its macro-regional collocation and its inadequacy to keep pace with the most important international traffic flow. The region is disadvan-

taged due to its distance from the Rhine Rhone Valley super-corridor in Western Europe, from the large scale commercial route connecting CIS countries along the London–Berlin–Warsaw–Moscow axis, and from Hamburg–Prague/Paris–Munich–Vienna–Budapest–Belgrade–Bucharest–Istanbul corridors.

4.7.2 A Strategy to Implement DRT Services in Hungary

The South Transdanubian region is not an implementing region in the TWIST project, however we have discussed the usage of the DRT system in our region with interested parties (transportation companies, micro regions). Although interest exists, there are a lot of obstacles and difficulties which have not permitted us to implement the system. Some of our research experiences are listed below in order to reveal possibilities in the field.

Although the county branches of Volán Coach Transport Company are planning to decrease the frequency and density of coach services in the hinterland they are not interested in introducing an investment intensive alternative transport development model. Their fares and state subsidies are almost fully covering their expenses. Big bus transport companies have monopoly rights for servicing their area until the year 2013. There is an alternative plan for the entry of private transport service providers into the market but it is not operational. The major problem here is that Hungarian laws have maximised the servicing rate for private coach transport services to 35%.

This is not an attractive perspective for the market players as it offers no opportunities for gaining profits and in line with this concept coach services fall in the regulated market rather than free market category. Today the number of coach services in Hungary is decreasing. A plan was developed for the ‘privatisation’ of coach services in an attempt to reform the present anomalies of coach transport. Accordingly the operation (and ownership) of Baranya County Coach Company should have been transferred to the county seat (Pécs) local government free of charge, but this experiment failed.

The Volán Coach Transport Company monopoly in county coach services prevents the extension of the bus services of Pécs Public Transport Company into the agglomeration zone. The importance of railway services in the Szentlőrinc micro region (a potential implementing micro-region in the future) which should maintain its leading role in the system must be underlined. One of the critical problems in the current transport system is that it does nothing to improve the employment situation in the area. The micro-region’s active population cannot get jobs because they cannot commute to centres of attraction nor work in shifts due to the inadequate transport services.

For these reasons the utilisation of TWIST Programme would be of extreme importance for Szentlőrinc micro-region. The micro-region has prepared a plan for the implementation of a networked transport system that, adapting to the micro-region's special features, could significantly improve the efficiency of intraregional transport services. There is a potential technical method, which could be applied in this area – especially in the south and south-west areas – due to the lack of high mountains.

This method is used by the Local Transport Company of Pécs. All company buses have an onboard GPS device and a duplex USW radio communication system to maintain contacts with the Call Centre. As operation of the GPRS interactive and permanent vehicle tracking system would impose high costs on the company, the interactive passenger information system on the Internet is not available to the greater public yet. The present communication system maintains contact between bus drivers and the Call Centre within a 30 kilometre radius. Using this method, the Public Transport Company of Pécs had plans to extend its bus service area into the suburban zones of Pécs but the above mentioned laws prohibit this until the year 2013.

The recent political and budget situation in Hungary is another difficult obstacle for these micro-regions. Lack of investments and development in the area cannot help solve the problems. Hopefully, the successes of TWIST project implementations in partner countries and regions will reveal an appropriate model as a kind of solution for transport development.

4.8 The potentials of DRT as a result of experimentation

As the areas involved show us, experimental areas have mountainous geographical background. Both data of population and the data of aging rate show us that the micro-regions involved in the pilot projects have difficult accessibility. The high aging rate and other experience of the experimentation show that these elderly people and these areas need this kind of mobility. Most of the municipalities involved had not satisfying transport service before.

Concerning previous European experience the flexible transport systems try to serve low demand areas. The characteristic of these areas is usually different. We find suburban or rural, mountainous or plain areas. So as we can see the geographical specialities do not determine the necessity of the use of DRT system. But on the other hand – as we could realise – the high rate of aging, the high number of young people, the low population density, the lack of local facilities and the high variation of demand can result a claim for flexible transport solution.

As it has been mentioned, DRT systems are somewhere between personal taxi using and the traditional public transportation. The exact place of DRT depends on many indicators. But as our and previous experimentation shows us, we have to make a distinction between urban and rural provision areas. The efficiency in urban areas (for example DRT minibuses airport services in Budapest) is much higher than in rural areas (for example in Abruzzo). Parallel the decreases of efficiency the role of non-for-profit stakeholders (self-governments) are increasing.

In rural areas the DRT volume is lower than in urban areas, because of the density of population but on the other hand there is no direct correlation between the decrease of population density and the using of DRT systems.

One of the most important roles of the DRT systems is that they help people to reach one point, which can be an attraction centre, a facility or a main transport corridor/system. We think that it is very important that people reach the main transportation line (for example in Prefecture Ioannina where the main aim is to get the service Ioannina–Athens–Ioannina) in order to reach the attraction centres and facilities (medical centre, leisure facilities etc.).

