COMPARISON OF OPERATIONAL COSTS FOR FIXED-ROUTE BUS SERVICE AND DEMAND RESPONSIVE TRANSPORT SYSTEMS. THE CASE OF KOSICE REGION - SLOVAKIA

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Resume

The issue of sustainability of public transport is constantly receiving attention from both government and research. One possible solution, demand responsive transport (DRT), can increase accessibility in rural areas, improve the quality of service as well as reduce the costs. This paper estimates the operational costs for different types of vehicles in DRT in person-kilometers and compares it to the current costs of standard bus transport for year 2021 and analyses the capacity, occupancy and ticket prices of fixed-route bus transport. As the results indicate, in many cases the costs of DRT are higher compared to standard bus transport, but by increasing the occupancy of vehicles the DRT can provide savings up to 66%. The use of cars, as well as car-sharing, show higher costs, which is mainly related to a low transport capacity. As the most appropriate vehicles of DRT have been identified micro buses and minibuses.

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1 Introduction

Many countries and regions face problems of the public transport cost-efficiency especially in remote rural region. Current issues with their origins in Covid pandemic, caused dramatical drop in public transport usage. Together with the new increase in petrol prices are the former problems in rural areas transport accessibility articulated even to a higher extent.

The purpose of the paper was to compare the operational costs for providing bus transport in rural areas of Kosice region in Slovakia. Currently the bus transport in Kosice region is organized as a standard bus transport. Based on publicly available data, regarding the costs of bus transport in rural areas of the region is becoming less economically sustainable from year to year. The expenditures of all the public transport providers increased between 2009 and 2019 by 32%, operated milage stayed nearly consistent but the number of passengers decreased from 27.8 million In 2009 to 20.5 million in 2019. This is nearly 30% decrease in number of passengers compared to the level before pandemic. When the first pandemic year 2020 is considered, the decrease in number of passengers is more than 50%.

One of the possible solutions to improve the accessibility of people living in rural areas in Kosice region is to introduce some type of Demand responsive transport system, which could substitute or complement existing standard bus transport system in the region. These types of systems can increase the accessibility especially for disadvantaged people (older of disabled) living in rural areas. On the other hand, these types of systems come usually with higher operational costs.

The first part of the paper summarizes the literature about the DRT systems with aim to identify basic types of DRT system based on their flexibility. The second part describes the methodology used for estimation of operational costs for both transportation systems and the last part provides discussion of the results.

This paper is prepared as a part of the wider project dealing with Economic and social aspects of accessibility in rural areas using demand-oriented transport and flexible transport systems, which aims to explore the possibilities of improving the accessibility of rural regions by applying new "smart" solutions based on demand-oriented transport and flexible transport systems.

2 Literature review

According to Demand Responsive Transport (DRT) is partly a form of public transport, bearing the marks of fully flexible use of taxis and regular public transport. According to a study [1], DRT is partly a form of private or quasi-public transport, where routes are changed according to passengers' demand without the use of fixed timetables. However, as pointed out by [2], even the use of timetabled schedules is possible in DRT.

Within the literature review, a total of 454 articles dealing with the topic of DRT have been identified using the bibliographic platform SCOPUS, which provided the most articles from the search request. Three main types of DRT have been identified, categorized according to the level of flexibility offered by the service. More flexible services adapt better to customer requirements, but on the other hand they generate much higher costs than the less flexible services. It is the degree of flexibility that represents an important issue in planning the implementation of this service.

2.1 Forms of DRT

Based on the level of flexibility of the service, the following types of DRT have been identified:

Fully flexible DOD (door-to-door service)

Demand-oriented transport with all the components flexible, is usually referred as door-to-door service. These services pick up the customer in front of their own house door and take them to the door of the destination place. Such a service is primarily intended for passengers who cannot, or do not wish to, walk to the bus stop for various reasons. This form of DRT is also characterized by its full-time flexibility, which means that the pick-up time is fully dependent on the actual demand. It is mostly served by the low-capacity vehicles, such as cars with up to 6 passenger seats, or minibuses with a seating capacity of around 12. The type of a vehicle, used by the service, usually depends on the option of sharing the journey with other passengers. For such services, it is advantageous to have the highest possible occupancy of the vehicle, however, on the other, it also creates negative effect for passengers, where duration of the journey is longer due to multiple stops of the vehicle. Therefore, the real-time tracking and the optimization of the routes is necessary for such a service. Services, that do not allow ride sharing are closest to conventional taxi services and usually use smaller cars. This form of service is more expensive than a shared service where passengers with similar origins and destinations have the option of using a single vehicle [2-6].

