CHAPTER **10**

The Role of Intelligent Transport Systems for Demand Responsive Transport

Robert Clavel,* Elodie Castex, Didier Josselin

Summary

Demand Responsive Transport (DRT) is a public transport system, which provides the user with the advantages of both public transport and taxi services. It was often considered as a marginal mode of transport reserved for areas with low population densities. Since the end of the 1990s, the numbers of DRT systems have been increasing consistently, with new investments in urban, suburban and rural spaces, and with varying degrees of operational flexibility. The flexibility and efficiency of DRT systems are influenced by several factors, the most important being technological. Most of these technological developments are in the field of Information and Communication Technologies (ICT). This paper illustrates the use of technology to improve DRT efficiency with two case studies from France (Pays du Doubs central and Toulouse). The type and level of ICT used is strongly dependent on the type of DRT service, its level of flexibility, and its specific optimization problem. The examples of Doubs Central and Toulouse, two different areas, show that technology can play a key role to optimize DRT trips and bring quality service to the population in a large area, or when the patronage is high. Technology offers the potential for achieving real-time demand responsiveness in transport services, particularly in complex networks, to a level far in advance of manual systems.

*Corresponding author: robert.clavel@gmail.com

1. INTRODUCTION

Originating in the mid-1970's, Demand Responsive Transport (DRT) services initially aimed at serving areas with low population density, and offered an alternative form of transportation to disabled people. Now DRT is also used in urban and suburban areas, and offers a large variety of services: ranging from transport for all types of passengers in regular commuting schedules but with low volumes of passengers, to transport for specific areas (airports, etc.). The development of suburbs and the dispersion of origins and destinations of trips led to the emergence of this form of public transport.

The general idea of DRT is to provide people with a public transport service when conventional transport services would be too expensive. DRT responds particularly to dispersed mobility needs, including hours of low demand, areas with low population, and target users dispersed among the general population (e.g. disabled, elderly, students, and tourists).

DRT is a flexible transport service, which adapts to the demand of passengers who have to book their trips. So DRT introduces an innovative approach to mass or collective transport, both in terms of service production and target population: the transport service is not provided on a fixed line but is offered over a defined area. The bus trips are not bound to a specific route or fixed timetable as in the case of conventional service, and the flexibility is provided by the capability to adapt the service to the level and characteristics of demand. Each trip is planned based on the user request in terms of start/arrival timing and origin/destination. In DRT services, the bus will reach the stops only when it is needed and at a pre-arranged times, avoiding long and useless waiting at stops by the users. It exists in the form of different types of services: door-to-door[1], fixed routes, fixed routes with deviations, free routes among a set of points[2] (Burkhardt et al. 1995; Ambrosino et al. 2004; Castex 2007). These services are more or less flexible depending on the public, the area and the goals of the service.

In different European cities and regions, many advantages and benefits are associated with DRT services that are complementary to conventional and scheduled public transport. One of the main reasons for the emergence and success of DRT services is the availability of different information and communication technologies (ICT). These have radically improved the possibilities to provide personalized transport services, in terms of interface with potential customers, optimization and assignment to meet travel requests, and service provision and management. The support of adequate ICT tools is particularly necessary for the management of user-booking volumes, number of trips, etc.

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[1]"A service that picks up passengers at the door of their place of origin and delivers them to the door of their destination" (Burkhardt et al. 1995).

[2]e.g. stop-to-stop services.

This paper first provides an overview of existing DRTs in France, and subsequently demonstrates how technological opportunities can contribute to the management and development of DRT. Examples of the use of ICT for DRTs are provided for two case study locations in France.

2. STATE OF THE ART OF DEMAND RESPONSIVE TRANSPORT IN FRANCE

DRT in France is managed by transport authorities, which correspond to administrative divisions such as communes[3] and the county council. Sometimes an association or a private firm can also manage a DRT. In certain cases, a transport authority can manage several services of DRT, each "service" corresponding to one specific offer of transport located in a particular space.

A database of 650 DRT services in metropolitan France was established between 2003 and 2005 (Castex 2007). It includes a national census on the DRT (DATAR, DTT, ADEME, 2004; UTP, 2005), as well as information gained from websites or directly from the transport authorities. The objective of the database is to make an inventory of DRT services at the scale of the "service" and not at the scale of the "transport authority." This provides information on the evolution of DRT services and helps map them.

2.1 Increase in the number of DRT services since the late 1990's

In 2005, there were 615 DRT services, managed by 384 transport authorities, covering more than 7000 communes. Figure 1 presents the number of new DRTs services created each year and registered in the database. Their number has increased in France noticeably since the end of the 1990s. This growth was encouraged by several laws[4] oriented toward the better management of transportation systems in accordance with the needs of urbanization and environmental protection. DRT services are especially promoted in cities or in territories without transportation and offer a large variety of services. It is possible to distinguish different kinds of DRT according to their users targets. A majority

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[3]The commune is the smallest administrative subdivision in France of which there are 36 000 in metropolitan France.

