



Directions of broadening the range of tariff systems functionalities in urban transport

A.URBANEK

UNIVERSITY OF ECONOMICS IN KATOWICE, 1 Maja 47, 40-228 Katowice, Poland

EMAIL: anna.urbanek@ue.katowice.pl

ABSTRACT

The systems of selling tickets for urban transport services, realized basing on paper tickets, is severely limited, both within the aspect of collecting data concerning the services demand, and as far as the possibilities to diversify the prices and to shape transport tariffs are concerned. The development of the advanced IT technologies enable the use of telematic technologies in tariff systems of the local collective transport. Investing in the modern payment systems for the urban services is connected with considerable financial contributions from public resources, and the expected effect of the implementation is the defined functionality which is to substantially support the process of pricing and of transport offer optimization. The goal of the article is to present the possibilities resulting from the use of telematic tools in the process of shaping transport tariffs and to present the potential and the desired directions of the changes in the tariff systems of the local collective transport.

KEYWORDS: tariff systems functionalities, urban transport, transport tariffs, telematic tools, electronic payment systems

1. Introduction

Urban collective transport prices fulfill various roles, the urban collective transport users and urban collective transport managers who set the prices have also different expectations and preferences. Getting used to the range of the offered services is also not without the impact, being the factor limiting the tariff changes. Prices are expected to provide certain level of profit, but at the same time to encourage using public transport. Financial means redistribution among various social groups, understood here as offering the rights to travel with reduced price tickets or free of charge, is also important.

Present, commonly used systems of selling tickets for urban transport services, realized basing on paper tickets, are strongly limited within the aspect of prices diversification, the possibilities shape transport tariffs and the options to collect data concerning the services demand and based on that the possibility to manage the transport offer. Therefore, in many cities in Poland and abroad

IT and ICT technologies are more often used in the form of various types of electronic payment systems, which are expected to realize many functions allowing for more effective tariff management in urban transport.

2. Tariff systems in urban transport

In Poland and abroad one meets various tariff systems, fulfilling the expectations demanded from them to different degrees. In urban collective transport zone tariff dominates; it is based on the mechanism of the payment being changed in the moment of zone border being crossed [1]. Zone borders could be defined in many ways; they may be administrative borders of the cities, districts or artificial borders implemented from the perspective of urban transport organizer. The advantages of zone tariff include certain (to some degree) independence of the payment from the distance

combined with relatively simple tariff and the possibility for a passenger to calculate the price. The disadvantages include certain injustice when the journey starts just before the zone and the way a passenger identifies the zone.

Another type of the tariff is the time tariff. There is great analogy to the zone tariff, except that the border is understood as some time limit after which the price changes. The problem of time tariff is the variety of traffic speed for vehicles in different parts of the city, which creates the situation when in case of the same line one may travel far for the same fee and in case another lines, running for example through the city centre, one may travel only for the short distance. The third type of the tariff is the distance one, where the fee is calculated depending in the covered distance; most often, the distance is measured with the number of kilometers. So far, this tariff has been mostly used when travelling for greater distance, meaning in regional or national transport [2, 3].

The type of the tariff used depends on one hand on the expectations, and on the other hand- on technical possibilities to use the chosen method of payment differentiation, providing efficient ticket distribution systems, respecting the set cost limits of ticket selling system, providing ticket accessibility and the ease to use tariff systems [3].

Tariff systems in local collective transport, based on paper tickets, are combined with the limited possibility to differentiate prices and, following that issue, to shape transport tariffs. As a consequence, the price management process, which goal is to reach certain economic effects, in practice is limited only to ticket price increase or decrease. Broadening the discount offer, e.g. through trade discounts or via implementing new types of tickets, significantly complicates ticket sale in external networks and increases distribution costs. Another important limitation of the system based on paper tickets is the lack of the possibility to collect data concerning service demand and therefore the limited possibilities to manage the transport offer [4]. Data concerning the demand is collected via field research, based on counting the passengers in urban transport vehicles. It requires employing relatively big number of observers and research coordinators. They are time- and cost-consuming, for example, Municipal Transport Union of the Upper Silesian Industrial District (KZK GOP) every year spends around 350 thousand PLN to measure it [5].

