Slow Vehicle Traffic is a more Attractive Alternative to Fast Vehicle Traffic than Public Transport

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Abstract. The environmental groups support usually the extension of the public transport as an alternative to roadway improvement. The public transport is looked upon as the very alternative to the vehicle traffic. It is not taken into account, that there is another alternative to make a more efficient use of existing roadway capacity.

It is usually assumed, that the No Build option leads to gridlock, if the growing demand exceeds capacity. This is wrong. The limited capacity leads to a speed reduction and the majority of car users decrease their length of trips. Only a minority changes to public transport. The reason for that is quite simple. Even if the speed is reduced, vehicle traffic usually remains faster than public transport. The most attractive alternative to the fast vehicle traffic is usually the slow vehicle traffic and not the public transport.

Measurements and traffic models based on such measurements show, that slow vehicle traffic is in the majority of road networks more attractive than public transport. The highway advocates as well as the environmental groups often ignore this fact. Sometimes they realise, that roadway capacity expansion results in longer vehicle trips, which induce travel. But the implications of induced travel are underestimated.

Only in special cases public transport can be more attractive than slow vehicle traffic. In Paris and London the speeds of vehicle traffic and public transport are nearly equal. In this case a growing demand leads to a growing use of public transport. The self-limiting equilibrium of speeds is maintained (Mogridge Conjecture).

The concept of slow vehicle traffic can be evaluated by benefit-cost analysis. Ignoring induced travel in transportation planning tends to skew decisions toward highway improvement and away from more efficient alternatives. Therefore the evaluation methods developed for roadway improvements have to be changed considerably

Key Words: slow vehicle traffic, fast vehicle traffic, public transport, induced travel.

1 Introduction

The slow vehicle traffic causes less person kilometres of travel and needs a lower road capacity than the fast vehicle traffic. Higher speeds induce travel and lower speeds disinduce travel. This induced travel is widely ignored by environmental groups, city planners and highway engineers.

The UBA (German Federal Environmental Agency) suggests scenarios, which include drastic speed reductions [16]. Thus the concept of slow vehicle traffic is supported by the UBA. It is surprising, that speed reductions aren't suggested as an alternative to capacity expansion but in addition to capacity expansion. An economic evaluation of the suggested combination of speed reduction and roadway improvement is missing.

City planners assume that the trip lengths and with that the person kilometres of travel depend on the land use and not on the speed [11]. It is acknowledged that by the land use only a potential of short trips can be created. The consideration is missing, that the speed decides whether the potential of short trips is accepted or not. The supporters of the town with short trips should support the concept of slow vehicle traffic. However clear remarks are missing to the topic.

Highway engineers ignore the induced travel largely. In the BVWP (German Federal Transport Plan) till now the induced travel was ignored totally [14]. In the future it is intended to take into account 7,7 % of the induced travel [5]. It is assumed, that only 7,7 % of the time savings are reinvested. The German EWS 97 (Recommendations for trunk road assessment) ignores the induced travel [6]. Since the evaluation methods for roadway improvements lead to high economic disbenefits for the concept of slow traffic one can conclude, that highway engineers are highway advocates and don't support the concept of slow vehicle traffic.

It is obvious, that highway advocates influence not only highway engineers. The UBA and the city planners avoid conflicts with the highway advocates. Environmental groups therefore have a weak scientific support [1,10,13].

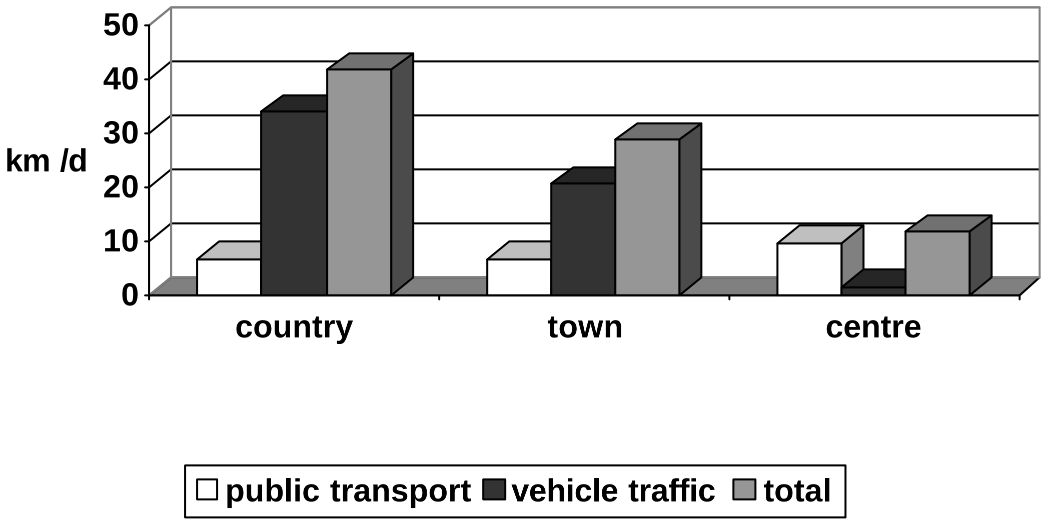
This paper is organized as follows. First, the daily distances travelled in real networks with different speeds are compared. It is shown to what extend the person kilometres of travel can be reduced by speed reductions. This is followed by a discussion of the modelling frameworks that can be employed to incorporate induced travel. Finally it is pointed out, that induced travel changes economic evaluation essentially. Thus a sketch for an Environmental Transport Plan is given.

