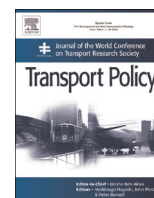




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## Assessing the impact of different policy decisions on the resource requirements of a Demand Responsive Transport system for persons with disabilities



An Neven<sup>a,\*</sup>, Kris Braekers<sup>b,c</sup>, Katrien Declercq<sup>a</sup>, Geert Wets<sup>a</sup>, Davy Janssens<sup>a</sup>, Tom Bellemans<sup>a</sup>

<sup>a</sup> Transportation Research Institute (IMOB), Hasselt University, Wetenschapspark 5 bus 6, B-3590 Diepenbeek, Belgium

<sup>b</sup> Hasselt University, Research Group Logistics, Agoralaan building D, B-3590 Diepenbeek, Belgium

<sup>c</sup> Research Foundation Flanders (FWO), Egmontstraat 5, B-1000 Brussels, Belgium

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### ABSTRACT

Demand Responsive Transport (DRT) services are frequently offered in the context of door-to-door transportation of elderly and persons with disabilities (PWD), but are expensive to provide. Therefore, the present study aims to determine the impact of different policy decisions on the resource requirements of a DRT system, in terms of vehicles and drivers required and kilometers traveled. A number of policy scenarios are analyzed in the case study of Flanders for the prediction years 2015, 2020 and 2030: a base scenario assuming a geographically covering subsidized DRT system; a more economical scenario limiting the subsidized DRT services; a more accessible public transport; more flexibility of the users of the DRT system; an increase in the service area of the DRT service providers; and a doubling of the current supply of transport by volunteers.

A microscopic simulation of the demand of elderly and PWD for transportation was performed in order to obtain a detailed overview of all transportation requests that need to be processed. Next, each simulated transportation request was assigned to a specific service provider and a separate vehicle routing plan was created, taking into account heterogeneous users (persons with different severity and type of disabilities), heterogeneous vehicles (regular and wheelchair adapted vehicles) and multiple geographically distributed depots. Resource requirements were calculated for each of the considered scenarios.

The results show that changing the modal split (the mix between the different DRT providers), as well as the realization of adequate public transport and an improved flexibility, seem to be key elements in Flanders to minimize the resource requirements of a DRT system. Our applied methodology can easily be transferred to other regions or areas, as the flexibility of the model allows to easily modify the input criteria based on the specific context. This information can be used by governments for the optimization of their DRT system.

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## 1. Introduction

Demand responsive transport (DRT) services may be considered as transport on demand from passengers, using fleets of vehicles scheduled to pick up and drop off people in accordance with their needs (Grosso et al., 2002). In order to reduce operating

\* Corresponding author.

E-mail addresses: [An.Neven@uhasselt.be](mailto:An.Neven@uhasselt.be) (A. Neven),

[Kris.Braekers@uhasselt.be](mailto:Kris.Braekers@uhasselt.be) (K. Braekers),

[Katrien.Declercq@uhasselt.be](mailto:Katrien.Declercq@uhasselt.be) (K. Declercq), [Geert.Wets@uhasselt.be](mailto:Geert.Wets@uhasselt.be) (G. Wets),

[Davy.Janssens@uhasselt.be](mailto:Davy.Janssens@uhasselt.be) (D. Janssens),

[Tom.Bellemans@uhasselt.be](mailto:Tom.Bellemans@uhasselt.be) (T. Bellemans).

costs, passengers may be grouped together in a vehicle (Chevier et al., 2012). Hence, DRT is an intermediate form of transport, between fixed-route fixed-schedule public transportation and personal taxi services. Several variants of DRT exist, both in literature and practice, and the concept is also denominated as demand responsive transit, dial-a-ride services, or paratransit, among others.

Two main types of applications of DRT may be distinguished. On the one hand, these kinds of services are offered in rural areas with low demand for public transport (PT). On the other hand, DRT services are frequently offered in the context of door-to-door transportation of elderly and persons with disabilities (PWD). This paper focuses on the second application. PWD often cannot make

use of general PT services because these are not adapted to their needs. Age, walking difficulties and employment status are considered as important factors in the decision to make trips with DRT (Ben-Akiva et al., 1996). Besides lower employment levels and associated lower income levels, disabled persons are less likely to live in areas with easy access to services (Maunder et al., 2004) and might have an increased level of car dependence (Davison et al., 2014). As an alternative to costly taxi services, authorities might introduce (subsidized) on-demand transportation systems to provide PWD with an affordable means of transportation. This should allow PWD to participate in social life, as individuals have a personal need to perform activities, requiring traveling to the destinations of these specific activities. Such DRT projects, offering transport for PWD, have been reported in many large cities around the world already. These types of services are expected to become even more widely spread in the future due to the ageing population in many western countries (Nguyen-Hoang and Yeung, 2010; Nuworsoo, 2009), with associated potential to develop physical limitations in large numbers.

