Hanna Kalenoja, Lic. (Tech.), M.Sc. (Civ. Eng.), Tampere University of Technology

Fast and attractive

Travel time plays a key role in making public transport attractive. Besides ride time, walking, waiting and transfer time also need to be considered.

Travel time is one of the most important service level factors impacting on the attractiveness of public transport. As public transport travel includes several time-consuming elements absent in passenger car travel, reducing travel time in public transport poses quite a challenge compared to passenger car travel. Besides ride time, travel by public transport also includes the walking time to the stop, waiting time, transfer time and walking time from stop to destination. The weightings of the various elements of travel describe how stressful passengers perceive them to be. Studies conducted in various countries have in general estimated the weightings of walk and wait times as being about twice that of ride time. The weightings are affected not only by personal valuation preferences, but also factors relating to trip length and supply of public transport. The weightings of the various elements of travel in public transport play an important role in planning measures to enhance the attractiveness of public transport and in examining mobility choices.

Travel time limits everyday mobility

Travel time is usually the most important factor impacting on choice of transport mode and destination. This choice can largely be explained by travel time in the transport models applied in urban regions. Reducing travel time in public transport is thus one of the most important transport policy goals to enhance the competitiveness of public transport against the passenger car.

Since it plays a material role in everyday travel decisions, the impact of travel time on mobility choices has been examined in several contexts. The daily travel time budget, referring to the amount of time people are willing to spend in order to manage their everyday life, has often been used to explain mobility choices. The existence and significance of the travel time budget has been contemplated especially in transport forecasts and when evaluating the effect of the growing pervasiveness of the information society on mobility needs. Several time use studies have shown that the travel time budget is fairly constant in the national and even international perspective. The average daily travel time budget is approximately 1.1 hours regardless of continent, culture and place of residence. (Schafer and Victor 2000, Schafer 2000, Metz 2004)

There are quite substantial differences between individuals in the amount of time spent on daily travel, however. Daily travel time typically varies by age, gender, disposable income, working hours and employment, lifestyle and car ownership. The travel time budget has been estimated as an intuitive constant largely beyond the impact of cultural factors. On the other hand, it has also been interpreted as a budget subject to the individual's time constraints in which time use habits play a particular role. The travel time

budget has further been thought to reflect the inclination of the individual to strive for the greatest possible benefit. (Schafer 2000, Mokhtarian and Chen 2004)

The assumption in traditional transport modelling is that travel involves "travel friction", factors which individuals are prepared to put up with in order to manage their daily affairs. Travel friction is often made up of travel time specifically but may also comprise other service level factors or e.g. the cost of travel. When modelling choice of transport mode and destination, travel friction is usually minimised by assuming that individuals strive to maximise their benefit in travel-related choices. The concept of travel time budget transforms travel into a distinct function with intrinsic value and purpose. Individuals would not specifically seek to minimise travel time as long as they stayed within their budget, but instead would strive to use the travel time as meaningfully as possible. The significance of swift modes of travel is highlighted here as well. (Mokhtarian and Salomon 2001, Metz 2004)

Appreciation of travel time is growing

Average trip length and total travel distance have increased in several countries in the past few years. In Finland, the main reasons underlying this development are increased motorisation and changes in urban form. The expansion of commuting areas in particular has led to persons with long commutes not being fully able to compensate their longer journey to work with faster modes of transport. (Schafer 2000).

The importance of travel time in mobility choices is highlighted by the fact that time use studies have shown disposable time to be the scarcest commodity of all, above even disposable income. According to time use studies in Finland in the early 2000s, approximately one third of the working-age population constantly felt rushed. Roughly half of the men and 60 percent of the women surveyed suffered from a scarcity of time to such an extent that it resulted in them having to forego on weekdays some activity they would have preferred. From the lack of time perspective, mobility competes with other time-consuming activities. The marginal value of time has indeed been presumed to rise as travel time increases, and the value of alternative uses of time increases when the travel time budget has been exceeded. (Metz 2004, Pääkkönen 2005)