Therefore DRT has three main functions:

- *The role of carrying on/off*: The DRT system can help to reach the corridors from the background area.
- *Additional services*: When DRT Public transport cannot provide enough service for example for disabled people, In this case DRT has a special function to serve a special segment of the whole transportation.
- *Replacement role*: In this case DRT has to try to fill in the “black hole”, where public transport absolutely not exists. (Usually DRT can not function as a totalitarian actor in the whole transportation network.)

But in all models mentioned above it is very important to focus on the cooperation with the main public transport provider either it is a bus company or a railway company.

We can suppose as well that different settlement structures need different solution and different mixture of transport services. This is why it is difficult to apply one appropriate solution. As in the implementing region can be seen the different geographical (natural, infrastructural, societal etc.) circumstances resulted different (DRT) answer to the modelling question among different implementing areas and countries as well.

The good practice can be born after identifying the actors in the rural areas how have or be able to provide these transportation services with social target.

5 DRT Controlling and Cost-Effect Analysis

The evaluation of a pilot project supposes the analysis of the cost efficiency. Although a clear DRT system can not be profitable the application of business calculations in order to create for instance a Public Private Partnership is necessary.

The basic approach to calculate the economical effects of DRT services come from the common controlling systems within line oriented bus services. Cost-benefit analysis of line oriented services can be transformed to a relevant analysis bases on the service performance (operated kilometres) and additional operational indicators.

Besides performance costs have to be taken into consideration seriously. That includes costs for operation itself including personnel costs, for the vehicles and if necessary for infrastructure like stops or large scale technical investments (operational control centre etc.).

Like in many cases the public transport operation in rural areas with demand problems can not be operated with full cost coverage. Therefore cost coverage can not be expected in the field of DRT services as well.

The theoretical approach to use a cost-benefit analysis for DRT cost controlling will not be used often, because a detailed separation of different cost elements is not common in many operating companies. They only survey the costs appeared in the previous operational period.

The cost oriented decision to implement a DRT system bases on a comparison of the costs that would have appeared when operating as a fixed line service with the costs of the DRT service provision. The comparison can easily be performed by using of cost benchmarks for a kilometre of line oriented service and for a kilometre of DRT service.

5.1 Model Contracts for Subcontractors in DRT Operation – A German Example

Especially the DRT prices are influenced by the operator models. Often subcontractors will be used because they own small scale vehicle that are ideal for DRT use. In Germany therefore a standardized contract has been designed whenever it was possible to use it. They would suggest an equal treatment of all competitors. It is not sure that all taxi and rental car companies accept identical treatments yet. Despite different commitments, the essential parts of a possible basic agreement already are in use.

Basically it is possible to vary in about four different schemes reimbursement in the contractual relationship between municipal transportation companies (principal) and taxi or rental car companies (agent):

- *Refund of Service Kilometres and Additional Stand-by Payment (Without Guaranteed Benefits)*: All effective operated service kilometres are compensated. It is not guaranteed if or how many passenger requests have to be served at all. Additionally, the agent receives a basic stand-by payment for every day providing DRT services. With this additional amount the agent has to ensure his operational readiness during the whole service hours of the DRT.
- *Refund of Service Kilometres (Without Guaranteed Benefits)*: This model is partially established e.g. in the TWIST DRT service of Northern Oberhavel (Gransee). It is not guaranteed if or how many passenger requests the agent has to serve. Therefore this only generates benefits in case of a high level of service kilometre commitment reconsidering the agents' purposes.
- *Refund of Total Kilometres (Service Kilometre and Empty Running; Without Guaranteed Benefits)*: In this form of contract all operated kilometres are refunded. This includes both service kilometres and empty running and tends to compensate the lack of a stand-by payment. This mode of commitment was used at the former existed dial-a-bus service of Gerswalde. Contrary to this contractual relationship it is recommended to use of the first commitment model with a payment of service kilometres and an additional stand-by payment (without guaranteed benefits) to avoid high total costs or additional deficits in DRT services.
- *Refund of Service Kilometres (Guaranteed Benefits)*: Agreements based on service kilometre compensation and a guaranteed amount of rides are used in the fixed TWIST Services in the district of Oberhavel. This model is established in case of fixed route services appearing especially in low demand periods e.g. late evenings, weekends, public or school holidays. These transports are defined as hailed shared taxi or fixed route taxi as a bus substitute.

As follows the experiences in German DRT operation using subcontractors will be concluded to present a practical guideline how to realize Subcontractual Agreements.

Subject of the Basic Agreement (§ 1)

Subject of the basic agreement is the operation of DRT transport services according to §42 of the Federal Law for the Transport of Passengers (PBefG). The principal is licensee of the DRT services and assigns the agent as subcontractor.

Duties of the Agent (§§ 2–5)

The basic agreement includes the duties of the principal and his employees. It refers to the existing laws and to the prescriptions. Important arrangements are punctuality and reliability in the service provision. It is also defined in which way the agent is liable for the property and for the technical equipment of the principal. Important is that the agent is bound to use the exact route is defined by the principal. Usually this will be the direct way.

Fares, Tickets and Account (§ 6)

Passengers are just allowed to be carried within the common VBB fares and terms of transport. Only tickets according to the VBB fare are permitted to be issued. The principal receives the amount which is charged for all issued tickets.