Semi-flexible DOD (service serving stops/ points of interest)

In contrast to fully flexible demand-responsive transport, semi-flexible systems are characterized by limitation of transport flexibility. In the literature, it is usually referred to as "stop-based service", or service serving stops or specific points of interest. The limited flexibility may also apply to the changes of the route itself. Unlike the fully flexible transport systems, where car sharing is optional, the sharing of the vehicle is the basis of these services. Semi-flexible transport systems are also characterized by different time flexibility of the service. They can be fully dependent on the actual demand of the passengers, or have a fixed schedule with vehicle departures, which is mostly used by systems with defined stops. A third option is a combination of the two previous ones, where, for example, only the departure time of the vehicle from the starting stop is determined and subsequent arrivals are dependent on the number of intermediate stops on the route [2-8].

Car-sharing

A third, slightly different form of flexible transport systems is the car-sharing service. This form of service does not directly provide transport, but only a vehicle for short-term transfer to the destination. The system can be considered fully flexible within the area served, but the passenger must physically come to the vehicle. The service usually provides a capacity of 2 to 4 seats. The original idea of car sharing has several alternatives already, such as shared motorcycles, bicycles or scooters [2, 9].

2.2 Costs and ticket price in DRT

The objective of this paper was to estimate the operational costs of different types of Demand responsive transport in person-kilometers (personkm) and to compare them to the current costs of standard bus transport in Kosice region Slovakia. The paper also compares potential sales volume of these two different services and subsequently analyzes whether it would be possible to replace the standard fixed timetable bus transport with the DRT. Since we are only trying to reduce the costs of existing fixed-route bus transport, we do not deal with the transportation of vulnerable groups of passengers, such as children, disabled persons, pensioners. In the study [10], the main reason for the DRT failures have been identified higher costs. In addition, simpler services have higher chance for survival, as the higher flexibility is linked with higher costs. Therefore, this paper´s aim was to analyze the possibility to replace the fixed-route buses with the DRT on the same or similar routes as buses, especially for low demand areas and off-peak hours, as suggested by [11].

As [12] stated, the accepted price represents the satisfaction with ticket price and the travelling time to the station had have significant impact on usage of urban transport in this study. The lower the price, the higher the usage of public transport should follow. However, as study [13] stated, willignes to pay (WTP) of DRT can be higher than regular bus transport, because of other benefits of DRT transport, such as shorter waiting times, shorter travel times, higher comfort and flexibility. Those assumptions have been confirmed by [14], where they stated that the perceived costs, in the form of reasonable ticket prices, are positively related with travel satisfaction. This paper also suggested that the accessibility and the societal and environmental importance of the public transport are significant, as well. All these attributes are higher in the DRT transport and thus despite the fact, that the DRT is linked with higher ticket prices, the other positive attributes can overcome the higher fares. Application of the DRT can improve the transport serviceability of an area, as well [15].

3 Methodology and data

The first step was the estimation of operational costs of the different types of the DRT systems. Although the direct identification of such costs is not possible, these costs have been traced down and simplified to the types of vehicles used to transport people in the region by available commercial services. Therefore, market survey was conducted and 20 transport options have been analyzed for the region of Kosice. The results of this survey are shown in Tables 8, 9 and 10 in the Appendix. Data were also obtained from the largest standard bus operators in Kosice self-governing region (KSK), Arriva and Eurobus. These contain information about all the bus lines that operated during 2019 in the region of KSK, related to transported passengers, travelled kilometers, annual sales and costs of the bus lines.

We assume that the pricing strategy of the commercial services covers all the operating costs, vehicles´ wear and tear, as well as generates a reasonable profit. When a real DRT service is implemented, additional costs, related to the information system development and operation to organize the DRT system, will be required. However, we assume that these costs will not be significant from a long-term point of view and, therefore, we abstract them in our analysis. Based on the literature review the DRT systems usually operate with standard cars (with or without the share of the journey) [3, 5, 9]; microbuses [3, 8, 16]; minibuses [16]; buses [6]; shared cars [2, 9] and shared motorcycles [17].

