TIME VALUES IN PUBLIC TRANSPORT

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Abstract

The role of public transport in our personal and working life is essential and influences not only persons who regularly use public transport but also the users of private cars and others. Although public transport time issues tend to be associated mainly with time spent in a vehicle during the journey, it is evident that the total time related to the use of public transport is much more complex. A particular feature of public transport is that walk and wait time can represent a significant addition to generalised costs and that savings in these types of time can be expected to be valued more highly than IVT (in-vehicle-time) savings. Thus the value of time in public transport should be examined in term of split by time of walking, access time, wait time and headway and in-vehicle-time.

Public transport use also involves walking to and from services or transfer between vehicles or modes. Consideration of time issues in solving problems of public transport can bring not only better and more sustainable solutions but can also

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improve the image of public transport in wide society and help this way to solution of global problems in a transport sector.

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Introduction

Time value in public transport is upcoming topic resulting in new conceptions of transport policy and it has been also applicable for more steps in the approach of marginal congestion costs and solutions in evaluation and pricing of public transport.

Marginal congestion costs

The congestion costs are the costs that an additional user imposes on other users during the traffic process that can include not only travelling but also queuing and from that reason it is clear that the most relevant cost is the cost connected with time losses. Generally we can include in congestion costs those following categories of costs: time loss cost, higher fuel consumption and creating polluting emissions and noise with consequential costs for others, bigger inconvenience and higher risk of an accident.

Primarily the congestion costs depend on time costs. The additional transport user influences other users during the traffic and if the flow is higher than a certain level then the other users lose time and time costs increase.

The driver, or the vehicle operator, incurs the costs of operating the vehicle, including maintenance and depreciation as well as the value of the driver’s time and that of any passengers or goods carried. But the vehicle also imposes costs on others. As each additional vehicle joins the road, so each incurs and imposes similar costs, until drivers cannot travel at their chosen speed because another, slower, vehicle is in the way. The faster drivers have to reduce their speed, and their journey will now take longer, thereby incurring extra time costs and other congestion costs.

In the case of a road, as the internal costs of using it increase, drivers might choose to use a different route, to travel at a different time of day, to go somewhere that avoids the use of that road, to travel by bus or train (another way of transport could be congested as well) or not to make that particular trip at all. Thus, as internal costs increase, so according to economic rationale, demand decreases, with the result that at high costs, we have little demand and low traffic flows, but at low costs we have high demand and high traffic flows. It can be seen in figure 1.

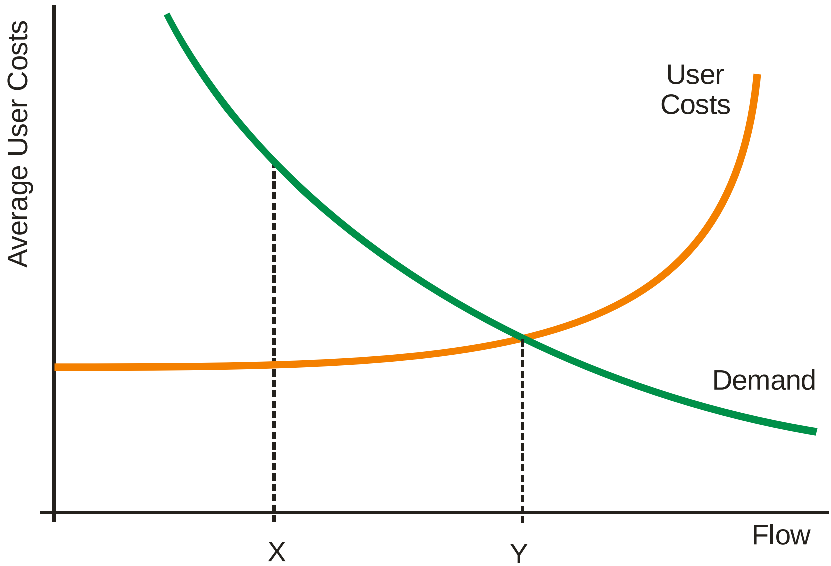

Fig.1: User costs/demand diagram

So we need a calculation of the time loss caused to third parties by an additional transport user. This is the key component of the marginal congestion costs. The loss of time may be caused in two ways and it is by a slowdown of the traffic flow or by the build up of a queue. In the first case, the congestion costs are calculated on the basis of a speed/flow relationship and in the second case the queuing theory is being applied.