Replacement of Vehicles in Case of Operational Disorders (§ 7)

The breakdown of a vehicle of an agent means that the principal himself has the responsibility to inform the agent and he also has to arrange the replacement with his own vehicles and employees. If the agent is not able to replace the required operating resources the principal has the alternative to use his own vehicles and employees. The agent bills the principal for the additional costs.

Commission (§8)

The commission of the agents is not regulated by the basic agreement yet. The reason is that presently a number of different basic attempts are used. But it is intended that at least all agents of all dial-a bus services in one area are supposed to be remunerated similarly. Finally, this question will be decided within the transport market and not because of idealized perceptions with standardized structures.

Duties of the Principal (§ 9)

The duties of the principals are also included in the basic agreement. The principal has to provide all required technical equipment (PDA, ticket-printer included clamp, vehicle signage) to the agent. The principal has the responsibility for the dispatching process of passenger requests and he also transmits the requests/orders to the vehicles of the agents.

Insurances, Commitment and Adjustment (§§ 10 – 12)

The contract of transport exists between the passenger and the principal. That is why the agent substitutes the principal in front of the passenger. The operator of vehicles has to be the agent which is written down in the jurisdiction code. He releases the principal from all receivables which can be used against the principal because of his transport service. The agent is in duty to sign up the casualty insurance and he has to keep up the insurance coverage for himself and his employees as it is included in legal terms.

Duration of the Period, Cancellation (§ 13)

The contract lasts for 12 months and is extended to a new schedule period if the contract is not cancelled within the expiration date which is a month before the contract will expire. If general regulations change, both parties have the right to cancel the contract. A cancellation without previous notice is also possible. The reason for a previous cancellation is the damage of the contractual obligation or the damage of the interests of one of the contractual partners.

5.2 Potentials for Cost Efficiency

- 1) The costs of the DRT can be reduced in comparison to the fixed line services only if a low demand has to be served.
- 2) DRT enables an extension of the service level via timetable-free operation or additional rides that only operate by a pre-booking. Normally the total transport performance decreases after the DRT introduction compared to the substituted fixed line services. This effect can be reported in many German experiences and results in a cost reduction even if the operator is the same like before.
- 3) The use of cost differences between municipal transportation companies and private bus or taxi operators open another potential for cost reduction. The following benchmarks of German cases figure a bandwidth of options and limits for cost savings when operating by different actors.
- 4) Additional cost that appear in DRT operation have to be calculated (*Table 6*): Disposition of DRT rides; additional vehicle equipment, planning and consultancy costs, etc.

Table 6

Benchmarks for Costs in DRT Operation

Average Costs of Public Transport Operators (Costs per hour in Euro) ¹	
– Municipal or State owned Transport Companies:	18,00 – 26,00
– Private Transport Companies:	13,00 – 18,00
– Taxi Operators:	10,00 – 13,00
Average Costs per DRT Kilometre (East Germany) ²	
– Taxi Operator or Private Bus Operator with Subcontract:	0,80 – 1,50
– Municipal or State owned Transport Companies:	1,50 – 2,540

Sources:

¹ Bundesministerium für Verkehr, Bau- und Wohnungswesen BMVBW (Hrsg.) (1999): Planungshandbuch für den öffentlichen Verkehr in der Fläche.

² Own Research and Calculation.

6 Transferability

Without final statements, establishments and suggestions a pilot project has no relevance and in this case it is not more just time wasting. On the other hand the flexible transport solutions even Demand Responsive Systems are very complex. Not only do chiselled way concern to the socio-geographical circumstances but also concern it to technical solution. As we realised solving the mobility problems sometimes goes hand in hand with fixed timetable provision next the clear method of DRT service.

6.1 Applied Models in the TWIST Project – A DRT Service Model

With regard to the implemented DRT systems within the TWIST project the complexity of possible DRT solutions has been showed clearly. The following table (*Table 7*) shows the different DRT aspects in a theoretical overview. Every other DRT solution can be designed by a variation of the given characteristics.

So as it can be seen on the tables at rural DRT areas – where mostly the TWIST experimentation is taking place – the model of few to one is the most appropriate. The “ONE” can be an attraction centre where facilities are available (like medical centre, leisure centre, Sunday service etc.). On the other hand the “ONE” point could be a transport corridor (for instance in Prefecture Ioannina it is the corridor of Ioannina-Athens-Ioannina), which can be either “normal” traditional public bus transport or railway station or complex transport nod.

The few transportation modes can be flexible routs with fixed and requested stops. The rate of these stops depends on several aspects (texture, orographic or geographic aspects, infrastructure provision).

The experimentation of the TWIST project is performed dominantly in rural DRT systems which suggest us that the role of non-profit stakeholder is of specific importance.

As the table shows us, nearly all experimentation includes fixed timetable services. This is very important for the introduction of a new service especially for elderly people.

The booking technology shows us two different things. Primarily the call centre is very important in the service in any time and DRT system should be based on it. The introduction of the booking procedure trough the Internet is supposed for some other requests. Secondary it presupposes the Internet provision of marginal geographical areas – like mountain municipalities – on the other hand computer/Internet users are needed. Computer users mostly are the new generation, and the middle-aged of the urban population.