The maximum number of seats in each vehicle was determined based on a study of [18]. As stated in the case study [19], DRT aims to maximize vehicle occupancy through various trip optimization techniques, such as adjusting service times to the busiest times and locations. This is due to the high costs of the drivers themselves, which represents up to 50% of the total costs of the service, as stated in [20]. On the other hand, standard bus transport operates buses and microbuses with an average capacity of 49.5 seats, however occupancy can be also higher due to standing passengers. Therefore, standard bus transport is preferable in the areas with large travel demand. In addition, the problem of congestions is a rising issue for all but especially larger cities [21,22]. However, the main objective of this paper is to analyse operational costs and sales for DRT vehicles. These DRT vehicles could replace existing fixed-route bus services, where the lower capacity of the DRT is acceptable and application of DRT would lead to savings because of lower costs or higher sales volume.

Based on these assumptions research of private operators of different transports services in Kosice region was done in November 2021. The aim was to identify the price policy of these operators. The structure of the analysed transport operators is described in Table 1.

From these inputs the operational costs in person-kilometer for different vehicles possibly used for demand responsive transport and for different expected vehicle occupancy were estimated.

***Table 1** Structure of the analysed operators and costs with Value-Added Tax (VAT)*

	DRT Vehicles				Sharing services		
Operators	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing	Standard bus transport
Number of operators	6	4	5	3	1	1	2
Max number of seats	4	8	15-25	52-55	2	1	49.5
Costs per kilometer [€]	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing	Standard bus transport
Average	0.69 €	0.74 €	0.83 €	1.50 €	0.42 €	0.22 €	1.5495 €
Std. Dev.	0.2735	0.2945	0.1775	0.0849	N/A	N/A	0.0740 €
Min	0.35 €	0.40 €	0.60 €	1.38 €	N/A	N/A	1.4612 €
Max	1.00 €	1.20 €	1.02 €	1.56 €	N/A	N/A	1.6141 €

***Table 2** Statistics of regular standard bus transport*

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Operation milage [in 000 km]	26493	26777	26323	26455	26155	25881	26173	26182	26342	26520	26852	25542
Number of passengers per year (in 000)	27839	26953	25336	24498	23921	23050	22352	21466	20930	20627	20523	12876
Operational costs of operators per year [in 000 €]	27025	27781	29663	30756	31337	31575	31514	31373	33458	34643	35744	33481
Subsidies from Regional budget per year [in 000 €]	10863	12346	13720	15015	15858	16663	17138	17138	19939	21231	22288	29980

Source: [23]

***Table 3** Costs of DRT for different types of vehicles with VAT*

Operators	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing
Seats 50% - 100%	2 - 4	4 - 8	10 - 20	27 - 54	1 - 2	1
Costs per kilometer [€]	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing
Costs for personkm (1 traveler)	0.69	0.74	0.83	1.50	0.42	0.22
Costs for personkm (50% occupancy)	0.34	0.18	0.08	0.06	0.42	N/A
Costs for personkm (100% occupancy)	0.17	0.09	0.04	0.03	0.21	N/A

The second step represented the analysis of the operational costs for providing a regular standard bus transport in rural area in the Kosice region. Two private companies provide suburban bus transport based on a contract for the provision of services in the public interest with the Kosice self-governing region. Based on this contract, Kosice self-governing region provides subsidies to these two companies to provide suburban bus transport on agreed fares. These subsidies cover the loss from operation and a reasonable profit for private operators. Table 2 provides collected information from 2009 to 2020.

Using these inputs, the operational costs in person-kilometer for actual standard bus transport in the Kosice region were estimated.

4 Results and discussion

Based on the above-described data and methodology, the market costs of personkm (number of persons transported per 1 kilometer) were estimated for different types of vehicles that can be of a potentially use for DRT systems in the Kosice region. These costs reflect the actual market regionally specific prices. Table 3 describes costs for all the types of vehicles of DRT based in three levels of their occupancy during a trip: 1 passenger (also costs of vehicle per kilometer); 50% occupancy and full occupancy.