In general, the amount of time spent on work decreased rapidly between 1940 and 2000. In the early 1930s, Finns still worked an average of 2,300 hours per year. By the year 2000, the figure had dropped to roughly 1,700 hours. The amount of time spent on work is anticipated to continue to fall in future, albeit at a slower rate over the next few decades. The annual number of hours worked is estimated to stabilise at a level of some 1,600. Shorter working hours have resulted in more disposable free time. More time is being spent on personal activities such as housework and eating. The average sleeping time has seen little change between 1980 and 2000. Time use habits differ greatly at different ages and stages of life. (Andreasson and Helin 1999, Niemi and Pääkkönen 2001)

Recent changes in the information society have shown that working time has shifted towards the working conventions of post-industrial society, where irregular working hours are on the rise. In industrial society, work was done on weekdays and its opposite was leisure. In the information society, working hours as well as employment relationships have grown increasingly atypical. The boundary between work and leisure has become blurred. Knowledge workers find it difficult to draw the line between work and leisure, as work tends to spill over into leisure time as well. One way or another, changes in working are reflected in the demand for transport, as the proportion of travel to work is substantial, especially during rush hours. (Pyöriä 2005, Pääkkönen 2005)

Although knowledge work usually involves many opportunities for flexible work, people in knowledge work professions have been estimated to experience greater lack of time than average. It would seem that although work is less tied to place and time in the information society, time use habits would not seem to be shifting towards a more relaxed use of time. (Pääkkönen 2004, Pyöriä 2005)

Elements of travel time in public transport

In most cases, public transport finds it difficult to compete with passenger car transport because travel by public transport includes several elements absent from travel by passenger car. Passengers also have little control on the duration of these elements, unlike in passenger car travel. Travel time in public transport is more difficult for passengers to anticipate than in travel by passenger car. Figure 1 is a diagram of the elements of travel by public transport and the weightings against travel by passenger car obtained for these elements in various studies. Ride time in public transport is perceived as approximately 1.6 times longer than when travelling by passenger car. Looking at total travel time, the proportion between travel time in pub-

lic transport and by passenger car grows, especially in short trips taken in populated areas where the relative proportion of walking and waiting time is high. (Stangeby ja Norhem 1995)

In future, public transport will increasingly often compete for those passengers who could also make the same journey by car, as motorisation is forecast to remain on a fairly swift growth track in the coming decades. The larger the urban region examined, the higher the number of car-owning passengers in public transport. In the Tampere region, for example, more than half of the trips on public transport taken by adults are taken by passengers from households owning a car. From the viewpoint of car-owning passengers, factors highlighted in choosing between passenger car and public transport are travel time and enjoyability, which are the most critical service level factors in public transport. Public transport fares are also important, as car-owning households have already committed to the purchase and upkeep of a car and the fixed costs of car ownership must be paid regardless. Therefore car owners tend to compare the fare to the cost of using the car – in most cases, fuel costs only.

Different weightings to different elements of travel

The weightings of walking and waiting time in general have been found to be approximately double those of ride time in studies conducted in several countries. The weightings have mainly been determined by using the SP or stated preference method. The weightings of the various elements of travel are usually compared in the studies to ride time, which has been given a weighting of 1.

In Norway, the weightings were examined in several urban regions of different sizes in the 1990s. The urban regions studied were Oslo (pop. ca. 475,000), Drammen (ca. 100,000) and five smaller towns (pop. 25,000–80,000). The weight of walking was double that of ride time in Oslo and 3.2 times that in Drammen. The weighting of wait time came to 1.5–3.4. Waiting time was perceived as most stressful in Oslo whereas in other urban regions it was perceived as even more enjoyable than walking. Conversely, transfers in Oslo were perceived as only slightly more stressful than ride time while in the mid-sized town of Drammen, transfers were perceived as up to nine times more stressful than ride time. (Kjoerstad and Renolen 1996)