TWIST DRT Service Model

	TWIST DRT Service Model					
	Abruzzo, Italy	Ioannina, Greece	Marche, Italy	Molise, Italy	Oberhavel, Germany	Puglia, Italy
Route concepts						
“One to one” with fixed lines and partly fixed timetables	x	x	x		x	x ¹
“Few to one” with flexible service within a corridor including route deviations	x		x	x ²	x	x ¹
“Many to one” with sector operation in an area to defined stops				x ²		
“Many to many” with area-wide service (no fixed stops and no timetable)						
Booking concepts						
Non Pre-booking						
Direct booking	x	x	x	x	x	x
Trip notification (User request – proposal for schedule – precise information short time before departure)						
Collecting requests – defining service						
Booking technologies						
Operator / Call Centre						
Internet	x	x	x	x	x	x
Other						
DRT integration into public transport network						
Stand alone service						
ORT feeder service	x		x	x		x
Integrated ORT service	x	x	x	x	x	x

x¹ Flexible routers and schedules; x² Two flexible interchangeable routes operating on demand.
Source: Edited by Gipp.

But DRT systems usually provide – as in our cases – in rural, marginal areas. The main target is to avoid social disadvantages especially for elderly (who usually don't use computer) and disabled people.

6.2 The setting-up of a Theoretical Model

Demand responsive transport (DRT) solutions become more and more important especially in times and areas with low demands. The growing economic pressure of public funds leads to a high need for adequate possibilities to keep a good service quality in public transport and to reduce the necessary budget. The transport market is usually dominated by line oriented bus services, especially in rural and mountainous areas.

The figure (*Figure 4*) is due to show how to built up a DRT service process, and its the main elements.

Due to the lack of experience with DRT solutions in a number of European countries it is obvious that the focus has to be put on investigation and knowledge transfer in the field of rural public transport. The present draft for specific planning principles represents the basis for a theoretical model in the field of DRT solutions that has to be considered within the TWIST project.

Within the theoretical model the following elements have to be discussed:

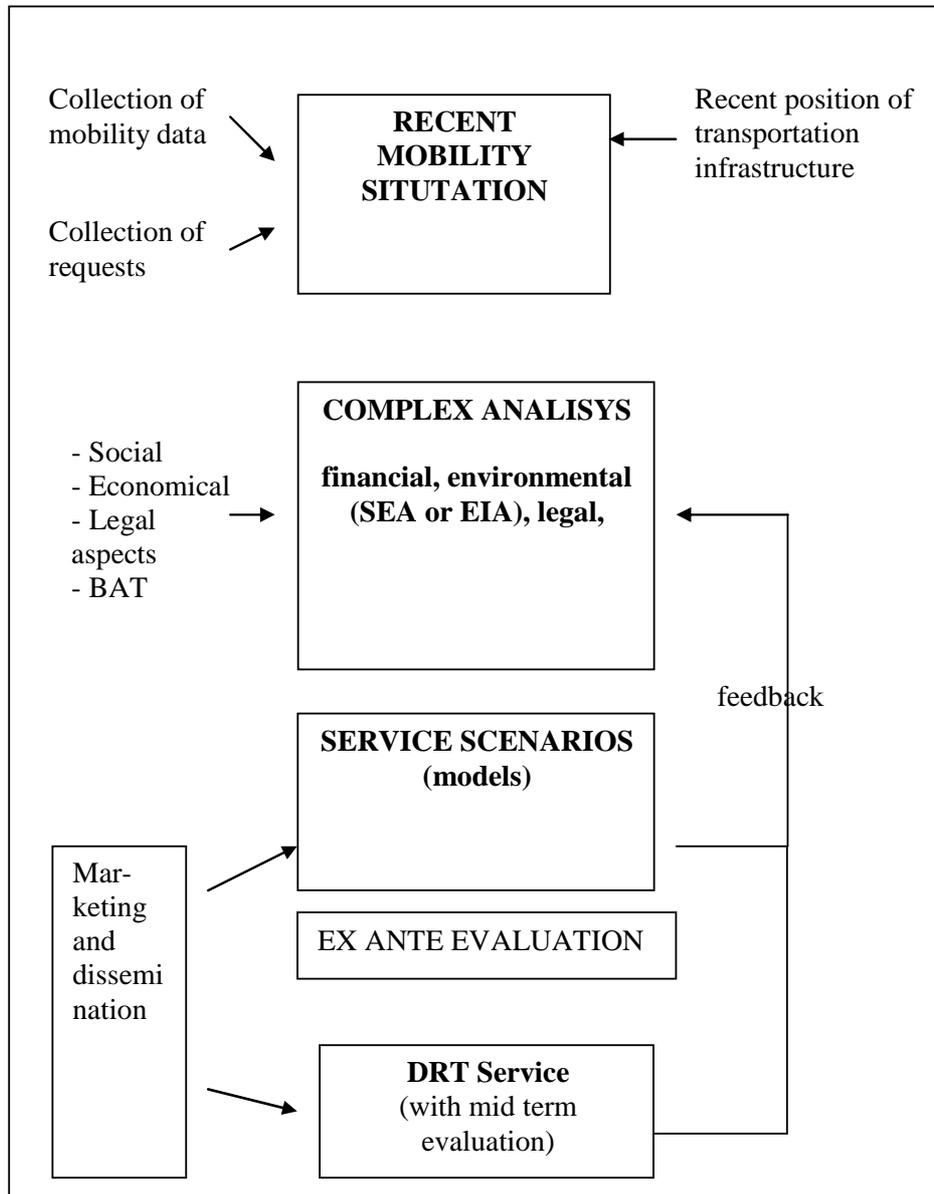
- Identification of the service area;
- Fare system;
- Operational rules for DRT operation;
- Licensing process and legal aspects;
- Liability for operation and subcontracting.

