

INCREASING THE AVAILABILITY OF PUBLIC PASSENGER TRANSPORT BY INDIVIDUAL CAR BY USING TRAVEL APPLICATIONS

Abstract. The article deals with the implementation of the co-modality in public passenger transport. The article includes a brief description of the co-modality and the selected region and describes the benefits of the co-modality. The article concludes with a proof of concept and isochrones showing how public transport becomes more accessible to society using co-modality.

Keywords: passenger public transport, ride-sharing, ecology, travel applications

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Introduction

Public passenger transport (PT) is perceived as a more environmentally friendly mode of transport compared to individual passenger transport. However, its lower flexibility causes passengers to prefer to use their private vehicles to make the necessary journeys. Poor first and last mile coverage is also a frequent problem with PT. In this case, co-modality is a tool that allows passengers to cover the first and last mile using their car and then transfer to PT.

The main objective of this paper is to characterize the commodal approach and its potential benefits for individual users of public passenger transport. The next section of the article includes a characterisation of a selected district where the benefits of commodality have been demonstrated. The article also includes a case study if the commodality were implemented in the selected region. The paper concludes by describing other recommendations that can support the whole concept.

It is also noteworthy that the overall concept of the commodity can be supported by a tool (mobile and web app) that will assist public transport users in finding a comprehensive door-to-door travel solution and enable them to utilise individual modes of transport that will be linked to public passenger transport, particularly to cover the initial and final stages of their journey. Such an application has the potential to facilitate and increase the interest of citizens in travelling by public passenger transport.

1. Objectives and methodology

The objective of this paper is to propose and evaluate the benefits of implementing commodality in PT. Transportation has become an essential part of our lives. The ever-increasing performance of individual

passenger transport is causing a negative impact of transport on the environment (Koreňová 2022).

The methodology of the paper is divided into several steps.

Step 1 - To clearly understand the commodality and its potential benefits, it is necessary to define and characterize the commodality in detail. Just such a characterization is the first step of the article methodology. This step also includes a literature search of the literature that has dealt with the commodality.

Step 2 - To specifically apply the commodality to the selected area, it is necessary to describe and characterize the problems of the selected area in conjunction with the PT. Therefore, the next step in the methodology is to characterize the region to which the commodality can be applied.

Step 3 - The final step of the methodology is the direct application of the commodality to the selected territory. A software solution that can plot isochrones showing the temporal availability of railway stations was used for the application. The 10-minute commuting distance by walking, bicycle and private car is compared on the map base.

2. Mathematical dependences Characteristics of the commodality and its possible implementation in public transport

The concept of commodality was first introduced by the European Commission in 2006. It is a concept that focuses on the use of all modes of transport, both individually and in combination, insofar as this leads to an optimal and sustainable use of resources. In other words, commodality is the perception of all modes of transport, where it does not look for the negatives of individual modes of transport, but on the contrary, aims to find the positives of all modes of transport, combine

them and use them all in a rational way. Such an approach can significantly reduce individual car transport, increase the flexibility of public passenger transport and reduce the production of greenhouse gases from transport (Pálková 2022). There are several ways in which commodality can be achieved, but this paper focuses on the use of commodality to ensure that the first and last mile is overcome, which in many cases is a crucial aspect in passenger mode choice.

The current trend of globalisation and the change in societal behaviour has been reflected and reflected in the behavioural patterns of travellers. There are fewer and fewer job opportunities in rural areas and, conversely, more and more job opportunities are being created in large cities. For this reason, people try to live as close as possible to places that offer such opportunities, but the cost of living is much higher in cities compared to more remote villages. Therefore, many people still live in villages that are tens of kilometres away from larger cities. They use their private vehicles to commute to work, school and other duties, as it is often the case that PT is not sufficiently provided from their place of residence. Current statistics show that the car occupancy rate for commuting to work in European countries is approximately 1.1 persons per vehicle. Such habits have a negative impact on the state of road traffic, parking policy, and the environment (R2R 2019).

Figure 1 illustrates how a commodal approach to PT can be introduced to provide first and last mile coverage, increase the availability of public passenger transport, its flexibility from the passengers' point of view, increase the utilization of transport means, reduce the average transport distance travelled using individual car transport and, conversely, increase the transport distance travelled using public passenger transport.

In this case, individual car transport is perceived as a complement to PT and can be called a "feeder" of PT. The traveller is transported by private individual transport from his/her place of residence/point of departure to the point where PT is provided to a greater extent (carrier lines). He/she then transfers to public passenger transport, which he/she uses to reach his/her destination, if possible. The whole positive concept of the commodality can be supported by the fact that the first part of the route, which is made by individual car transport, can be shared by other commuters, making it a ride-sharing journey, thus increasing vehicle occupancy and the overall accessibility of the transport for the travelling public.