[4]The law of « orientation for national transport », dec. 30th, 1982 which establishes that the right of transport for everybody must be fulfilled, and defines DRT as a possibility for transport authorities

The law for »development of rural areas », Feb. 23rd 2005, which establishes that in case of lack of public transport services, DRT can be developped

The law for « equality of rights for disabled people » which establishes that specific DRT can be developped when regular lines can't be accessible to disabled people

of DRT services provide transportation services to all the people like the other modes of transport (General DRT), while some services are dedicated to specific users like disabled people (Paratransit), customers of private firms (Private DRT), members of assocations (Social DRT), or railway users (TAXITER).

FIGURE 1
Number of New DRT Creations in France

DRT Creation
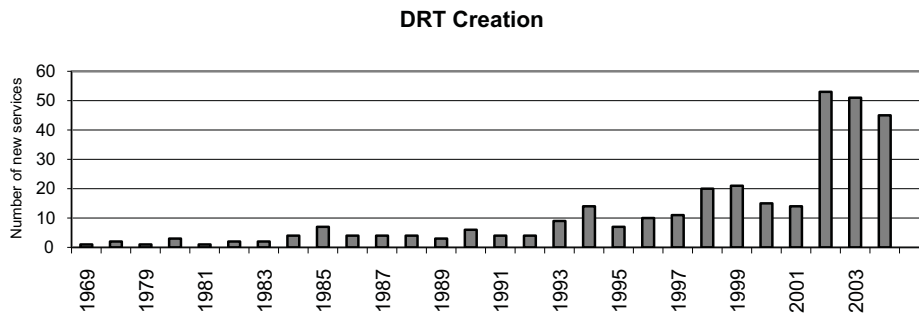
Source: Castex 2007.

2.2 DRTs services in France

Figure 2 shows that DRT services are scattered all across France. DRT services for all users (general *DRT*) are more numerous than the others, and a number of them are located in rural areas. Social DRT are widely common in rural areas, but serve relatively few people (only members of relevant associations). TAXITER is also used in rural areas where rail travel is not very common.

A lot of cities use general DRT in order to complete their transportation system. Typically, general DRT is used to serve the outskirts of the bus network or to take the place of bus routes during off-peaks hours or at night. It is also numerous in suburbs, where the transportation network is less efficient. The area with a presence of general DRT services represents only 15 % of the French territory but contains 50 % of the population. Most cities have also established the paratransit type of DRT service. Private DRT services exist only in the larger cities. The different types of DRT services, together, are present in 24.4 % of the French territory, which corresponds to an area where 90 % of the French population live.

FIGURE 2
Location of DRT in France

Sources : E. Castex / Université d'Avignon - DATAR/DTT/ADEME - UTP
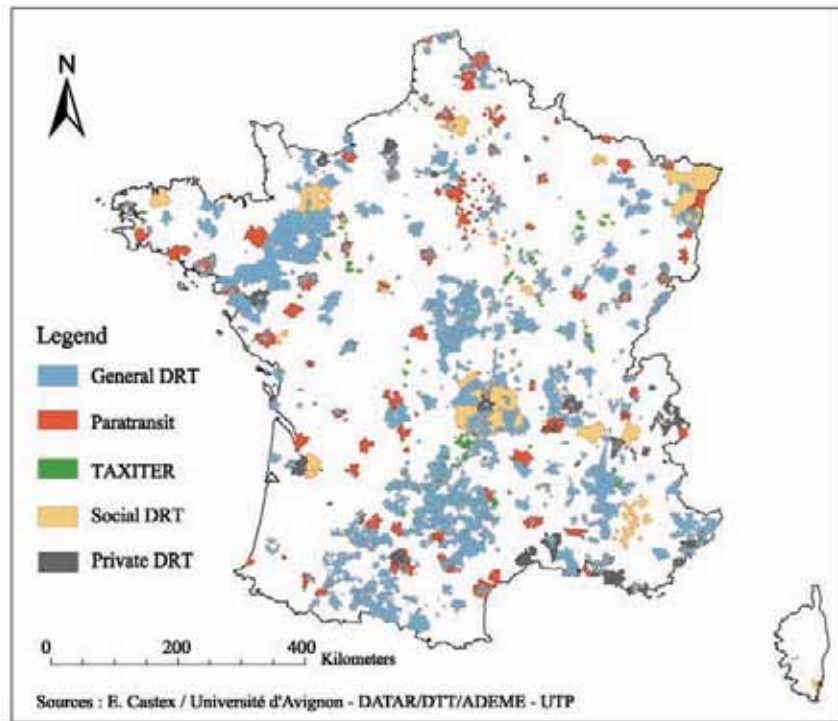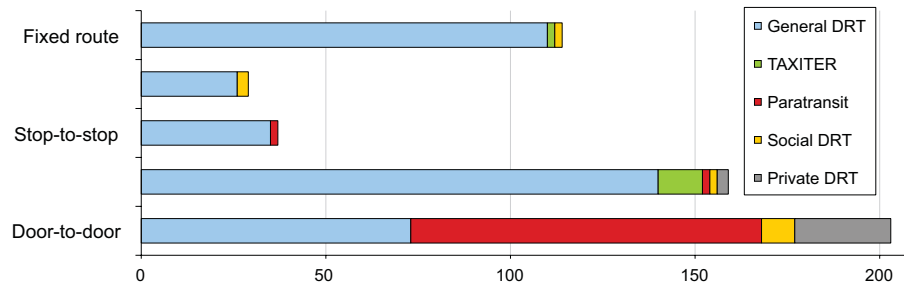
Source: Castex 2007.