2 Daily Distances Travelled

The speeds and the daily distances travelled in real traffic networks are important to assess the potential of traffic volume reduction.

In Figure 1 the daily distances travelled in the country and in town are presented [8]. It can be seen in Figure 1 that in town the daily distances travelled are considerably smaller than in the country. The essential reason for that is the lower speed of vehicle traffic. The daily distances travelled in public transport don't change. The slower vehicle traffic in towns remains more attractive than the public transport.

Figure 1 Daily distances travelled in the country, in town and in the centres or Paris and London ([8],[12])



The daily distances travelled in the centres of Paris and London are also presented in Figure 1. It can be seen in Figure 2, that journeys made by car entirely within the city centres achieve about 8 km/h door-to-door direct speeds. This is the same as that achieved by rail. An equilibrium between the two is achieved in which the flow on both adjusts so that the average direct speeds are equal (Mogridge Conjecture). Increases in road capacity will then merely affect the modal split and will not affect direct speeds [12].

Figure 2 Time budgets and speeds ([8], [12])

	In the country	In town	Centres Paris, London
Time budget /(min/d)	76,4	87,7	90
Speed of car traffic /(km/h)	39,4	25,7	8 (direct)
Speed of public transit /(km/h)	27,6	15,1	8 (direct)

Speeds of vehicle traffic and daily distances travelled differ widely. So the concept of slow traffic can reduce person kilometres of travel considerably. Moreover the slow vehicle traffic is more attractive than public transport as long as the slow vehicle traffic is faster than the public transport.

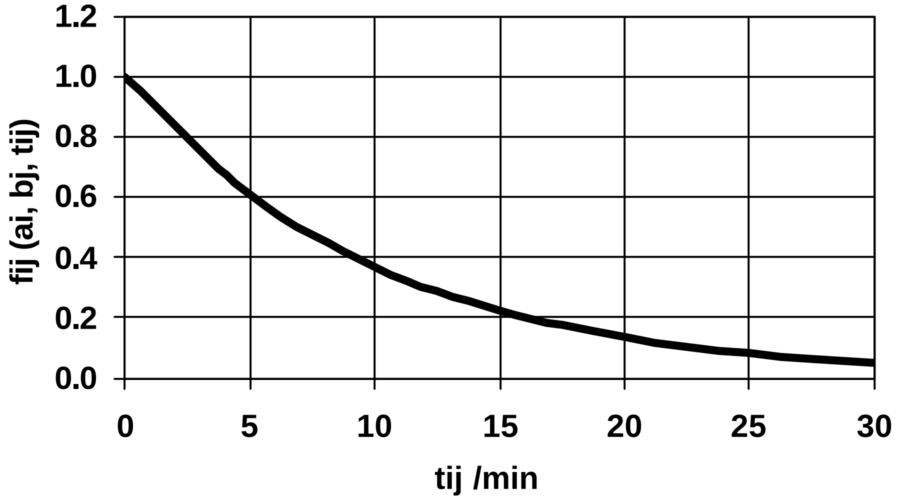
3 Travel Models

A travel model for the concept of slow vehicle traffic should predict the results shown in Figure 1 and Figure 2. The model must incorporate the induced travel, the Mogridge Conjecture and capacity restraints of the road network.

The induced travel changes primarily the trip lengths. Therefore the induced travel can be incorporated in the trip distribution. Figure 3 shows a deterrence function, which depends not only on the journey time tij between origin i and destination j but also on constants ai of the origin and bj of the destination. With this deterrence function the travel time budgets of origins and destinations can be kept constant [15].

For constant travel times there exists a unique solution and an algorithm to find the solution. The experience shows, that no problems arise, if the flow depends on the travel time on a link.

Figure 3. Deterrence function with parameters depending on the origin i and the destination j



It can be seen in Figure 1 and Figure 2 that the vehicle traffic is shifted to public transport, if the speed of vehicle traffic becomes equal to the speed of public transport. Incorporating induced travel and using a modal split function presented in Figure 4 can model the Mogridge Conjecture.