3. Benefits of the commodality in selected region

The district of Krupina was chosen to confirm the benefits of the commodality for the whole society. Current economic developments have caused the boom of large cities. More and more job opportunities are located in large cities, while job opportunities in smaller municipalities are declining. For this reason, the cost of living in cities is higher than in more remote communities [3]. And many households must commute regularly to larger cities for work, school, and other responsibilities

for this reason. They often prefer individual car transport for commuting. The map in Figure 1 shows municipalities by population. The district consists of 34 municipalities and 2 towns, with the largest town being Krupina. The second town located in this district is the town of Dudince. The total population of the district is 22,050 people of which 58% live in villages and 42% live in towns (DSaS 2020).

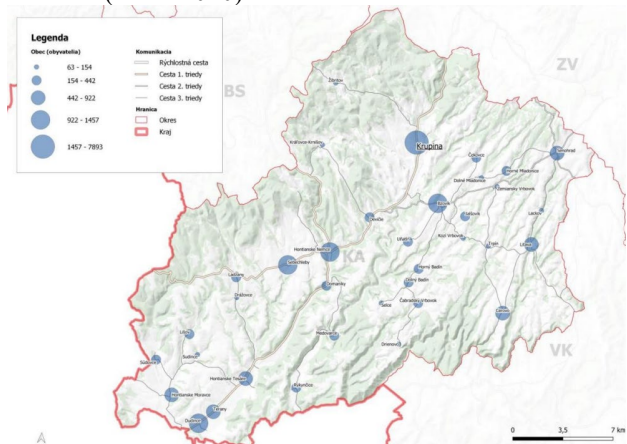


Fig. 1. Location of villages and towns in Krupina district

Krupina as a district town offers the most job opportunities of the whole district. Figure 2 shows the enterprises on the map base. The size of the circle shows the number of employees in the enterprise. From the figure it is clear that most of the workers have to commute several kilometers a day to work, as most of the residents live outside the cities that offer job opportunities (DSaS 2020).

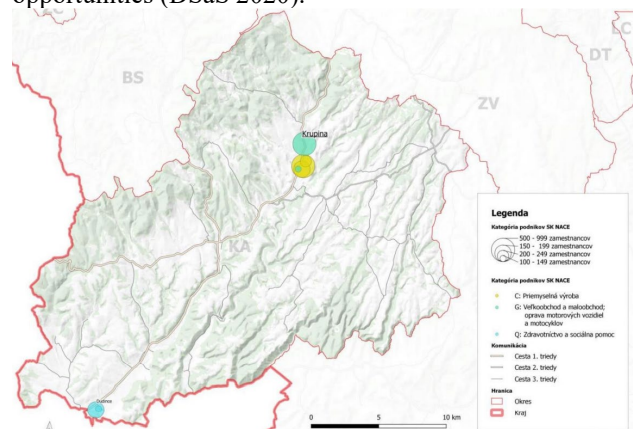


Fig. 2. Location of enterprises in Krupina district

There are bus and train services in the selected district. The carriers operating in the district are SAD Zvolen and ZSSK. The figure below shows the bus lines as well as the railway line passing through the selected district. The figure shows that many villages have poor transport services, so passengers are forced to choose the private car for their transport purposes, whether to the district town, but also to other districts. For many commuters it is difficult to reach the feeder routes (feeder routes are often also referred to as rail services - especially where an integrated transport system is in place) without using individual car transport. It should be

mentioned that many residents of the district commute to other districts for work, education and other duties, for example to Zvolen, Banská Bystrica, etc. In such cases, commuting is even more difficult for the residents and thus the use of commodality is more beneficial for the society (SAD ZV 2020).



Fig. 3. View of bus lines and railway line in Krupina district (Source: SAD Zvolen)

4. Application of the commodality in selected region

The unavailability of public transport in a way affects its use. The increasing demands of passengers for quality of service need to be taken into account if PT is to remain competitive. There are several criteria that influence passengers' choice of mode of transport. Criteria include the availability of public transport and sufficient transport information (Páľková 2022).

The isochronic display clearly shows that the availability of public passenger transport is increasing significantly with the use of private cars. Since in many cases the carrier lines are within the rail transport, for this reason the figures below show the commuting distances to the rail stations within the selected district.

QGIS geographic software was used to plot the isochrones, which allows to produce the map outputs shown in the following figures.

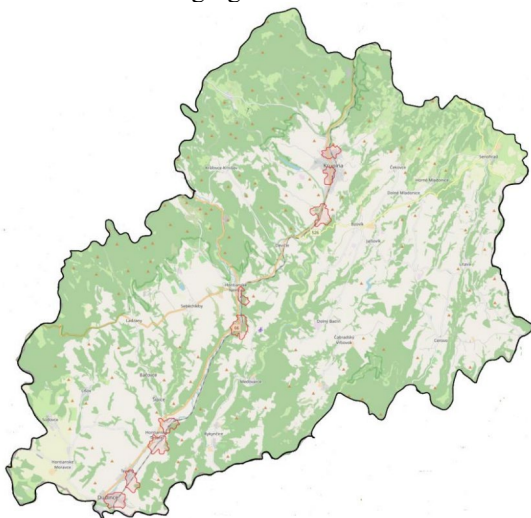


Fig. 4. Isochronic representation of the 10-minute walking distance to railway stations within the Krupina district

Figure 4 shows that when commuting by walking for 10 minutes to train stations to use PT, only a small area around the stations is covered. Therefore, it may be difficult for residents to reach the station by walking, which has a subsequent negative impact on PT usage. The figure also shows that even for all residents of Krupina, a 10-minute walking distance is not sufficient to reach the railway station.