In addition the technical environment of DRT systems is essential for the success and operability. This aspect already was described within the technical reports of Work Package 3 Transport System Planning. To resume the technical requirements the following components have to be considered within a DRT concept:

- Computerized Operational Control Centre (also known al Dispatching Centre or DRT operator);
- On-board devices for communication, ticketing, routing and positioning;
- Communication network between customer, and operator / Call Centre and vehicle.

Figure 4

The setting up of a DRT process



Source: Edited by Viktor Varjú using adding the model of Prileszky–Horváth–Tóth (2007a).

6.2.1 The Identification of the Service Area

The size of the service area for DRT services depends on various aspects like population size, population density, geographical aspects, points of interests in the service area and mobility behaviour. In Germany for example the dimension of DRT service areas varies from approx. 10 km² to more than 200 km². The decision for the optimal area size has to be made with regard to the specific regional conditions.

The route distances within the areas interact directly with the number and requested distance of passenger trips. The area size is also related to the available car pool and to the organisational structure of public transport operators and taxi companies.

The following indicators give an overview for the estimation of the service area dimension:

- Distances between the settlements/ communities within the planning area;
- Comparative data for the traffic flows and density in public or individual transport (Commuter census; School statistics (Students per settlement); Passenger census in existing public transport lines; etc.);
- Number of points of interest within the planning area (public facilities, hospitals, shopping facilities, schools, cemeteries, etc.);
- Public transport connections within the planning area.

6.2.2 Fare System

Different experience show that DRT service fares depend on the level of service. If the level is comparable to line oriented bus services the fare should be the same. If there is a higher quality with temporal flexibility and free routing the fare has to skim this added value with a higher price level that has to be under the common taxi tariffs. Another option is a basis fare with optional extra charges for higher service levels.

If there is more than one operator involved in DRT service, it is important to agree upon a constant and equal fare level including rules for sharing the revenue. In areas with market structures in form of an integrated public transport service (e.g. many metropolitan areas like Rome, Paris, London, Berlin) there should be the integration into the common public transport fares.

Basically the following fare models for DRT systems can be classified:

- Non integrated fares: Independent DRT fare without acceptance of any other public transport tickets

- Partly integrated fares: acceptance of long term public transport tickets / commuter passes with or without extra service charges; special DRT fare for other passengers
- Totally integrated fares: acceptance of all public transport tickets with or without extra service charges

The integration of DRT fares into the existing integrated public transport fare systems like in the TWIST case of Germany is a basic condition for user acceptance and identification of DRT systems as part of the common public transport network. Integrated fares allow trips with changes to other transport modes (e.g. line oriented bus, railway, metro, etc.) and support the public transport networks efficiency.

6.2.3 Operational Rules for DRT Services

Operational rules are essential for the provision of DRT services because various interests have to be coordinated within the DRT concept. The different actors in the system are the passengers, the dispatcher / call centre agent, the driver, the transport operator, etc. Operational rules define the specific responsibilities and rights of each system actor and component. The main aspects of operational rules can be described as follows:

- Definition of service area and schedule / time concept.
- Restriction of non-scheduled operation by using defined operational hours and pre-booking terms
- Prohibition parallel services of fixed route busses and DRT services.
- Service integration within the further public transport network including the handling of connection assurance (Definition of guaranteed connections, connection points, maximum and minimum waiting times, etc.).
- Routing policy (Definition of deviations from fixed routes; usable roads under consideration of different vehicle types – turn over facilities, weight restrictions of roads, etc.) – mostly performed by predefined route options within the routing software.
- Fare system and tariff integration (see chapter Fare System).
- Bundling options of passenger requests (including definition of priorities in case of conflicts: first come – first served / first passengers with connections to other transport modes than passengers without constraints).
- Obligation of pre-booking and terms of booking (required personnel data, standing orders, maximum/minimum pre-booking times, etc.).
- Consideration of special requirements (disabled passengers, leisure transport – bicycles, baby carriage, luggage, etc.)

- Definition of minimum trip length to avoid short trips with high number of empty running kilometres.
- Cancellation rules.
- Liabilities according to transport contract and further legal aspects.
- Data protection of customer / passenger data.

6.2.4 Licensing Process and Legal Aspects

As performed in the second part the legal framework of public transport and DRT regulation is different in each European country. In some countries there is a strong regulation although other countries do not have any legislation for DRT systems.