One ought to pay attention to the fact that even data concerning the structure of sold paper tickets, combined with data concerning the number of passengers on the given lines is often not enough to create the precise system of calculations among the partners cooperating on urban transport integration, such as member municipalities of inter-municipality unions. The necessity to create the precise profit calculating system, e.g. concerning common tickets, is often a significant barrier for tariff-ticket integration.

3. The directions of development of tariff systems based on electronic payment

The payment systems based on electronic cards technology offer much greater possibilities as far as price differentiation and the charging are concerned, without any burden for passengers, as the implemented IT systems are able to monitor many factors level themselves, the factors which perhaps constitute the fee that is charged for the transport. When creating the starting point to determine the future functionality of the tariff system for urban collective transport based on electronic payment collection, one ought to first pay attention to set the designed system architecture, which is usually defined for the time limit of several years. For example, for the Silesian Card of Public Services project, the leader of which is KZK GOP, it is the period of at least 7 years (it includes the implementation and the period of 65 months of the project functioning). However, one needs to bear in mind that in practice such period will mean several decades, as it is difficult to imagine that such important investment will be returned in such short time [6].

Moreover, the system should enable to realize much wider range of functions and criteria of price differentiation that before, which is due to the fact that one of the crucial indicators for payment systems based on electronic money is integration of various public transport operators and of various branches of collective transport [7]. As a result, the system must enable the payments integration where there are various tariffs with different fees and fares and with different methods of price differentiations. One cannot therefore assume total harmonization of tariff systems for all collective transport operators who provide their services in the given area, especially in big agglomerations and in conurbations. In case of urban transport organizers integration with rail operators, it is practically impossible to unify the tariffs due to legal aspects- there appear various regulations within the area of the rights for travel with reduced price tickets and free of charge.

At the same time, implementing IT solutions in other sectors, differentiation of the society from the perspective of the income, material status and other factors, create the situation when there appear various expectations of the service users, which is visible through, among others, the expectation to be able to choose the tariff. Many various expectations towards the tariff are currently articulated: for example, the tickets for short distances, introducing tickets for certain number of journeys, implementing the lines with increased standard level and therefore using separate tariffs for those lines. All those may be influenced by legal regulations connected with registry of the rights to travel with discounted price tickets and free of charge for various social groups which may be connected with funding some of the profits lost due to statutory discounts.

Therefore, the architecture of the created system ought to provide the possibility to charge the fares in various tariff systems, with different range of price differentiation, where choosing certain tariff systems will be performed due to higher or lower price level,

but also, to some degree, a user will be able to choose between fares system. Moreover, during times of the increasing importance of ICT tools in client service, when designing the new system, one ought to take into consideration the fact that the communication among the passengers and the local collective transport provider will be realized mainly through the proper internet web-portal and through ticket vending machines and punchers in which there will be important data and, to some degree, there will be the possibility to make decisions for the users of the services concerning price systems.

Tariff solutions for payment systems should also motivate the service users (both in case of incidental journeys and in case of those using urban transport on regular basis) to use the services and the check-in - check-out system. Generally speaking, motivating the passengers to use check-in - check-out system is mostly realized via charging the passengers for the whole journey when they enter the vehicle and returning part of the fares if they were transported for shorter distance. It offers the urban transport provider additional possibilities, e.g. through the implementation of additional bonuses or points which will encourage to use the check-in - check-out systems. Using such system is crucial from the perspective of urban collective transport offer management: mainly, identifying the parts of the routes where vehicles are full or almost empty, identifying the profits reached on particular lines, parts of those lines, aligning them to particular municipalities and in case of ticket integration, for calculations among various organizers, providers and other parties functioning within the collective transport system.

Payment for the travel may also be paid in so called electronic wallet system, a passenger then does not pay earlier for the service package, does not determine tariff or other parameters of the payment, but only owns some financial means which will be charged for the travel. Yet another option of buying certain service pack (somewhat similar to present offer of seasonal tickets) which require the earlier purchase, defining the price and then using the previously bought pack.

4. Designing tariff systems functionality in practice

Electronic payment systems used for local collective transport are more and more commonly implemented in many cities in Poland and abroad. Most often, they are the systems based on electronic cards that functions focus on urban collective transport services. Some of the solutions used abroad also integrate payments for other city services, such as parking fee, within one technology. Silesian Card of Public Services, ŚKUP, may be the example of one of the most developed such systems. ŚKUP card will enable to pay electronically for urban collective transport services and for parking, as well as for fees required in city hall and in other urban objects, such as museums, sport centres or libraries, in the central part of Śląskie voivodeship.