Before performing the costs for personkm calculation in the traditional standard bus transport in rural areas, an analysis of the development of several indicators for suburban bus transport in Kosice region was carried out. Figure 1 shows development of four indicators between 2009 and 2020. We consider the year 2019 as the last standard year not impacted by the COVID -19 pandemic restrictions. The year 2020 is the first and probably most impacted pandemic year, when most of the restriction in connection to COVID - 19 pandemics were introduced.

As can be seed from Figure 1 the increase of the operational costs indicator of all the private transport operators per one operated kilometer is rather moderate. The operated milage was stable, so the increase probably reflects the increase in direct costs (fuel, salaries etc.). Due to the sharp decrease of passengers in this period the operational costs of operators per passengers increased in time (blue line) especially during the pandemic impacted year 2020.

When considering the same indicators from the Kosice self-governing region point of view, the situation is also very interesting. Subsidies from regional budget for operators raised sharply especially when considering subsidies per one passenger. This situation can also be described by the share of regional budget subsidies in total operational costs. While in 2009 subsidies covered 40% of all the costs, in 2019 it was already 62% and in pandemic year 2020 more than 90% of total costs.

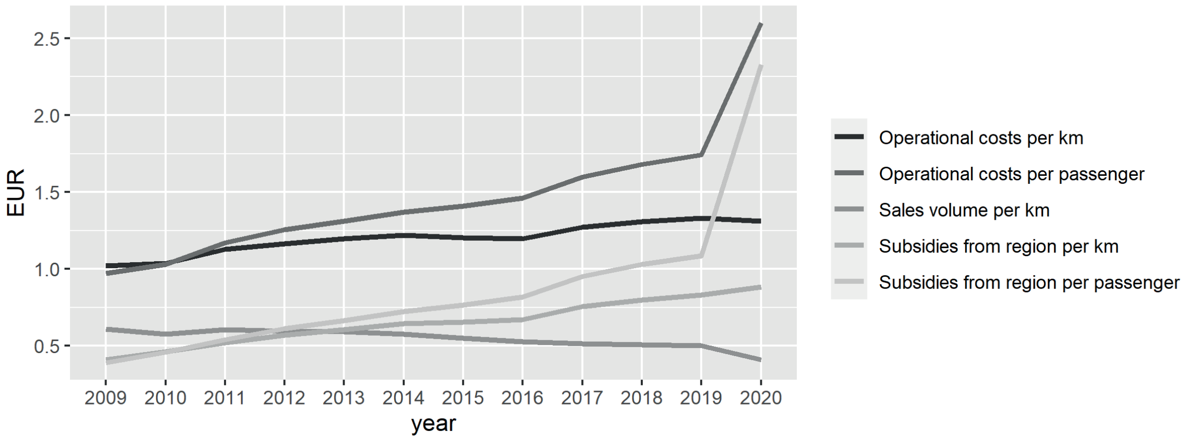

Figure 1 *Costs of traditional standard bus transport without VAT*

Table 4 *Operational costs and Subsidies per personkm with VAT*

	2019	2020
Operational costs/personkm [€]	0.06	0.10
Subsidies/personkm [€]	0.04	0.09

Source: Own calculations based on Annual reports of Kosice self-governing region

Table 5 *Standard market prices lower than subsidies*

Operators	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing
Seats 50% - 100%	2 - 4	4 - 8	10 - 20	27 - 54	1 - 2	1
Price per kilometer [€]	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing
Price for personkm (1 traveler)	0.69	0.74	0.83	1.50	0.42	0.22
Price for personkm (50% occupancy)	0.34	0.18	‡0.08 ‡	0.06	0.42	N/A
Price for personkm (100% occupancy)	0.17	‡0.09 ‡	‡0.04 ‡	0.03	0.21	N/A

From the cost-effectiveness point of view, this situation is not sustainable. In the light of increasing costs and subsidies we, therefore, tried to compare the costs and subsidies for person km in traditional standard sub-urban bus transport to the market prices for personkm. Table 4 shows the operational costs per personkm and subsidies from regional budget for personkm for both before pandemic (2019) and the first pandemic (2020) years.