In Sweden, the weighting of walking recommended for application in the project evaluations of the Swedish Road Administration is 2.0 and that of waiting time 0.5–2.0 depending on duration of waiting time. The recommended additional burden of transfers is an addition of five minutes to ride time and the recommended weighting of transfers is 2.0–3.0 depending on time consumed by the transfer. The common weightings used in the UK are 2.0 for walking and 3.0 for waiting time. In the US, car-owning households perceive walking and waiting time as longer than ride time by a factor of six and transfer by a factor of three. (Kollektivtrafikkommitté 2003, Wardman 2004, Ben-Akiwa and Morikawa 2002)

Studies in Norway and Sweden have shown that the availability of seats has a substantial impact on the perceived stressfulness of travel. According to the studies, ride time was perceived as much as four times longer by those unable to find a seat. Seating is valued especially in small and mid-sized urban regions. (Kollektivtrafikkommitté 2003, Kjoerstad and Renolen 1996)

In Finland, a study conducted in the Helsinki Metropolitan Area (HMA, with a population of approx. 1 million) in 1992 arrived at a weighting of 1.5 for walking while that of waiting time came to 2.3 and transfers to 5.2. In other words, transfers were perceived as much more stressful than walking or waiting. Other studies in the HMA have separately examined the weighting of transfer-related walking, which was found to be roughly double that of walking to and from stops. (Karhunen 1993, Kurri and Pursula 1994, Weurlander 1996)

The weighting of walking time has been found to be slightly higher in small urban regions than in larger ones in Finland. The weighting of walking time for bus passengers in Tampere (pop. ca. 200,000) came to 1.7 and in Pori (pop. ca. 76,000) to 1.6. The weighting of waiting time and concealed waiting time was significantly higher in Tampere than in Pori. Waiting time would seem to have a significantly higher weighting in larger urban regions than in small and mid-sized ones, where passengers are accustomed to fairly long intervals between buses. Bus passengers in Tampere perceived waiting time as almost double that of ride time, while the figure for car owners was 1.1. In Pori, both waiting time and concealed waiting time had a weighting lower than that of ride time. In both towns, car owners perceived the weighting of walking time as clearly lower than bus passengers. Transfers between public transport vehicles, which in Tampere and Pori were equivalent to 10–14 minutes of ride time, were perceived as particularly irksome. The weightings perceived by bus passengers and car owners in Tampere and Pori have been compiled into Table 1. (Kalenoja et al. 2006)