DRT services also differ according to the nature of their supply or availability, which offer varying degrees of flexibility. *Door-to-door* DRT services impose the least constraints, with service characteristics comparable to that of a private car or a taxi. At the other end of the spectrum, *fixed route* DRT services can be compared to a bus line: the trip is predefined with given departure and arrival times. The other types of DRT services available offer intermediate forms of flexibility: *stop-to-stop* services permit free routes among a set of points, but their flexibility depends on the number of stops and their location; convergent DRT users have their arrival point predetermined but their departure point is unrestricted. These two kinds of DRT services are relatively similar to *door-to-door* services in terms of flexibility while *fixed routes with deviations* DRT services are less flexible and relatively similar in nature to *fixed routes DRT.*

Figure 3 shows that door-to-door systems are the most widely prevalent,

especially with respect to services dedicated to specific users. Many general DRT services are convergent, i.e. their destination stops are predefined by the relevant transport authority, but fixed route DRT services are also numerous. Stop-to-stop services and fixed routes with deviations have been used less frequently in France, although their use is increasing with time.

FIGURE 3
Different Kinds of DRT in France

Source: Castex 2007.

2.3 Small-scale services

DRT services in France are mostly a set of small-scale initiatives, in terms of the scale of operations, and/ or the number of passengers carried. Indeed, the majority of services are located in smaller administrative areas. Some rural DRT services organized by county councils consist of larger operations, but they are in areas with low population density. DRT services in cities are usually located in the suburbs, where the population density is low too. Moreover, the spatial configurations of DRT services rarely correspond to the busiest commuter routes.

New technical innovations and solutions (both hardware and software) have been developed to make it easier to introduce applications to support demand responsive multi-modal public transport services. These innovations are primarily in the domains of vehicle-locating systems, communications and network, and they have generaly been developed for specific operators or functions. The main customers for such products are public transport operators, regional authorites and systems integrators, who seek a mix of technologies depending on the operational and financial strategies they wish to implement. Although some products have been developed for managing DRT services, they are few, and have not

been tested widely. Therefore, there is a strong potential market for products to support DRT technologies.

For the future, DRT services should be enhanced to a wider scale to improve their efficiency, encourage technological innovations to integrate their functional requirements, and extend their services to areas with high levels of population density and more intense commuting requirements (e.g. during the office-time related rush hour). The purpose of large-scale DRT services is to offer a better quality of service, a competitive supply and to realize economies of scale (Tuomisto and Tainio 2005). They can also contribute positively to the environment by substituting for the use of private cars.

3. DRT SERVICES IN EUROPE

Several large-scale DRT services are available in Europe, e.g., *Flexlinjen* in Göteborg (Sweden), *Treintaxi* and *Reggiotaxi* in the Netherlands (Enoch et al. 2004), and *Drintaxi* in Genoa (European project CIVITAS[5]). Technological improvements have enabled these services to be relatively flexible in their supply characteristics. Technology in European DRT services, such as SAMPO, SAMPLUS, FAMS[6] (Enoch et al. 2004,) or CIVITASis used in travel dispatch centers, and for communications systems including those on-board. Several types of DRT user interface systems are used through different channels like phone, internet, and GSM/SMS.

SAMPLUS is a European project (1999) which has demonstrated and evaluated Demand Responsive Transport (DRT) services using telematic technologies at five sites in four different EU member states (Belgium, Finland, Italy, Sweden). This project shows that the level of ITS support for DRT is a critical factor. Unless an operator can confidently predict high patronage and can afford a major investment in hard and software, it is recommended that low to moderate technology solutions are developed. Large-scale investment is most likely to be possible in regulated market environments where more resources, including manpower, are easily available. SAMPLUS also shows that public transport users may regard DRT services as a means of improving intermodality and system integration, especially where there is no such pre-existing service, thus opening up mobility opportunities for all citizens and moving one stage closer to seamless public transport journeys. More specifically, DRT services can be tailored to suit the requirements of the local situation, whether through highly

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[5] http://www.civitas-initiative.org
it aims at supporting and evaluating the implementation of ambitious integrated sustainable urban transport strategies in european cities

[6] DRT experimentations in Italy, Finland, Belgium, Sweden, England for citizens in rural and urban areas

flexible routing or by guaranteeing connections with conventional services. While it is not the objective of DRT services to adopt a dominant role in the provision of public transport, policy makers should regard it as a vital supplier of services where conventional solutions are untenable (e.g. in low demand areas for public transport). Thus, awareness raising should not only be directed towards local authorities and operators, but also towards central government institutions, which themselves exert considerable influence over the actions of local authorities.