We compared the subsidies for personkm for pandemic year - 0.09 € and the prices of the analyzed public transportation options. Cells highlighted by symbol ‡ in Table 5 represent the situation when the standard market prices for the use of Microbus and Minibus are equal or lower than the subsidies from the regional budget for personkm in pandemic year. Naturally, this is possible only when the DRT system could reach at least 50% occupancy in the case of Minibuses and full occupancy in the case of Microbuses. We have not considered the traditional buses as a DRT vehicle, since 50% occupancy of vehicles is not reachable in remoted rural areas in Kosice region during the analyzed period and the WTP was calculated as a price for services with a higher standard than regular bus transport, as well.

The DRT systems are usually related to the higher accessibility or/and comfort for passengers. This means that this type of services should increase the passengers perceived value of the service. In thesis [13] a small pilot primary research based on the WTP methodology with the aim to estimate the willingness to pay for the DRT service in three villages in Kosice region was carried out. The research sample was rather small - 100 households, but the results showed that the median value of the willingness to pay for DRT service was 0.09 € per travelled kilometer for a person.

In this context, we subtracted the median of willingness to pay per kilometer from the original market price and again compared the results to the self-governing region's subsidy per person-km. Cells highlighted by symbol ‡ now represent the situation when the passenger payments - market prices are lower or equal than the subsidies. This situation is present in the case of at least 50% occupancy, when

Table 6 *Standard market prices lower than subsidies considering willingness to pay*

Operators	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing
Seats 50% - 100%	2 - 4	4 - 8	10 - 20	27 - 54	1 - 2	1
Price per kilometer [€]	Cars	Microbus	Minibus	Bus	Carsharing	Motorbike sharing
Average	0.69	0.74	0.83	1.50	0.42	0.22
Price for personkm (1 traveler)	0.60	0.65	0.74	1.41	0.33	0.13
Price for personkm (50% occupancy)	0.25	‡0.09 ‡	‡-0.01 ‡	-0.03	0.33	N/A
Price for personkm (100% occupancy)	‡0.08 ‡	‡0.00 ‡	‡-0.05 ‡	-0.06	0.12	N/A

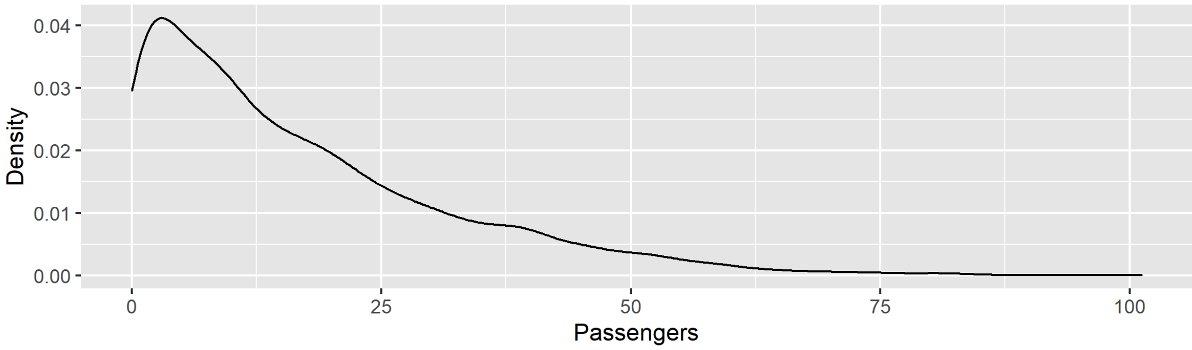

Figure 2 *Density chart of average occupancy of standard bus transport for year 2019*

Table 7 *Options for replacing fixed-route bus transport by DRT*

Average	Rides needed during year	Fixed routes replaceable by one DRT vehicle	Fixed routes replaceable by one DRT vehicle in %	Potential savings for selected routes %
Standard bus lines	6086			
Cars	28492	1341	22.03	55.47
Microbuses	15935	2239	36.79	52.24
minibuses	8624	4108	67.50	46.43
buses	6154	5918	97.24	3.19

Source: Own calculations based on Annual reports Kosice self-governing region

using minibuses and microbuses and in the case of full occupancy of cars, as well. Here, again, the traditional buses were not considered for the same reason described above. All these results are presented in Table 6.