A major problem in the licensing process for DRT services is, that the status of DRT services neither can be classified as scheduled nor as non-scheduled services using the terms the different national rules and laws of some European countries (e.g. Germany or Hungary). This results in uncertainties at the licensing authorities, how the rules laws may be applied to those unconventional transport concepts. In some cases this forbids the implementation of door-to-door services, since the definition of “scheduled service” comprises the fact that each trip must have an official stop as its starting or ending point. In other cases the implementation of DRT service is not possible at all due to strong market regulation (e.g. Hungary).

To enable equal chances for implementing DRT solutions European wide legislative rules are required. Only by this the strong social oriented objectives of the most DRT systems can be fulfilled.

6.2.5 Subcontracting and Liability for Operation

Within the concept phase of a DRT system the liability for the service provision and the operator itself have to be defined. Often the operator (licensee) is not the same legal body that will provide the services, because the introduction of subcontractors may be more cost efficient. The liability for DRT services is incumbent upon the licence of the DRT concession and not upon the subcontractor.

Basically DRT services may be performed by all transport, taxi and rental car companies if they fulfil all required legal and operational constraints. In taxi and rental car companies labour / personnel costs are often lower than in municipal public transport companies. Taxi companies are especially suited for the operation of DRT services in low demand rural areas, because they usually own

low-capacity vehicles. It could also make sense to consign the operation of a DRT service to a subsidiary of the dial-a-bus service licensee, if the total companies' efficiency has to be considered.

In conclusion the major decision criteria for subcontracts are the costs for the service provision and the availability of the suitable vehicle size for DRT operation.

6.2.6 Business Model

Although the task of a DRT system is not to be a profit oriented venture a DRT system has a business model as well. As in the CONNECT project („D10: Innovative Solutions and Test Cases concerning Business Development”. CONNECT Project – FP6-PLT–506959 funded by the European Commission, 2005) had been described the flexible transportation needs a business model as well (*Figure 5*). A business model has to include the followed elements:

- Who and how will launch the service?
- Who are the stakeholders of the transportation markets?
- What kind of role and targets will the project have?
- What is the network system like?
- What type will the division of responsibility follow?
- Who will finance and what about the income?
- What is the legal background like?⁷

The actors below can participate in the business model as well. They have not just regulative but financial role as well.

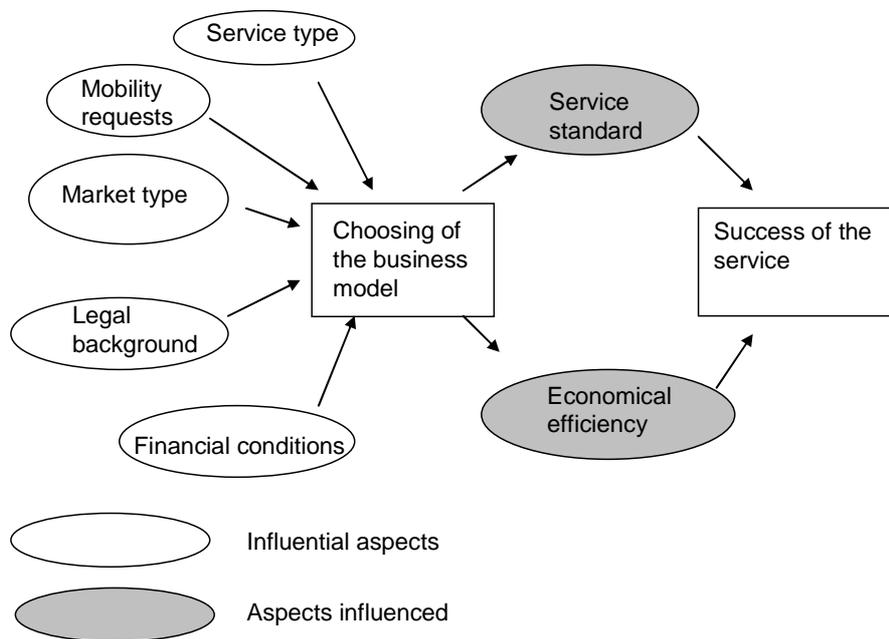
- State: Beyond the regulative actor the state can appear as a financial stakeholder who ensure the equality to the mobility
- Self-government: They have similar role as the state but they can participate in the experimentation using their sources (financial sources, bus, building, other equipments etc.).
- HealthCare Insurance Companies: They can finance the medical visits within the DRT service where they get financial advantages vis-à-vis traditional system.
- Medical Centres: They should promote the availability of their services for disadvantage people trough the DRT system.
- Civil actors: They also can help in increasing the efficiency of the DRT system using their specified information.

⁷ Prileszky–Horváth–Tóth, 2007b.

- For-profit companies: They can be involved in DRT system as an employer using their commuting buses and build them into the DRT service system.
- Other transportation provider: Cooperation is needed among all the transportation providers. Complex, integrated timetable, booking system is needed for the best mobility.

Figure 5

Elements and relations of a DRT Business Model



Source: Prileszky-Horváth-Tóth, 2007b, 90. p.

6.3 Transfer Strategies

TWIST aims to implement a common transnational strategy for regional development in order to optimise transport organisation in disadvantage and marginalized areas from both a geographic and social-environmental point, according to local requirements and with the objects of comparing and eliminating territorial differences.