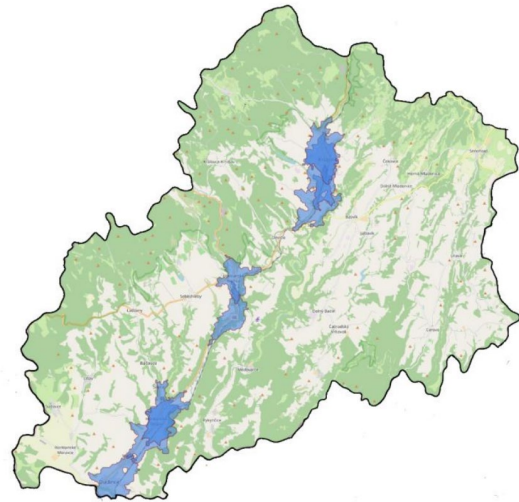


Fig. 5. Isochronic representation of the 10-minute walking distance to railway stations within Krupina district by bicycle

When using a bicycle to commute to rail stations (for 10 minutes), the area covered by such a commute distance increases significantly (see Figure 5) compared to the walking commute distance. Such commuting distance also allows to cover areas that are further away from the railway stations, not only the immediate surrounding of the stations. However, it should be stressed that there are not enough cycle paths in Krupina district. However, the aim of the paper is to highlight the potential importance of the commodality.

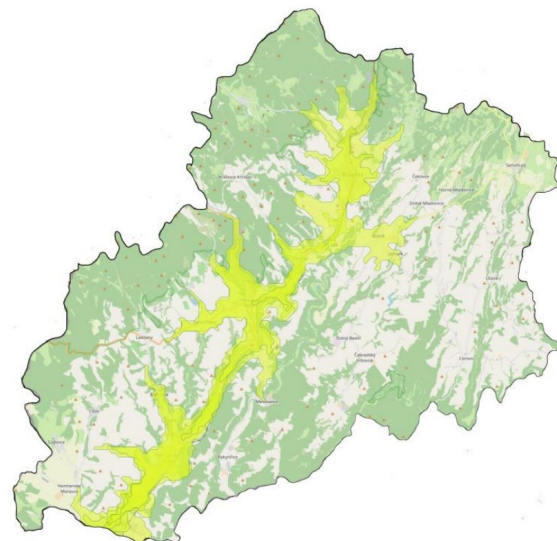


Fig. 6. Isochronic representation of the 10-minute walking distance to railway stations within the Krupina district by private car

Logically, individual car traffic will cover the largest area for commuting to the railway stations, as shown in Figure 6. In this way commuting can be ensured to cover a large area for which PT becomes available. In addition to the adjacent territory, more distant villages are also covered. However, it should be mentioned that to make use of individual car transport for commuting to the railway stations, it is necessary to allow passengers to park their vehicle close to the station.

Conclusions

The commodal approach can boost the availability of PT in a significant way. In the past, there was an emphasis on the complete elimination of individual car transport, but it did not take long to find that this was not possible. Commodality does not look for ways to eliminate individual modes of transport but seeks to find the most optimal solution to use all modes of transport. This will make public passenger transport more accessible, make it more attractive, increase the willingness of passengers to use public passenger transport and reduce the environmental impact of transport. In a specific district, it has been shown that commodality makes PT more accessible to its users (SAD ZV 2020).

The whole concept of commodality can be supported by creating a mobile application that will be able to account for the integration of private modes of transport with public passenger transport. A sufficiently high-quality information system (application) can facilitate convenient and seamless use of services across the entire commodality, thereby enhancing the quality of services provided by public passenger transport. A software solution that provides users with access to information can be a significant factor in the utilisation of public passenger transport, particularly when users are able to employ the solution in a multitude of ways, from planning their journey, to purchasing a travel tickets, to following the selected connection. The greater the convenience of the services available to customers, the more attractive the solution is to them. Furthermore, users must be informed of all the options available to them for reaching their final destination from their desired location. Current projects are already focusing on such integration and trying to offer the best possible software solution to the society, which brings many features to the users in one place.

However, it should not be forgotten that in the case of commodality implementations it should be borne in mind that the current legislative conditions do not regulate ride-sharing services in any way on the territory of the Slovak Republic. Therefore, in the future, if the commodality is implemented on our territory, it is necessary to precisely define the responsibilities and rights of the subjects.

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