As can be seen, car and motorbike sharing services represent a more expensive way to assess the accessibility problem, therefore we do not consider them as an alternative to standard bus transport. On the other hand, large buses as the DRT vehicles have multiple disadvantages, as limited comfort, limited flexibility and lower transport speed considering the high number of passengers that bus have to serve, although the higher seat capacity leads to higher savings when all the seats are occupied. Cars as the main vehicles of the DRT fleet are associated with the highest comfort and the fastest travel times, but their costs are high and even at full occupancy the savings would be too low. Therefore, the two main alternatives remain as the most appropriate ones for standard bus transport, microbuses and minibuses.

This paper analyzed the average occupancy of the fixed-route bus transport during the year 2019. As can be seen on Figure 2.78% of all the bus lines had the occupancy lower than 50% of the maximum seat capacity.

Therefore, we have analyzed the potential substitutability of the standard bus transport by different DRT vehicles. If we would like to replace all standard bus lines by DRT with one type of vehicle, the number of rides would grow, especially in category of cars and microbuses. However, we suggest replacing only the fixed routes, where one vehicle would be enough. As the minibuses and microbuses have been selected, the potential savings are up to 52.24% for replaced routes, as can be seen in Table 7.

Then we compared the calculated WTP to the

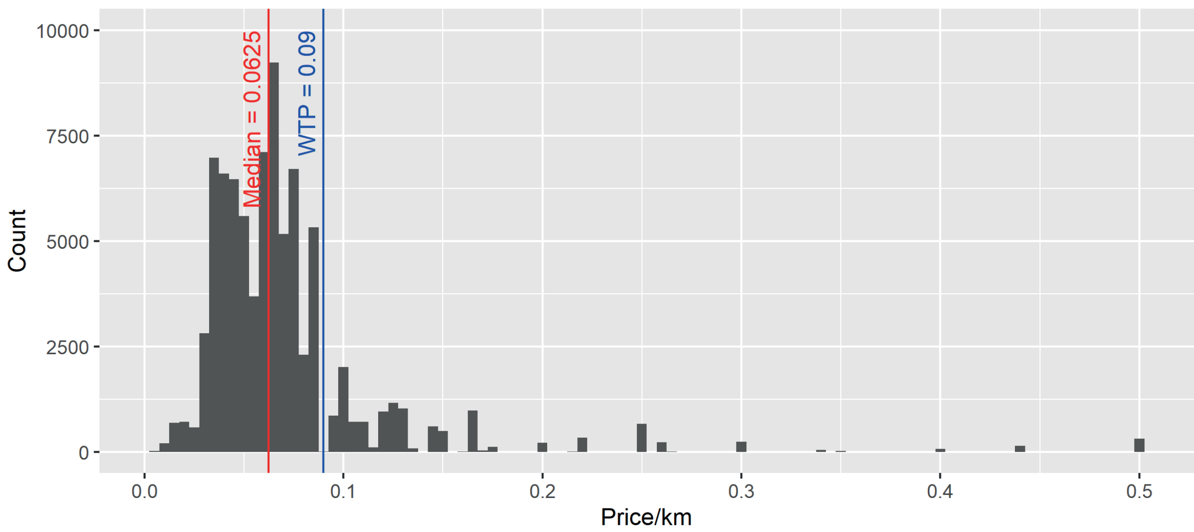

Figure 3 *Ticket price in EUR of standard bus transport (Grey histogram and red as median) and WTP for DRT (blue) per kilometer*

prices of standard transport tickets purchased during one normal working day in the Kosice region. Price of one personkm for one bought ticket was calculated as follows:

$$P_{km} = \frac{P_t}{KM}, \quad (1)$$

where:
P_t is ticket price,
KM is number of kilometers.

Figure 3 shows the histogram of calculated prices per personkm for a given day. Even though we took only intercity transport into account, some bus connections may also serve as urban transport in smaller cities. In addition, standard bus transport use tariff prices, depending on the distance range. Transports over the short distances is for customers much more expensive than transport over the long distances. Due to these facts, it is possible to see clusters of prices over 0.2 €km. Since extreme values can significantly affect the calculated average price, we used the median for comparing to calculated WTP.