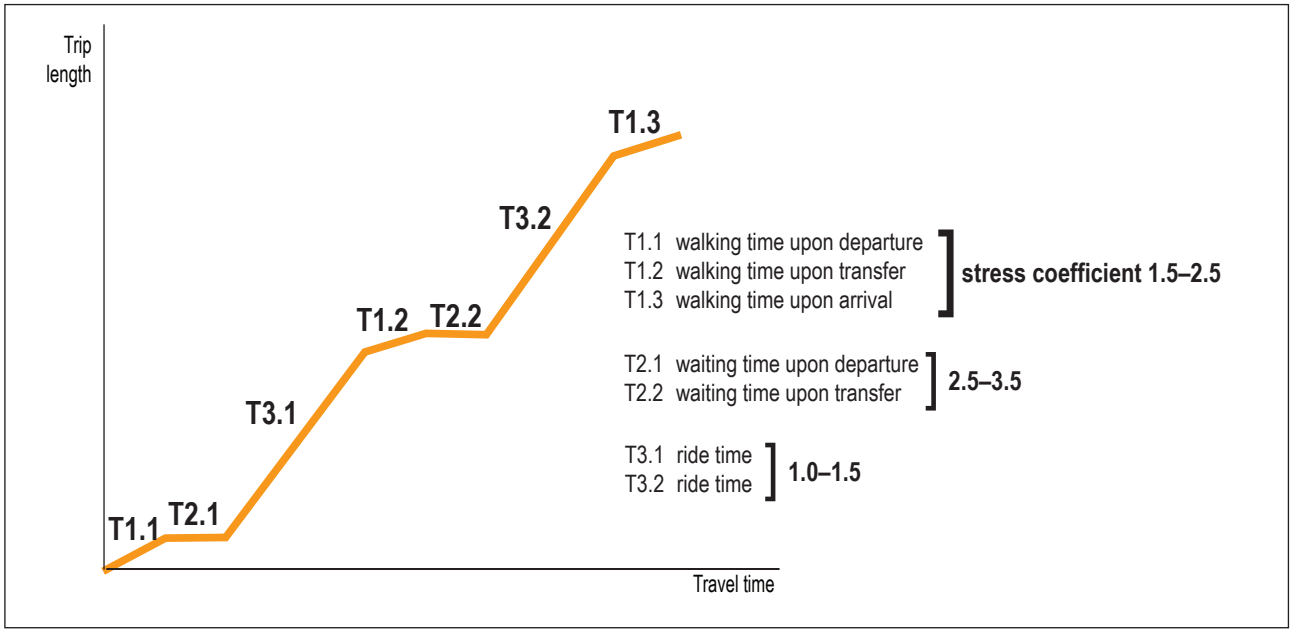

Figure 9–1. The stages of travel in public transport. Different studies have obtained different weightings for the elements of travel, depending on personal valuation preferences, standard of service of public transport and standard of service of other available transport modes (RIL 1988)

The greatest differences in comparison of the weightings of groups of passengers and groups of trips were observed in the weighting of transfers. Young passengers have been found to be much more critical of transfers than older passengers. Passengers under the age of 30 preferred a ride of up to 20 minutes longer over a transfer. Transfers were also given somewhat higher weightings by families with children than by childless households. (Kalenoja et al. 2006)

Younger age groups have been found to be quite critical of walking and waiting time as well. The weighting of waiting time and concealed waiting time on trips for study purposes was higher among bus passengers than in other groups of trips. Older bus passengers perceived waiting time and concealed waiting time more favourably while giving a higher weighting on average to walking time than passengers of working age. (Kalenoja et al. 2006)

Existing public transport passengers have been found to be somewhat more critical of walking time than car owners who travel by public transport only occasionally. The weightings of the elements of travel in public transport in the studies conducted in Tampere and Pori were nearly the same among car owners regardless of whether they travelled on public transport regularly, occasionally or seldom. Nor was there much difference in the weightings of the elements of travel in public transport between women and men. Studies have shown men to be slightly more critical of walking time than women while the weightings given by women to waiting time and transfers were slightly higher than those given by men. (Kalenoja et al. 2006)

Table 9–1. Weights of elements of travel relative to ride time (Kalenoja et al. 2006)

respondents	weight of element relative to ride time			
	walking time	waiting + concealed waiting time	ride time	transfer
Tampere				
Bus passengers	1.7	1.9	1.0	13.8
Car owners	1.2	1.1	1.0	10.2
Pori				
Bus passengers	1.6	0.7	1.0	12.5
Car owners	1.3	0.6	1.0	11.3

The weightings of the elements of travel in public transport also differed somewhat depending on purpose of travel. In Tampere and Pori, walking time had a higher weighting when travelling for shopping or errands than for other reasons. The differences between groups of trips are quite great especially in smaller urban regions – weightings on travel to and from work are typically lower than on travel for other reasons. (Kalenoja et al. 2006)

Travel time compared to the passenger car

Since the potential public transport passenger will in future increasingly often come from a car-owning household, public transport must be able to compete with the passenger car on travel time more often than at present. Car-owning groups of passengers are usually more critical about travel time than groups of passengers who do not have access to a car for their daily travel. In travel time studies, car owners have indeed been found to be more critical than other passengers especially in respect of ride time. Public transport should be fast and convenient, as in addition to ride time travel in public transport also involves other elements increasing the uncertainty of total travel time. (Kalenoja et al. 2006)

If public transport is to be perceived as an attractive alternative, travel by public transport in local traffic should take no more than twice as long as by passenger car (Figure 2). In traffic between urban regions, the target should be set at always offering a shorter travel time than by passenger car. (Kollektivtrafikkommité 2003)

Time management has been observed to be different in public transport than in passenger cars – travel time may be perceived as longer than it actually is when the public transport route is not optimal in light of the passenger's destination and stops add to the total travel time. Total travel time in public transport further involves dependence on timetables, which puts more constraints on travel than the more private transport modes. The many elements of travel in public transport may introduce additional friction to travel perceived by the passenger as longer minutes.