4. NEW TECHNOLOGIES TO ENHANCE THE FLEXIBILITY OF DRT SERVICES

Flexibility is an important characteristic for transportation modes. A private car provides strong flexibility in comparison to other modes of transport since it does not involve predetermined trip bookings, and allows for door-to-door trips with easy accessibility. However, in European cities its ease of use is now increasingly constrained by traffic jams and limited parking availability, especially in the city centers. Therefore, public transport systems are more efficient in these areas, although users criticize their lack of flexibility and the numerous connections to be made between them due to fixed itineraries. In more sparsely populated suburbs and smaller towns, the private car still offers the most effective mode of transport. DRT, which is an intermediate form of transportation between a private car and a bus, can provide services with a variable level of flexibility, the degree of variability depending upon the choices of the relevant transport authority.

4.1 Defining Flexibility with Respect to DRT Systems

Several factors influence the flexibility of a DRT service. These include prerequisites with respect to booking a trip, and the nature of the trip route. Figure 4 compares and evaluates levels of flexibility in DRT services. Each axis represents the main features that may influence flexibility in different modes of transport, which can also be applied in the context of DRT functioning. The placement of a DRT service at the center of the graph symbolizes a low level of flexibility, while an outward movement, away from the center of the graph, indicates greater flexibility. Flexibility is assessed in terms of temporal accessibility (represented in the bottom half of the figure), and spatial accessibility (represented in the top half of the figure, in grey).

FIGURE 4
The Eight Components of the DRT Flexibility
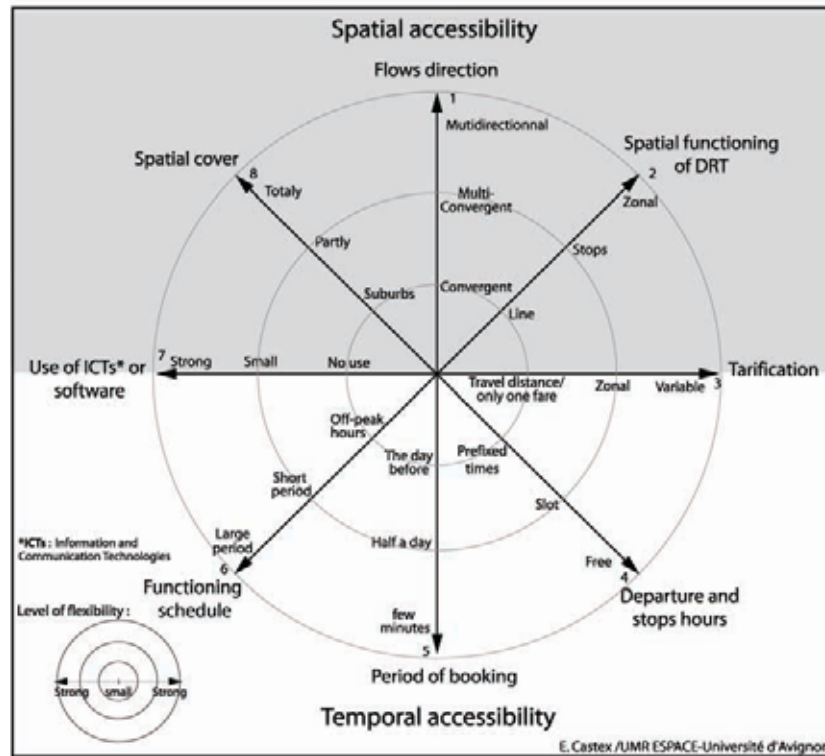
Source: Castex 2007.

For instance, in the top half of the diagram, the axis "direction of flows" indicates flexibility levels in trips opportunities available with a service. A DRT can have multidirectional flows (all trips are possible in a given area) or convergent flows (only trips toward a convergent point[7] are possible), with the first being more flexible. Multi- convergent flows represent intermediate levels of flexibility where several "convergent points" may be available. To the right of "direction of flows" is the axis representing the "spatial functioning" of a DRT: a service can have a zonal functioning (e.g. door-to-door), an organization based on stops (e.g. stop-to-stop services) or on lines (e.g. fixed routes, fixed routes with deviations). The "spatial cover" axis represents the fact that a DRT service

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[7]A convergent point can be a railway station, a town or a shopping center.

can cover all the territory under the administration of a transport authority or segment of it. The above three axes together indicate the spatial accessibility of a DRT service. On the other hand, temporal accessibility is determined by:

- the flexibility of the departure and stop hours; they can be free, pre-determined, or limited according to time slots;

- the "period of booking" which varies from a few minutes to one day;

- the "functioning schedule": the DRT can offer services for a large duration of the day (e.g., 8 am to 7 pm), a relatively short duration (e.g., 10 am to 5 pm) or only during off-peaks hours.