The median price per personkm was calculated at the level of € 0.0625, while the determined WTP price was € 0.09. Considering this difference, we can assume that there is a room for an increase in transport prices for the use of DRT, because people are willing to pay extra for the higher quality of services offered by the DRT. However, this difference is not enough to completely switch to DRT transport for this region.

According to [10], despite the 40 years of experience with the DRT, its higher costs are the main factor of DRT failure. Reducing the risk of high costs could be achieved by a combination of standard bus transport and the DRT, where these forms of transport alternate depending on demand. Outside the peak hours, the DRT would improve the quality of the transport service and during the peak hours, standard bus transport would maintain sufficient availability, as analysed by [21].

5 Conclusions

A total of three groups of the DRTs were identified within demand-responsive transport literature, categorized based on flexibility and services provided. Fully flexible DRT services can be seen as an alternative to taxi services as pointed out by [7]. Therefore, [22] emphasizes the creation of a regulated environment and the co-operation of different forms of transport. Partially flexible services, as the most widespread form of DRT, allow a higher degree of flexibility than the public transport, but with the aim of reducing costs compared to fully flexible services.

In this paper we have analysed four types of DRT vehicles and two sharing services as an alternative for the fixed-route bus transport. Due to the high costs of sharing services, the DRT represents a better alternative. There were four types of DRT vehicles analysed, cars, microbuses, minibuses and buses. Due to low capacity of cars and relatively high costs when the cars are running not fully occupied, personal cars have been marked as unsuitable for long-term operations. On the other hand, buses have the lowest costs when considering the full capacity of the vehicles; however, this assumption is not feasible when analysing the available data or considering the real occupancy. In addition, longer times, lower flexibility and comfort of this vehicle cannot be associated with the higher WTP identified for smaller vehicles.

Therefore, within the DRT, vehicles with lower transport capacity have been identified as the most used vehicles, namely minibuses and minicabs. The costs' survey confirmed that the higher the vehicle capacity, the higher the costs per vehicle km. However, due to the possibility of sharing the journey with other customers, the costs at the maximum vehicle utilization are approximately twice as low, when using minicabs compared to cars, or approximately four times lower when comparing to minibuses and cars. In many cases the DRT can be much more expensive than the standard bus transport, however, the real-time planning and route optimization can increase occupancy and thus reduce costs up to 70 % compared to standard transport.

On the other hand, the fixed-route transport cannot be fully replaced by the DRT, because of high travel demand in peak hours and for busy places. Such a substitution would lead to congestion when multiple DRT vehicles would need to replace higher capacity buses. However, this paper considers replacing only bus lines with low demand and by which the higher flexibility of DRT would lead to higher accessibility of rural areas, especially in off-peak hours.

At the same time, the willingness to pay has been analyzed and determined at the level of 0.09 € personkm, while the total operating costs of standard bus transport are 0.10 €. Such values were possible to achieve at a higher vehicle occupancy. Following these results, a real-time optimization of the route and the appropriate choice of vehicles according to the demand have a decisive influence on the success of the DRT. Thus, as stated in [10], there is a strong link between the DRT higher costs and its failure, while the simpler services have better chances to survive than the complex ones.

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Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX

Table 8 *List of all operators analyzed - part 1*

Operator	Company	Vehicle type	Maximum passengers	Price per km €	Price per personkm with 50% occupancy €	Price per personkm with 100% occupancy €	Price for 1 hour waiting €	Starting fee €	Minimum fee €	Pollution fee €	Note	Web
YellowTaxi	Yellow Kosice s.r.o	car	4	0.90	0.45	0.23	12.00	1.00	3.00	30.00	Price when driving from the street 1.10 €/km	https://yellowtaxikosice.sk/cennik/
CTCTaxi	CAB s.r.o.	car	4	1.00	0.50	0.25	12.00	1.00	3.50	25.00		https://www.ctctaxi.sk/sk/cennik
EasyTaxi	easytaxi	car	4	0.50	0.25	0.13	12.00			20.00	Price in KE 3 €/ per address	http://easytaxi.sk/kosice/?sid=2
Hopin	HOPIN, s. r. o.	car	4	0.40	0.20	0.10	6.00	1.20	3.00		Price in the city is 0.40 €/km	https://hopintaxi.com/
T-Taxi	Zumark s.r.o.	car	4	0.96	0.48	0.24	15.00	0.80	3.50	40.00	The rate of 0.96/ km is valid when ordering by phone. otherwise 1.10/km	https://www.t-taxi.sk/
Transport Taxi s.r.o.	EASY TAXI s.r.o.	car	4	0.35	0.18	0.09	10.00			40.00	Note: Standard fee in KE 5 €	https://transporttaxi.sk/referencie
CTCTaxi	CAB s.r.o.	microbus	8	1.20	0.30	0.15	12.00	0.00	15.00	25.00		https://www.ctctaxi.sk/sk/cennik
SLAVOMÍR PÁSZTOR	Slavomír Pásztor	microbus	8	0.75	0.19	0.09	10.00		50.00	20.00	Price depends on distance. from 0.60 € to 0.90 €/ km. Flat fee for trips up to 100km is 50 €	http://www.taxi-.sk/cennik/
Transport Taxi	Transporttaxi s.r.o.	microbus	8	0.40	0.10	0.05	10.00			40.00		https://transporttaxi.sk/referencie
TaxiBus	Ivan Bodnar, Serhiy Lashkay, Vitaliy Bodnar	microbus	8	0.60	0.15	0.08			10.00		Price depends on distance. 0.80 €/ km from 1 to 99km. 0.70 €/km from 100 to 299. 0.60 €/km from 300 to 1000km.	https://www.taxibus.sk/preprava-.com-kosice/

Table 9 *List of all operators analyzed - part 2*

Operator	Company	Vehicle type	Maximum passengers	Price per km €	Price per personkm with 50% occupancy €	Price per personkm with 100% occupancy €	Price for 1 hour waiting €	Starting fee	Minimum fee	Pollution fee	Note	Web
Citybus	Ing. Radovan Stefko	minibus	15	0.65	0.09	0.04	10.00				Price up to 50 km out of town 60 €. price in town round trip 50 €.	http://www.city-bus.sk/
Minibuseuropa	Minibuseuropa s.r.o.	minibus	15	0.60	0.08	0.04	7.20				Price based on calculator	http://www.minibuseuropa.sk/#snami
Minibuseuropa	Minibuseuropa s.r.o.	minibus	20	0.84	0.08	0.04	7.20				Price based on calculator	http://www.minibuseuropa.sk/#snami
Minibuseuropa	Minibuseuropa s.r.o.	minibus	27	1.02	0.08	0.04	7.20				Price based on calculator	http://www.minibuseuropa.sk/#snami
Fevel	FEVEL s.r.o.	minibus	25	1.02	0.08	0.04	10.80				Minimum price 150 €	https://www.fevel.sk/
Minibuseuropa	Minibuseuropa s.r.o.	bus	52	1.38	0.05	0.03	7.20				Price based on calculator	http://www.minibuseuropa.sk/#snami
Fevel	FEVEL s.r.o.	bus	49	1.56	0.06	0.03	10.80				Minimum price 150 €	https://www.fevel.sk/
Fevel	FEVEL s.r.o.	bus	55	1.56	0.06	0.03	10.80				Minimum price 150 €	https://www.fevel.sk/

Table 10 *List of car-sharing services*

Operator	Company	Vehicle type	Maximum passengers	Price per km €	Price per personkm with 50% occupancy €	Price per personkm with 100% occupancy €	Starting fee	Minimum fee	Price per 1 minute	Note	Web
Sharengo	CARSHARING s.r.o.	Shared cars	2	0.42	0.42	0.21			0.29	The price per km was calculated based on a base rate of 0.29 €/min and an average vehicle speed in the city of 41 km/h based on the European Road Safety Observatory 2016 survey	https://site.sharengo.sk/
Antik SmartWay	ANTIK Telecom s.r.o.	Shared motorcycles	1	0.22	0.22	0.22			0.15	The price for Antik customers is 0.10/min, the price per km has been calculated based on a base rate of 0.15 €/h and on the average speed of vehicles in the city of 41 km/h based on the European Road Safety Observatory 2016 survey	https://www.antiksmartway.sk/sk/motorbike-sharing