Speed/flow relationships

In the case that t represents the driving time (for example in minutes for one kilometre), and x represents the number of vehicles per hour in passenger car equivalent units, it is then simple to deduce the driving time t from the speed/flow relationship. It appears that the driving time t is a rising function $t(x)$ of the traffic flow x. The total time consumption by all vehicles x to drive one kilometre then equals $x \cdot t(x)$, while the marginal time input (increase in total riving time due to an additional car) equals

$$\partial [x \cdot t(x)]/\partial x = t(x) + x \cdot \partial t(x)/ \partial x$$

The additional car itself spends $t(x)$ time. The remaining $x \cdot \partial t(x)/ \partial x$ is therefore the delay this car causes to others. This figure is the number of cars x that have experienced a delay multiplied by the effect $\partial t(x)/ \partial x$ that the additional car has on the driving time during the kilometre that it remains part of the traffic.

The marginal congestion time cost is therefore expressed by the formula

$$x \cdot \partial t(x)/ \partial x$$

Queuing times and values

Speed/flow relationship is applied if congestion results in reduction of speed. This happens in road traffic as long as the level of congestion remains relatively low. However, congestion often reaches such proportions that a queue is formed and in order to calculate congestion costs in such events, the build up of the queue must be analysed. The following cases may be distinguished: fixed arrivals and fixed service times, fixed arrivals and stochastic service times, stochastic arrivals and fixed service times and stochastic arrivals and stochastic service times.

Fixed arrivals are arrivals occurring at identical intervals during a given period and fixed service times assume identical values during a given period. While stochastic arrivals and service times assume different values by chance.

Public Transport – Values of Time Aspects

We can use next presented conclusions as follows from various studies relating mentioned thematic areas [3].

Walk time covers time spent during walking to and from the main mode of the journey. This is primarily usually a public transport mode, or passenger’s car. Furthermore we must cover time spent walking as a mode too.

Public transport travellers can choose between random and planned arrivals at their boarding point.

Value of time variation depends on variations in the marginal utility of time (or money). Money values of walk and waiting time may vary with journey purpose, user type, length of journey and levels that walk and wait time take.

There are doubts surrounding the widely used convention for valuing walk and wait time. There are differences relating valuing trip time independently on transport mode, region and economic situation too. Wait time is more highly valued than walk time or trip time. Convention of valuing walk time as twice IVT (in-vehicle time) is more justified than for wait time.

Public transport values are independent of the evidence for car users. Bus users have the lowest values and car users the highest values in urban context (the same situation is in Great Britain and in the Czech Republic).

The value of walk and wait time involved in the access and egress of a railway station is weighted at twice in-vehicle time, although time spent accessing the rail network by other modes can have different weights in part influenced by whether there are any money costs involved. Admittedly it depends on walking distance. The value of headway used in influenced by the proportion of random arrivals, which is higher for more frequent services, and by "penalty" for those who do not arrive at random. The time valuation of headway therefore varies across routes and different levels of headway.

Variations in the value of time are due to variations in the marginal utility of time or money, and there are a number of possible distance related influences on the value of time. Time savings on longer distance journeys can be more highly valued. There may also be a relationship between the values and levels of walk time, wait time and headway. The opportunity cost of time spent travelling is presumably greater for longer distance journeys. Shorter distance trips tend to be made more frequently. The larger income effect may mean travellers are more sensitive to cost variations whereupon shorter distance journeys might have lower values.

At short distances, frequencies are higher and hence random arrivals could be more common. The headway valuation therefore reflects wait time to a greater extent. At longer distances, frequencies are lower and the headway value is dominated by schedule delay. Wait time is valued more highly than schedule delay, it is not unreasonable that the value of headway is lower for longer distance journeys.

Largest values, as expected, relate to air travellers and combined rail and air travellers. This applies even after allowing for journey purpose and distance effects and is presumably because business travellers in these categories are more senior and the purpose of their journey is more important, whilst the leisure travellers in these categories have relatively high incomes. There are not enough observations to distinguish these effects by journey purpose. *Air users have higher values than combined rail and air users which is not surprising.*

Of the more common modes of travel, rail users have the highest values, presumably because of their higher incomes (London, England).

Car users have high values of walk time "Car-Walk" and wait time "Car-Wait". They are much less used to either than users of public transport modes, they have relatively high incomes and their higher values of walk and wait time may have contributed to them being a car user. Car users have a low value of headway compared to most other categories of users.

Conclusion

This paper deals with the problematic of time evaluation in transport from the point of view of different users. The target of the paper is to take in to account as many as possible factors relating to this field. Even if there are some exact results of professional studies from which the information are mostly used together with research activities of the authors it is obvious that outright results of exact price of time cannot be directly deduced, because there is an influence of more economic factors like for example level of income and many others. However general rules occurring in the relation among users behaviour and perceiving time value can be specified and it is worked in the paper.

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