Between these two axes (spatial and temporal accessibility) are located the components that depend on both time and space variables. Tariff systems can be based on time (e.g. variable tariffs based on peak and off-peak hours) or space (e.g. distance covered, or a zonal price). ICT or software use includes time and space dimensions too by permitting better trip management. Without them it is impossible to manage a flexible service in a large area, or one targeted toward a large number of users. Three levels of flexibility with respect to ICT use are represented in Figure 4: no use, minimal use, and strong use.

4.2 Description of Technologies Used for DRTs

The success of DRT services is due, in part, to the availability of different ICTs which have radically improved the possibilities to provide personalized transport services in terms of interface with potential customers, optimization and assignment to meet travel requests, and service provision and management. Continued advances in IT platforms (advanced computer architecture, web platforms, palmtops, PDAs, in-vehicle terminals, etc.) and in mobile communication networks and devices (GSM, GPRS, GPS, etc) have supported:

- DRT operators with respect to service model dimensions, including route, timing of services and vehicle assignment, and have enabled them to alter the service offered in response to current or changing demand;

- A more flexible evolution and use of the operational cycle of DRT services for both transport service operators and passengers. These have made easier aspects related to trip booking, user trip parameters, negotiation phases between the operator and the user, and communication of trip to drivers, service follow-up/location, reporting the completed service.

Usually, ICT-based computer architectures supporting DRT operations are organized around the concept of a TDC (Travel Dispatch Center). The TDC is the main technological and organizational component supporting the management of DRT service provisions. Computer architecture developed for DRT operations include the following:

- Several integrated software procedures to support the operations and management of DRT Travel Dispatch Centers. These include technological developments to ease procedures with respect to handling user requests, trip booking, service planning, vehicle dispatching, vehicle communications and location notification, system data management, and regular Public Transport notification;

- A communication system usually based on public or private long-range wireless telecommunication networks, supporting communication and information exchanges (both data and voice) between the TDC and the DRT vehicles;

- Several types of DRT user interfaces, enabling communication between the user and the TDC through different channels (i.e. phone, internet, GSM/SMS-Short Message Service, and automated answering devices – Interactive Voice Response (IVR) with Computer telephone integration (CTI));

- On-board systems (IVT — In Vehicle Terminal) installed on DRT vehicles to provide driver support functions during vehicle operations in the form of dynamic journey information, route variations, passenger information, and driver/dispatcher messages.

All existing DRT installations are realized through variations in the above basic computer architecture schemes, the implementation of which is made possible by a number of key enabling technologies. These include:

- Booking and reservation systems to manage customer requests;

- Regular public transport information (dynamic or static) meant for DRT operations that support regular public transport services, but also avoid conflicts of DRT schedules with regular public transport schedules;

- Web, Interactive Voice Response System (IVRS), Computer Telephone Integration (CTI); and hand-held devices to assist customer booking;

- Dispatching software for allocating trips and optimizing resources;

- Communication network to link the TDC with drivers and customers;

- In-vehicle units to support the driver;

- GPS-based vehicle location systems;

- Smart-card based fare collection systems;

- Management information systems, administrative systems, and other data analysis systems

The role of the TDC is important for the maintenance of system performance and service provisions (Figure 5). The optimized management of user requests through the TDC with the help of ICT also leads to a potentially more economically efficient model of DRT operations.

FIGURE 5
DRT Architecture
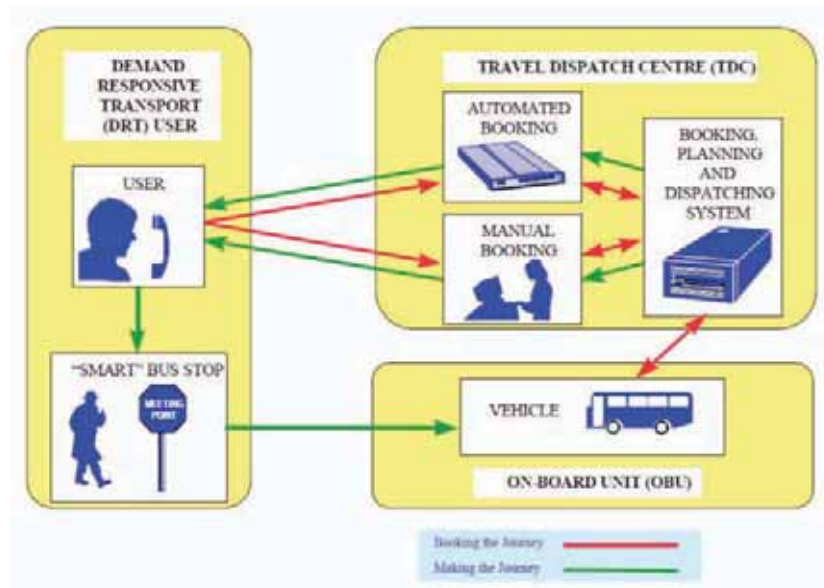
Source: Ambrosino 2004.