Originally, the application of the DRT concept in the context of transportation for PWD grew in the 1970s and 1980s, when countries started to develop legislation for transport authorities to provide transport to PWD (e.g. Sweden, the UK, the USA) (Nelson et al., 2010). Some countries have been successful at integrating elderly and PWD into the mainstream PT by implementing accessible PT (e.g. Sweden), but in other countries conventional fixed route PT was often not sufficiently designed for use by PWD. Therefore, this disability discrimination legislation has led to many DRT services being developed to meet this transport challenge (Mulley et al., 2012). Most DRT in systems in Europe were created and maintained locally, evolving from a local need for transportation, without strong involvement of higher levels of government (Nelson et al., 2010). Since two decades, there is a growing interest of governments to coordinate the organization of DRT from a higher level, but the impact of legal barriers, the position of the DRT system in the PT network, and its rules and arrangements, still vary greatly from country to country.

Mainland European schemes typically benefit from a commitment to funding at a national level and a robust planning framework at a regional or sub-regional level (e.g. by a small number of call centers that take bookings from passengers anywhere in the country); and have been implemented within the context of an integrated network of PT. The types of DRT schemes operating in for example the Netherlands and Switzerland typically use a fleet of small vehicles, providing shared transport to passengers who pre-book. In the UK, the licensing of taxi operators is locally regulated and operated. DRT services in the UK tend to be small-scale, door-to-door, and only for a defined region or specific community of people. UK schemes have historically focused on providing access to local shops and health care for rural residents who do not have a car, so integration with wider PT is limited or absent. Many UK schemes were implemented using 'Bus Challenge' funding streams (funding of the government to subsidize services falling outside the commercial network) with a finite end-date (Ambrosino et al., 2004), and therefore often seen as transitory experiments (Commission for Integrated Transport, 2008). In recent years, since the deregulation of public transport services, a greater range of local stakeholders appeared to be involved in planning DRT services, and the focus has shifted more towards rural locations in order to fill the gap caused by the withdrawal of conventional bus services (Davison et al., 2014), whilst the voluntary sector continued to address the need for more specialized travel (Brake and Nelson, 2007). In Australia, conventional bus services are typically provided by private operators under contract to the State government. Local governments are funding flexible transport but these are typically for a restricted user group, while innovative services developed by bus operators which are open to

the public, are difficult to develop. In the USA, the primary funding for (public) transport originates at the local level and decisions about the type of service are generally within the purview of the local PT authority and its local political overseers (Mulley et al., 2012).

Recently, countries are expanding their view on the potential users of the system, and there have been considerable moves towards a more coordinated model in some countries (e.g. Netherlands, Denmark), in which the DRT for PWD (so-called 'target market' users with special eligibility permits to travel) is combined with the open DRT for the general public (e.g. intermediate or complementary PT service in (sub)urban areas or rural transport, or for groups of school children or work transport). This coordinated model shares resources by a more efficient coordination and planning of different types of transportation (each trip with its specific needs, requirements and (lack of) flexibility) from many different authorities, and matching different user groups in the same vehicles, leading to a more efficient use of vehicles and a variety of economies of scale (e.g. costs associated with the purchase and maintenance of the vehicles). However, institutional barriers may be a major obstacle on these new developments in Europe, the USA and Australia, e.g. because of difficulties with integrating vehicle fleets when different operators use vehicles with different vehicles standards and specifications, or a fragmented nature of both political authority and funding source (Davison et al., 2014; Mulley et al., 2012). Population density and fineness of the geographic boundaries of municipalities may also play a role, as administrative fragmentation does not promote the coordination necessary to achieve economies of scale (Darbera et al., 2012).

Given its increasing importance for mobility impaired people, DRT has received more research attention as well (Nguyen-Hoang and Yeung, 2010). Stated preference studies revealed that DRT would be considered as the most preferred travel mode above all by seniors with physical limitations (Nuworsoo, 2009). However, DRT services for PWD are expensive to provide, which makes it imperative to maximize its efficiency. A recently published study about the current provision of DRT in Great Britain showed that long term financial sustainability of such DRT schemes continues to be questioned, with a limited number of schemes recognized as commercially sustainable (Davison et al., 2014). Another recent review paper about (barriers to implement) DRT confirmed that in most countries and regions, the adoption of DRT is challenged by the financial performance of this form of transport, which is invariably less cost-effective than higher volume fixed route services (Mulley et al., 2012). Given the increasing importance of DRT, with social participation enhancement of PWD as ultimate goal, a substantial proportion of the costs of DRT might be paid by society rather than by the individual consumer in some regions.

The aim of this paper is to determine the impact of policy decisions (e.g. improving the accessibility of the PT, changing the service area of the service providers) on the resource requirements of a DRT system, in terms of vehicles and drivers required and kilometers traveled. The results of the analysis of these different policy decisions can be used by governments for the optimization of their DRT system, in order to guarantee its financial sustainability. While this paper focusses on a DRT system specifically for PWD; partly similar policy decisions can be calculated for other DRT applications (e.g. employment- or age-related, rural areas with a low demand for PT) to determine their impact on the resource requirements.

## 2. Case study of Flanders

In this paper, a number of policy scenarios are analyzed in the case study of Flanders (the northern, Dutch-speaking part of

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