This specific object may be achieved through the possibility to replicate the in all European regions – especially in the eastern part of the EU, in the new member states – and to develop further actions at a EU level by the spreading of best practices.

Testing results will provide a new way to organise and manage transport services in disadvantaged areas, granting mobility – as a common right of human being.

The regions participating in the TWIST project show a lack of services and infrastructural balance in the rural and mountain areas. The growing isolation of the population, mostly represented by old people, is the cause and the effect of the progressive abandonment of these territories. As a consequence, the resources assigned to local transport services have been reduced, inducing the population to use their own means of transport and causing higher levels of traffic, exhaust emissions and road accidents. Starting from the survey of the supply and demand of the public transport in the territories of the pilot projects, the TWIST project implemented the experimentation of different on-demand bus services. A model to organize and evaluate these services had been elaborated and transferred to other regions with similar characteristics.

6.3.1 Transferability for the European Community

Adequacy to EU priorities as a need that TWIST can be a transferable solution to other EU member states and regions. The EU considers sustainability as a superior principle to which community policy (including environmental and transport policy) should comply with. Next sustainability to available all the services and goods to everybody is another important priority. In order to reach it we have to take into consideration how the TWIST project fulfilled the guidelines below.

Accessibility means that anyone should have reasonable access to places, goods and services. This criteria is especially important at rural, mountainous and disadvantages areas where TWIST has been implemented.

Concerning justice transport should meet the demands of various social groups and generations. As the example shows us the young generation can achieve easier these goods than elderly people. TWIST in this field has a goal that the project provide in high aging rated area.

Health and security mean that transport systems should be planned and operated making no harms for health and personal security. Regarding the means of transport in experimentation areas of TWIST this guideline has been fulfilled.

Education and involvement mean that people and communities should completely be involved into transport related decision processes. DRT system and

TWIST are a perfect example that in case that people and communities are not involved in it, could not exist.

Integrated planning requires various experts should be involved from different areas – environmental protection, health, energy management and urban planning should be involved into transport planning. This criteria is highly presented at TWIST transnational and internal national meetings where Best Available Technology and its representatives were appearance.

Transport system should efficiently use available land and other resources while keeping the diversity of the living world and biology. Sustainability guidelines refer to the environmental integration as well where transport should make no harms for public health, global climate and essential ecologic processes. On the other hand – as ecological footprint theory says – there is an area belonging to energy and material consumptions as well as the waste emission which can either produce or absorb them. Using buses with alternative fuel – either in Marche region or in Oberhavel – TWIST project is going on this way.

Definition of the general guidelines and transmission of the project outputs to the Authorities in charge to plan the transport services it can be established that TWIST project carry a good practice as a solution for elderly people and people who live in sparsely area either in mountainous or in plain territories.

6.3.2 The most Important Aspects of Transferability

As it has been mentioned before, the model of TWIST project is a special DRT system, because it has been realised in rural, disadvantaged mostly mountainous area.

Flexible transport appeared in 1980's in Europe. This phone centred system was Dial-a-bus or Rufbus systems. Parallel with the development of technologies this kind of flexible facilities developed as well. In 2000's telemetric based DRT experimentations appeared.

Compared with other experimentation (as SAMPO, SAMPLUS etc) the goal of the TWIST focused around the highlighted social aspects that harmonize with several EU priorities and guidelines (e.g. accessibility, sustainability).

Using the process of learn-adapt/convert-transfer/disseminate the main result of the TWIST project is that it can show appropriate way low demand, divergent zones and new member states – on their national, regional and local levels – providing model which allow elderly and other disadvantaged people to reach “normal” mobility.

In order to collect experience, to formulate considerations toward transferability of TWIST, we have to mention the aspects below:

- Legal aspects;
- Ideal service model(s);
- High variation of provision;
- Actors involved;
- Estimation of service parameters.

Concerning the legal aspects there are few common thesis on national level. Like in Greece as well as in Germany there are no clear definitions of DRT services on national level. But in Germany on regional level the claim for provision in low demand periods appears. In Italy in Abruzzo – which is a flagship in this filed – the regional legislation focuses on mountain communities as disadvantaged areas.

The worst example is Hungary (which example makes us pay attention towards the new member states) where there are no possibilities for the participation of private sector in transportation. Also in Hungary big bus transport companies (Public Transport Providers) have monopoly rights for services until 2012. The alternative private transport participation is allowed within 35% which is not an attractive perspective because there isn't profit possibilities therefore in this sector there are not free market but regulated market.

Concluded the legal aspects the following transferability can be drowned for other experiments:

- The introduction of DRT definition and classification into legislation (on regional level) is very important. It promotes the experimentation (Abruzzo, Oberhavel) but probably a more chiselled way is needed.
- New EU member states have legislation problems in the experimentation of DRT system. It also means that in these states EU priorities in connection with mobility, accessibility and sustainability do not emerge.
- In order to transferability if the variation of provision (like school, medical visits, tourism services, work, Sunday services) it is necessary to collect all the reasons of transportation. In this case examples help to other experimentation areas in the fields of planning, efficiency and transferability.
- In a DRT system it is very important question that the actors should be involved in facilities. It is because DRT system can not operate with one stakeholder. Of course circumstances depend on legal background.
- Concerning TWIST (and other) DRT experience, a DRT system is not suitable for profit activities. At least the next DRT provider (who can be for instance a volunteer) local government is needed (e.g. Abruzzo). On the other hand cooperation with other/main Public Transport Provider is unavoidable (KTEL). Other organizations as actors or participants can be:

employers, other transport providers (railway) (Germany, Hungary), taxi companies.