5. EXAMPLES OF DRT SERVICES USING SPECIFIC TYPES OF ICT

Provided here are two examples of DRT that illustrate the role of ICT for DRT management. The examples of Doubs Central and Toulouse, two different areas, show that technology can play a key role to optimize DRT trips and bring quality service to the population in a large area, or when the patronage is high. As noted,

technology offers the potential for achieving real-time demand responsiveness in transport services, particularly in complex networks, to a level far in advance of manual systems.

5.1 TADOU: An Innovative DRT in a Rural Area

The Pays du Doubs central is a grouping of 99 communes across five little towns, located in the northeast of France. To serve the mobility requirements of the sparsely populated area of 25 000 inhabitants with 38 inhabitants per square kilometer (Castex 2007), the transport authority of the area developed a stop-to-stop DRT service named TADOU (Transport à la Demande du Doubs Central) » using the Tadvance network[8].

A set of stops cover the entire territory in a system of multidirectional flows, and passengers can travel in any direction from one stop to another after having phoned the previous day to book their trip. A software innovation named "GaleopSys" developed by Tadvance is used for DRT service, which calculates the trips booked and rationalizes them. The input data requirements of Galeopsys are stop points, timetables, and the acceptable levels of delay-time.

> *GaleopSys achieves trip optimization using a Geographical Information System (GIS), the database of which contains information on all the stops and passenger addresses (figure 6). The software enables the calculation of the shortest routes while maximizing the number of passengers transported by as few vehicles as possible. At the same time it ascertains that users' time constraints are respected. The algorithm developed is based on Dial A Ride Problem with Time-Windows (DARPTW) (Garaix et al., 2007); the Prorentsoft firm distributes the software.*

The cost of travel depends on the distance travelled, and is proportionally less for a longer distance of travel than for a shorter one. In 2006, the number of trips was 1863 for 2454 passengers, which corresponds to 1.3 passengers per vehicle. At the beginning of the year 2007, the service had 230 trips a month (Castex 2007).

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[8] researchers network (Universities of Avignon and Belfort-Montbéliard) aiming at the development of DRT

FIGURE 6
Trips Optimization on GaleopSys Software (TADOU)
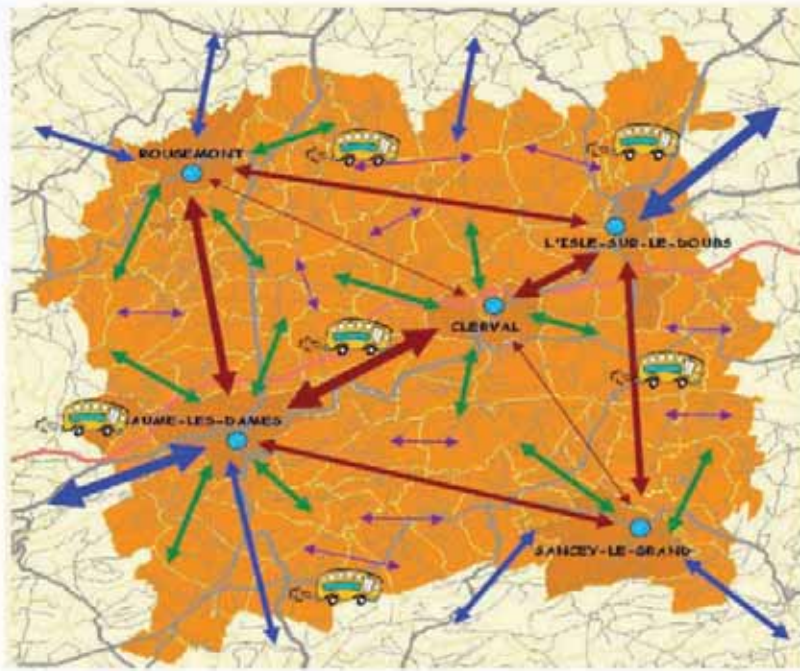
Source: Castex 2007.

5.2 DRT Services Complementary to Public Transport Facilities in the City of Toulouse

In 2004, a DRT service called TAD 106 (Transport à la Demande 106) was created in Toulouse by the Public Transport Authority Tisseo. The service operates as a public-private partnership with RCS Mobility[9] being the private operator subcontracting with Tisseo. The system provides people in the eastern suburban area of Toulouse with a flexible public transport service that is complementary to existing regular lines. ICT innovations used[10] for this operation focus on an information and reservation center operated by telephone and secured reservation website with a multimodal database. The database is regularly updated with software named SYNTHESE for the reservation and dispatching of trips. SYNTHESE is free software with a General Public License. Its input data requirements are the

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[9] « Réseaux, Conseils et Solutions Informatiques » (RCSI)

[10] Developed by « Réseaux, Conseils & Solutions Informatiques » RCSI firm.