The basic assumption when designing ŚKUP was to implement the electronic payment system based on electronic card, which would mainly enable servicing the already existing KZK GOP tariff, as well as the tariff of other organizers that are also joining ŚKUP,

and modifying the present time-zone system through adding many functions which have been impossible to add so far. One ought to point that ŚKUP is to be implemented as an open system, which would allow for widening its use in other agglomeration parts, parties and institutions. The particularly important possibility is to enable charging via ŚKUP the urban collective transport services of other providers, such as Jaworzno, Tychy, or MPK Tarnowskie Góry, as well as regional rail service providers.

Providing wide enough functionality of the tariff system, especially within the area of defining the discounts, zones or new tariffs, is a very important element of ŚKUP for KZK GOP, mainly due to great variety of passenger traffic in KZK GOP lines. Some of the routes are of typically urban character, characterized by high number of service runs and great passenger rotation within relatively dense stops. However, considerable part of the routes serviced by KZK GOP is of regional journey character. Those are the lines connecting the municipalities that are far from each other, sometimes with the distance of several kilometers and having only few stops, serviced rarely during a day. It is therefore relatively uncommon and unique urban transport system, requiring great variety of used tariff solutions [8].

Current KZK GOP tariff offer price differentiation due to the zones defined with the municipalities borders or with the time of the travel. Zones are described within the areas of the cities or municipalities (27 municipalities creating KZK GOP, 9 municipalities of MZKP Tarnowskie Góry and the municipalities where some of the lines serviced by those providers run) and the zone borders are defined by administrative borders of the cities/ municipalities; presently there exist 21 zone exceptions. Such exception means that crossing the zone does not take place when crossing the administrative border of a city/ municipality, but in the other, previously set, place [5].

KZK GOP tariff defines three zones within single tickets offer, defined by the area of the time of ticket validity [9]:

- area of one city or 15 minutes counted from the moment the ticket was validated in case the vehicles were changed,
- two neighbouring cities or 30 minutes counted from the moment the ticket was validated in case the vehicles were changed,
- and three or more cities, meaning the whole KZK GOP network, or 1 hour counted from the moment the ticket was validated in case the vehicles were changed.

Nonetheless, the newly designer system, within the frames the tariffs and price lists modules ought to enable price differentiation in greater number of the zones, e.g. several tens or even several hundred, among others due to the currently functioning common ticket of KZK GOP and Koleje Śląskie Sp. z o.o. It is believed that there will be also possible to implement other solutions within the range of common tickets, for example with Tychy or Jaworzno, which should be possible to implement without system restrictions. It is due to the fact that within KZK GOP area there already function MZK Tychy and PKM Jaworzno Sp. z o.o. lines, as well as other tariffs, such as orange tariff implemented by Tychy and the rail. Therefore, ŚKUP card is designed to integrate greater number of parties that it is currently so. It means that in the new system, the tariffs and price lists modules should enable:

- defining the zone border in various areas, not only according to the administrative borders of a city or municipality, e.g.

rail transport operators currently sell tickets for zones which are not determined by the administrative borders of cities or municipalities,

- defining zone borders as common with time zones,
- defining greater number of zones than the currently used.

More differentiating criteria are used in case of periodic tickets, which apart from the differences concerning the number of municipalities are also various depending on the means of transport (bus, tram, or bus and tram), validity period (e.g. 24-hour and 48-hour, 5-, 7-, 14-day, monthly, 2-month, quarterly) or previously described route (from point A to point B) in case of a school-route ticket. In the ŚKUP system definitions there should exist the possibility to differentiate periodic tickets depending on [10]:

- any, freely defined number of days (e.g. 47, 60, 72), as well as defined in any way time period,
- time of a day criterion, when a passenger uses transport service, e.g. different ticket price may be used beyond rush hours, during rush hours or at night with the possibility to choose any combination (when the time is to be defined freely in the system),
- character of a day – working day, weekends, so called long weekends, festivals, day without a car, summer or winter holiday tickets, semester tickets etc.,
- the number of services in clearly defined period of time (e.g. ticket for 30 days with the possibility to be used up to 60, 75 or 120 times),
- means of transport type e.g. bus, tram, trolleybus, train and any of the combination of the mentioned,
- type of a line, e.g. usual line, faster lines, express lines, night lines, special lines, such as to the airport,
- the route,
- transport provider, which means that in the system there should be the possibility to code many tariffs functioning separately for each transport provider, e.g. different tariff for KZK GOP, Tychy, Jaworzno, MZKP Tarnowskie Góry, rail transport providers etc. together with various combinations of the mentioned, e.g. common tickets in different versions.