Weightings provide additional information for planning

Data on the weightings of the travel elements can be utilised in planning public transport route networks and in anticipating passengers' choice of route. The findings also enable the assessment of different route network alternatives from the residents' point of view. The elements of travel may be issued values in project evaluations, allowing the determination of time savings for shorter intervals or walks to stops, or reduced number of transfers, for example. (Pesonen et al. 2006)

The findings concerning weightings suggest that passengers only seldom find connections with transfers attractive. A comparison of weightings indicates

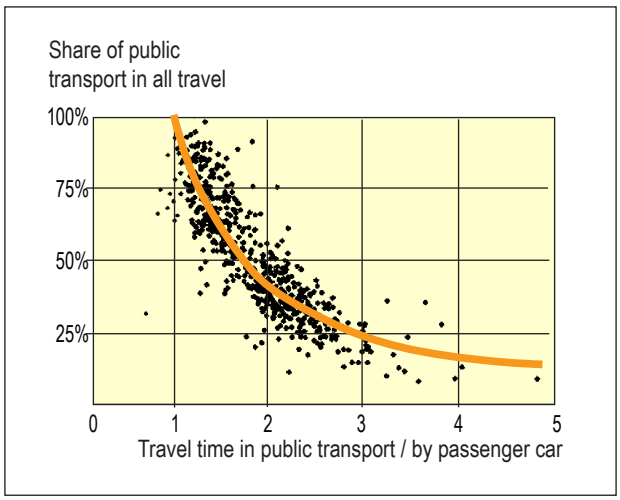

Figure 9–2. Dependence of modal split share of public transport on travel time in public transport and in travel by passenger car in the Stockholm region. (Kollektivtrafikkommité 2003)

that a trip with transfer would only be attractive to passengers if ride time on the trip was 10–14 minutes shorter than one with no transfer. Non-transferring connections are usually the most important and most desired service standard improvement in mid-sized and large urban regions. Transfers in most cases can be arranged in large urban regions, thus usually reducing the friction they induce. On the other hand, passengers whose trip had involved a transfer gave a relatively low weighting to transfers. As the weightings of transfers are substantial, the goal in route network planning should be to provide strong trunk lines with pendular structure that can then be supplemented with transversal routes. (Kalenoja et al. 2006)

In small and mid-sized urban regions, passengers prefer short walking distance over more frequent intervals, while the lower weighting given to walking time than waiting time in larger urban regions suggests that passengers value frequent intervals over walking distance when choosing their route. (Kalenoja et al. 2006)

Travel time matters more to passengers who own cars than to other public transport passengers. Enhancing the speed of public transport could therefore be used to impact on the total travel time perceived by public transport passengers and thus to attract new passengers especially from among the growing group of car-owning passengers.

The travel time perceived by public transport passengers can be shortened by speeding up ride time on the one hand and on the other, by allocating measures to enhance speed to waiting and walking time, which passengers perceive as the most stressful elements. The stressfulness of the elements of travel can also

be reduced by compensating the time consumed by elements perceived as stressful with service standard improvements concerning transport environment and enjoyability, such as pleasant stop environments and pedestrian access, real-time schedule information or transfer locations of a high standard. ■

Sources

Andreasson, K. & Helin. V. (toim.). 1999. Suomen vuosisata [Finland: A Century]. Statistics Finland. Helsinki.

Ben-Akiva, M. & Morikawa, T. 2001. Comparing ridership attraction of rail and bus. Transport Policy 9 (2002), pp. 107–116.