City of Toulouse DRT System

Features include:

- The coverage of a large geographical scale: trips are possible on every origin/ destination among 100 stop points across six municipalities;

- A direct connection to a fast and important transport mode (subway);

- High level of availability with departures every 30 minutes from 5 am to 12:30 am every day of the year;

- Flexible operations that require no pre-established itinerary, only stops and timetables are fixed;

- An adaptable system allowing for variations in the number of DRT vehicles on the roads, as a function of demand;

- A low constraint travel option for passengers since it provides the option for booking an unplanned return trip from the central area of town at the metro terminal; otherwise bookings are to be made one hour in advance with cancellations possible until the departure;

- Accessible information and booking center with special toll-free telephone lines available between 6:30am and 10:30pm everyday of the year and a secured website allowing customers to book places any time;

- The DRT service operates to complement the existing urban public transport network. There is no competition with regular lines and a common system of information is shared with them, with integrated tariff systems, etc.

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stop points by zone, timetables, the window of time allowed for prior booking, and pre-existing rules of no competition with regular public transport lines. The dispatcher can consult the real-time location of DRT vehicles with the use of GPS, and can inform passengers in case of vehicle delay. As roadmap trips are transmitted automatically to the drivers from the reservation center, operating costs are optimized. There is also a permanent radio link between vehicles and the information and reservation center and the system allows the display of real-time information of DRT departures; this is available on screens at the Balma Gramont station, which is the terminal metro station. Computer terminals at the Balma Gramont station have facilities for printing the tickets for the allocated trips. The capacity of the vehicles varies from 8 to 22 passengers.

Showcasing the success of this initiative are the statistics associated with this DRT service. On average, 650 passengers/day were transported in 2009 with more than 1000 passengers/day during particular events like the Music Festival; a total of 295 000 trips were made in 2009, a 95 percent increase from 2006, with a passenger satisfaction rate of 97%[11]. Many other unique, and innovative features are associated with this DRT service are shown in Figure 7 and the box below.

[11]Data collected from DRT operator in Toulouse

FIGURE 7
Principles of DRT « TAD 106 » in Toulouse
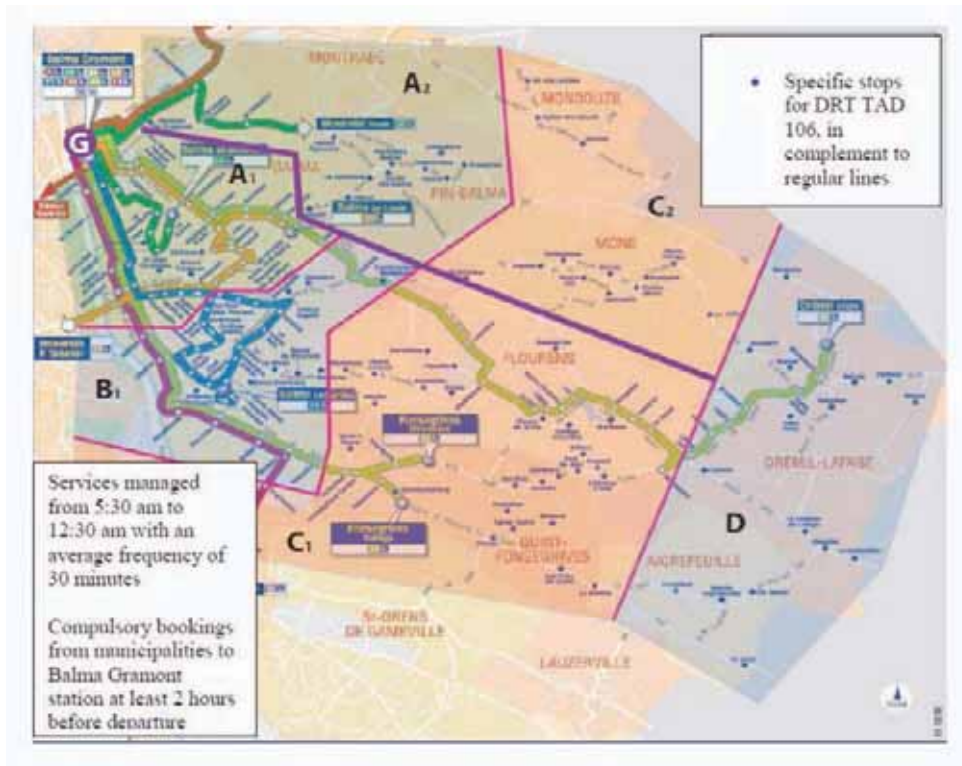
Source: DRT operator in Toulouse.

It is envisaged that future ICT innovations in several realms (see figure 8) will allow improvements in the quality of DRT services being offered in Toulouse and lead to the reduction of management costs. These will depend to a large extent on the will of the actors involved, including the local authority and the operators who will benefit from the integrated workings of communication satellite systems with local telecommunications networks.