In the ŚKUP system there was designed the possibility to define so called ticket packs, e.g. due to the defined number of kilometers in distance tariff, defined number of minutes in time tariff, defined number of bus stops in route tariff or in various combination of the mentioned, e.g. 3 bus stops in rush hours/beyond rush hours for an OAP for a fast bus/tram/trolleybus/train during summer holiday. In the ticket pack there should also be available the function to differentiate ticket price because of:

- social groups, e.g. family tickets, group tickets etc.,
- age, e.g. children up to 4 years of age,
- gained rights, e.g. tickets for war veterans, OAPs, students, youths, elderly, etc.,
- other social conditions (honorary blood donors, the unemployed looking for a job, etc.).

Moreover, one of the main settings of the ŚKUP system is the possibility to shape the discounts freely, due to their type, height, validity time and to determine the number of services available within the given discount. The statutory and the municipality discounts are defined directly in the tariff. In transport services

organized by KZK GOP there exist 100% and 50% discounts, as well as the ones due to certain rights given to the particular group of passengers. There exists various level of the discounts with particular transport providers and transport organizers due to legal regulations. Therefore, in the 20th June 1992 Act concerning discounted travels with the public transport means (Journal of Laws 2002, no. 175, 1440 as amended) there is the possibility to use discounts of 100%, 95%, 93%, 78%, 51%, 49%, 37% depending on the group of the people owning the rights to use such. That is why in the system there must be coded the algorithm enabling automatic calculation of the price of a common ticket for many transport providers/ organizers, which will take into account the possible various level of discount used by any of them [10].

The system should also enable defining special discounts, such as for families with many children, honorable blood donors, people looking for jobs or tickets connected with various mass events, journeys to the theatres, cinemas, concerts, tickets for organized groups etc. There ought to also be taken into consideration the difference among the discounts made by transport organizer (each of the organizers has the right to define their own discounts independently) and the discount paid by other parties, for example the City Social Assistance Centres might buy the discount for people looking for the job, a company may buy it for their workers, etc. It corresponds with the expectations to refund the discounts from the budgets of the organizations which bought them or gave the right to them. Therefore it is important for the system to provide the possibility to indentify the lost profits in discounts divisions which will or are in use, as well as the list of people having the right to the discounted price travel or the number of travels with the use of the particular discount.

The crucial functionality of the tariff module working within the ŚKUP system was, taken for granted, the possibility to manage special offers for passengers, meaning the option to grant special right to travel with discounted or free ticket in the described day for all passengers, or for some group of them. That is why tariff and price list module must allow to freely define the period of the special offer validity, the size of the offer, its subject and the group of passengers the offer is addressed to.

Moreover, in the system there should be installed the possibility to use the special offers that might be valid e.g. only for Park & Ride systems or within loyalty cards systems.

Currently, business model of collective transport organizer functioning is based on accepting grants from municipalities within the areas of which the services are provided. The grants are provided according to the formula defined in the Union status. It is based on the number of vehicle-kilometer and the number of passengers on particular lines. There is no precise, current data concerning the number of people from each of passenger groups entitled to use discounted fares. There is also no information about the final destination of each of the inhabitants and visitors.

The implemented system should allow for detailed calculations among collective transport organizer (Fig. 1) and particular municipalities that order the services. The main assumption of the new tariff system within ŚKUP is supporting check-in - check-out model of using electronic card both in case of single travels and when one travels with a seasonal ticket. A passenger, entering

collective transport means, must register this fact in the system through pressing the card to the reader. Such operation must be repeated when leaving the vehicle. The system will collect data concerning the transactions realized with the help of electronic wallet due to payments for single travel, information concerning the type and the number of realized seasonal tickets and the number and the structure of the discounts.