Kalenoja, H., Hintikka, S., Häyrynen, J-P. & Vihanti, K. 2006. Joukkoliikennematkan eri osien painoarvoja – käyttäjäryhmäkohtaisia tuloksia matkan eri osien arvostuksesta keskisuurissa kaupungeissa. [Weight of the different parts of a public transport trip. Results of valuating different parts of the trip by user groups in medium sized cities]. Ministry of Transport and Communications Finland Publications 32/2006. Helsinki.

Karhunen, K. 1993. Joukkoliikennelinjan valintaan vaikuttavat tekijät [Factors impacting on choice of public transport line]. Helsinki Metropolitan Area Council YTV. Pääkaupunkiseudun julkaisusarja C 1993:25. Helsinki.

Kjoerstad, K. N. & Renolen, H. 1996. Better public transport passengers' valuation of time and service improvements. 24th European Transport Forum. 2–6 September 1996. Proceedings of Seminar F: Public Transport Planning and Operations. PTRC Education and Research Services Ltd.

Kollektivtrafikkommitén. 2003. Kollektivtrafik med människan i centrum [People-centred public transport]. Statens offentliga utredningar, SOU 2003:67. Stockholm.

Kurri, J. & Pursula, M. 1994. Ajan arvo lyhytmatkaisessa henkilöliikenteessä [Value of time in short passenger transport trips]. Ministry of Transport Publications L51/1994. Helsinki.

Metz, D. 2004. Travel Time – Variable or Constant? Journal of Transport Economics and Policy. Volume 38. Part 3. September 2004. pp. 333–344.

Mokhtarian, P.L. & Chen, C. 2004. TTB or not TTB, that is the question: a review and analysis of the empirical literature on travel time (and money) budgets. Transportation Research, Part A, 38 (2004), pp. 643–675.

Mokhtarian, P.L. & Salomon, I. 2001. How derived is the demand for travel? Some conceptual and measurement considerations. Transportation Research, Part A, 35 (2001), pp. 695–719.

Niemi, I. & Pääkkönen, H. 2001. Ajankäytön muutokset 1990-luvulla [Changes in use of time in the 1990s] Statistics Finland. Kulttuuri ja viestintä 2001:6. Helsinki.

Pesonen, H., Moilanen, P., Tervonen, J. & Weiste, H. 2006. Joukkoliikenteen palvelutasotekijöiden arvottaminen [Valuation of quality of service in public transport]. Ministry of Transport and Communications Finland Publications 36/2006. Helsinki.

Pyöriä, P. 2005. Työelämän muutos tietoyhteiskunnassa [The changing world of work in the information society]. In book: Kasvio, A., Inkinen, T. & Liikala, H. (toim.): Tietoyhteiskunta – myytit ja todellisuus [Information society – myths and reality]. Tampere University Press. Tampere.

Pääkkönen, H. (toim.) 2005. Perheiden ajankäyttö [Time use in families]. Statistics Finland. Helsinki.

RIL. 1988. Liikenne ja väylät, osa 1 [Traffic and thoroughfares, part I]. Finnish Association of Civil Engineers RIL. Helsinki.

Schafer, A. 2000. Regularities in travel demand: an international perspective. Journal of Transportation and Statistics. Vol. 3, No 2, December 2000. p. 1–32.

Schafer, A. & Victor, D.G. 2000. The future mobility of the world population. Transportation Research, Part A, 34 (2000), pp. 171–205.

Stangeby, I. & Norheim, B. 1995. Hur behåller vi våra resenärer och får dom att åka mera? Delresultat från den norska försöksordningen för kollektivtransport [How can we retain our passengers and make them travel more? Part findings from the experimental scheme for public transport]. Institute of Transport Economics. Arbeidsdokument [Working document] 5.1.1995. Oslo.

Wardman, M. 2004. Public transport values of time. Transport Policy 11 (2004), p. 363–377.

Weurlander, M. 1996. Palvelutason ja hinnan vaikutus joukkoliikennelinjan valinnassa [Impact of service level and price in choice of public transport line]. Helsinki Metropolitan Area Council YTV. Pääkaupunkiseudun julkaisusarja C 1996:3. Helsinki.