FIGURE 8
Technological perspectives for DRT "TAD 106" in Toulouse
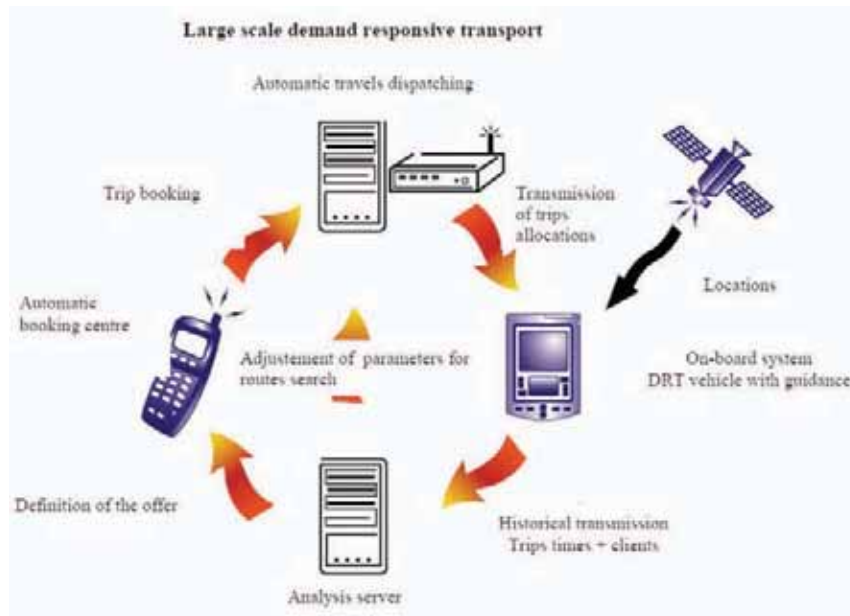
Source: DRT operator in Toulouse.

6. ENVIRONMENTAL IMPACTS OF DRT

An ADEME (French Environment and Energy Management Agency[12]) analysis (ADEME 2005) compares greenhouse gas (GHG) emissions arising from the use of urban DRT services against a theoretical situation where a passenger would use a private car for the same trip. The study concluded that:

- DRT services consume slightly more energy (10% more at the maximum), and therefore emit more GHG emissions when compared with the usage of private cars; and

- DRT operations consume much less energy than regular public transport services (at least 60% less) in areas with low mobility potential (e.g. those with low population densities).

Although the comparison shows a slightly higher level of energy consumption

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[12]http://www.ademe.fr

and corresponding GHG emissions arising from the use of private cars, as opposed to DRT services for a similar trip, the results of the comparison must be interpreted with caution since many trips would not be made without the availability of DRT services. This is because one of the objectives of the DRT model is to provide mobility to those who may find it difficult to use both private and public forms of transport (e.g., elderly people, disabled, and those who do not own personal transport and/ or have inadequate access to public transport).

Apart from the above, a simulation-based assessment was also conducted on the extension (to more municipalities) of the DRT service "Evolis Gare" that provides connecting trips to the train station in the urban agglomeration of Besançon (Castex 2007). This assessment showed that a DRT service with a high rate of demand (at least three people/vehicle) enables a decrease in the number of kilometers (up to 30%) made by DRT vehicles. Therefore, if trips are optimized, DRT services can contribute to a reduction in greenhouse gases emissions arising from transportation. However, additional studies would be needed to measure these environmental impacts of DRT system services and its related ICT infrastructure.

7. CONCLUSION

One of the main reasons of the development of DRT in recent years has been the development of technology. Advances in software, computers, digital maps, remote communications, in-vehicle computers and GPS technologies have helped make DRT services viable. The examples of Doubs Central and Toulouse, two different areas, show that technology can play a key role to optimize DRT trips and bring quality service to the population in a large area, or when the patronage is high. Technology offers the potential for achieving real-time demand responsiveness in transport services, particularly in complex networks, to a level far in advance of manual systems. However, the costs of establishing high-tech schemes are significant, resulting in local authorities sometimes being reluctant to make investments in such softwares. Moreover, suppliers often provide specialized hardware rather than adapting standard platforms, which increases cost considerations and thus constrains the greater use of technology for more efficient DRT services.

There is immense potential for DRT services to develop as an economically sustainable public transport systems and alternative to the private car. In particular, DRT helps to meet the travel needs for target groups of passengers like the elderly, disabled, and other special groups. These potential markets have largely not been met by transport services because cost-effective means of meeting such demands have not been adequately developed. Operators and local authorities increasingly believe that if technical barriers can be overcome, the transport market for DRT will accelerate.

The environmental benefits of an efficiently functioning DRT system have not been adequately established yet. However, it is conceivable that if DRT system can effectively use ICT developments to achieve more flexibility in their responses to mobility requests, they can help mitigate transport related GHG emissions by limiting the use of private transport.

Glossary

ITS : Intelligent Transportation Systems

IT : Information Technology

PDA : Personal Digital Assistant

GPRS : General Packet Radio Service

GSM : Global System for Mobile communications

GPS : Global Position System

TDC : Travel Dispatch Centre

DARPTW : Dial-a-Ride Problem with Time Windows

GIS : Geographic Information Systems

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