- The whole procedure is based on Public Private Partnership.

6.3.3 *The transfer of numbers*

Drawing the consequences we estimated and established a lot of transferable things. But guidance on the most appropriate service and system design is lacking. On the other hand there is little coherence which can be good practices.

During the ex ante evaluation of the project the most important thing is the number of potential clients. Therefore surveys are needed (questionnaire, interview, focus group).

A kind of estimation of users according to the previous transport mode (based on SAMPLUS and calculation) is available. Using the questions and transfer the result of the graph presented by the previous DRT project the following validity index can be calculated (*Table 8*). The survey question was: Would you change the means of transportation when DRT will be available?

As it can be seen in the table on one side taxi users in reality prefer flexible transportation, on the other side private car users do not want to change. Comfort (using own cars) is a stronger link to mobility than environmental or sustainability awareness.

Analysing data achieved throughout the experimentation we have to estimate that there is no strong stochastic connection between the use of DRT and the type of needs which means that different needs call for DRT in different areas.

Table 8

Validity index for estimating the further use of DRT transportation

Interviewee	Before, %	Realisation, %	Validity index
Pedestrian	5	9	1.80
Cyclist	13	12	0.92
LPT user	18	22	1.22
Train user	8	3	0.38
Taxi user	3	20	6.67
Private car user	18	4	0.11

Source: Edited by Varjú using the survey of SAMPLUS presented by Prileszky–Horváth–Tóth (2007a).

But there is a reciprocal ratio which shows that low population density does not go hand in hand with low use of DRT which means in number that disadvantaged area with population density of 30 resident/km² has minimum of 4 flexible passenger/day during higher population area (Oberhavel) has 4 passenger/day as well.

There is cohesion in the Italian implementing area. Next equal population density when the rate of aging above 200% the use of DRT system at least doubles (8) than in normal rate areas.

The know how is not shown either by regular mobility index or by the rating of preference of the LPT.

All aspects mentioned above support that especially elderly people require DRT solutions (*Table 9*).

7 Conclusion

Experience from the TWIST project suggest that for financial and scheduling reasons DRT services do not aim to be dominant public transport providers in a market, but are regarded as vital suppliers of services where conventional solutions are untenable, for example low demand areas, special transport services and where social exclusion is evident with low number of potential subsidy. Old-aged people, disabled social groups and individuals without cars may have extreme significance in servicing transport demands within the framework of DRT systems and as the goal of TWIST showed us.

Also TWIST experience has shown (on one side Abruzzo region on the other side South-Transdanubian region) that the more regulated the legal environment, the less conflict there is between DRT and other public transport modes.

It seems in terms of technologies for DRT services, the level of telematics support available at the local level too. The Best Available Technology is very important for a success experimentation. Regarding mobile phone and other ICT technologies, the telematics solutions for DRT are highly transferable to rural and to disadvantaged areas making the access to telecommunication services easier and cheaper.

Intermodality needs an adequate environment. Some fixed stops are needed by all means for interconnections. Services need fixed starting time and a definite starting point for departure. Completely circular schemed flexible routes very rarely prove to be viable in the long run.

Table 9
Some indicators in the implementing regions

The integration of DRT service into existing conventional (scheduled, fixed route) services (as it has been realised by Greek partner) may yield the following advantages:

- A greater flexibility in the servicing of travel demands with a maximum adjustment to them in time and space;
- Flexible routing of services allows access throughout an area rather than on specific corridors;
- Improved mobility allows citizens of sparsely populated areas for a greater mobility and helps to retain people in areas of declining population;
- It can also encourage inter-settlement tourism without cars.

For the adequate and functional operation of DRT systems it seems indispensable:

- To involve local communities into the planning of local systems and into decisions on solution alternatives.
- Great emphasis should be laid on the selection on emphatic drivers who sympathise with passengers paralysed from transport disadvantages (which could be a problem in Hungary).
- A number of additional and legal barriers should be tackled. Conflicts can be expected between other potential service providers (e.g. bus and taxi) and with other public transport modes (railway or shipping). Building cooperation with these other actors is a real necessity.

One of the most serious problems is the unclear juridical status and regulation of the governance of DRT systems. Their financial system with the charging mechanism is rather chaotic and hectic (too many subjective elements are built into the system) and the degree and efficiency of their subsidization system also leaves several question marks.

Drawing the consequences we estimated and established a lot of transferable things. But guidance on the most appropriate service and system design is lacking. For this, the objectives of the service must be clear and placed in the context of external constraints, such as political, legal, geographical and communicational restrictions. It is only then that the most efficient route design for the predicted demand levels can be considered.

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P.O. Box 199, 7601 PÉCS, HUNGARY

Phone: (36-72) 523 800

Fax: (36-72) 523 803

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Director general

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Editor

Zoltán GÁL

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