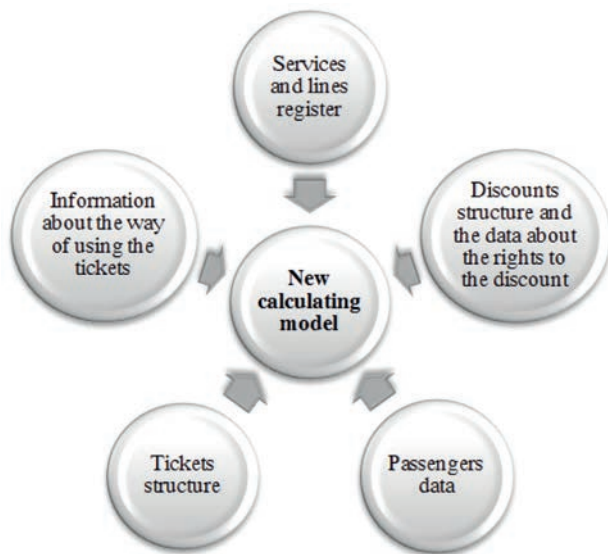


Fig. 1. Entry data to build new calculating model for KZK GOP based on data from the ŚKUP system [own study]

For each travel there should be available the information concerning the distance where a ticket was registered (bought) and the place where it was deregistered (preparing to leave the vehicle). Such data is enough to present the information about the number of passengers in a vehicle in greater detail, especially the passengers owning the rights to travel with discounted price tickets. At the same time, it is assumed that when using collective transport means according to check-in – check-out model there will be available the information about the number of passengers on particular parts of the line [8].

The build of the tariff system based on the rules for payment based on check-in – check-out mechanism will allow for defining the profitability of each of the lines and as well as their parts. This in turn not only will enable creating more precise calculation system, but also it will be an important tool for transport offer optimization, offer strengthening where it is most needed and lessening where it is not justified socially and economically to keep it in its current state.

Implementing ŚKUP system will also significantly change the method of communication among the local collective transport organizer such as KZK GOP and the passengers. For ŚKUP card users, the main channel of such communication will be a client web-portal, through which a passenger will have the possibility to verify, among others, the ticket price, the journey itinerary, the account state of the electronic wallet, to charge the card, buy periodic tickets or to check potential discounts available to them.

5. Conclusion

Urban transport services are of mass character and are provided for many social groups, which articulate various expectations towards the price and the level of its differentiation. At the same time, the tariff shape is influenced by the transport offer, as well as legal regulations in which there are defined the groups privileged to use discounted price or free tickets. It means that the electronic payment system must be designed and made in such a way so as to be flexible, and so that one may easily change it according to the changes of expectations or of legal regulations. The openness of such system is also of great value, as the journeys are usually performed by many parties/organizers, and at the same time, passengers expect common tickets and even greater integration.

Electronic payment systems based on electronic cards constitute an important IT tool, supporting the process of shaping the prices and of transport offer optimization. Greater possibilities when it comes to price differentiation, discount defining or special offer managing means more effectively run tariff policy, which is obviously an important tool to increase competitiveness and attractiveness of the urban collective transport.

Bibliography

- [1] Ceny transportu miejskiego w Europie, R. Tomanek (ed.). Prace Naukowe Akademii Ekonomicznej w Katowicach, Katowice (2007)
- [2] TOMANEK R.: Funkcjonowanie transportu. Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice (2004)
- [3] DYDKOWSKI G.: Integracja transportu miejskiego, Prace Naukowe Akademii Ekonomicznej w Katowicach, Katowice (2009)
- [4] Transport miejski. Ekonomia i organizacja, O. Wyszomirski (ed.), Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk (2008)
- [5] Internal data of KZK GOP
- [6] LUBIENIECKA-KOCOŃ K.: Modern tools of passenger public transport integration. In: Mikulski, J. (ed.) CCIS, vol. 395, Springer Heidelberg (2013)
- [7] MIKULSKI, J.: The possibility of using telematics in urban transportation. In: Mikulski, J. (ed.) CCIS, vol. 239, Springer Heidelberg (2011)
- [8] The description of functionalities and settings of tariff module for Silesian Card of Public Services, a document prepared by a project team for tariff issues, KZK GOP in Katowice (2012)
- [9] KZK GOP tariff, the Attachment no 1 to the Act no 3/2013 (2013)
- [10] The project of changes „KZK GOP tariff”, the document sent to public consultations, the Attachment no 1 to the Act no 72/2013 of KZK GOP board (2013)