Figure 4 Probability P for the choice of public transport depending on the travel time ratio

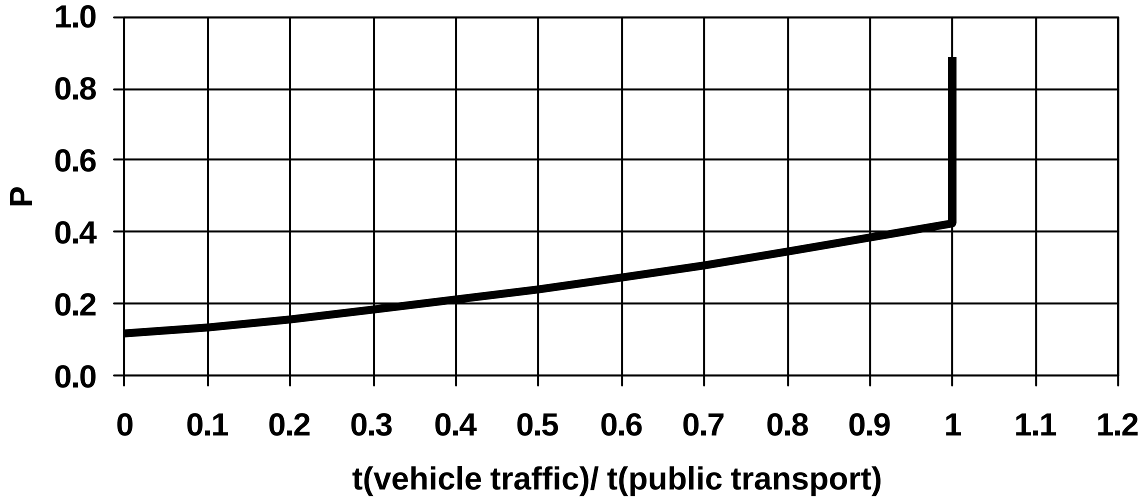
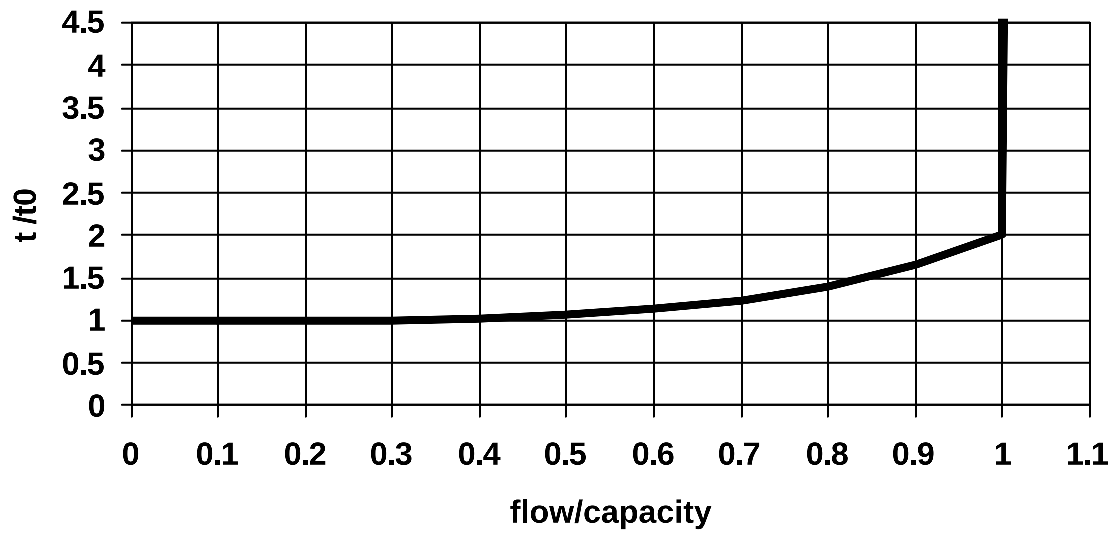


Figure 5 provides a representation of a time-flow relationship with a maximal flow. If the flow becomes equal to the capacity the travel time is no longer determined by the flow. It is necessary to take the induced travel into account, to calculate the travel time. The traffic assignment problem can be solved by a multiplier penalty method [15].

Figure 5. Time-flow relationship with limited flow



The UBA incorporates a gravity model with an upper constraint for the time budget [16]. If roadways are improved, this constraint doesn't get effective at all. Thus the induced travel is taken into account only roughly.

Public transit planners include a constant time budget in their model for the public transport [9]. For the vehicle traffic constant travel times are assumed, because it is not intended to influence vehicle traffic.

Highway engineers neglect the induced travel totally [6] or widely [5]. The BVWP model assumes, that only 7,7 % of the traffic can change the destinations [5]. Englmann, Haag and Pischner couldn't find any measurements neither in Germany nor all over the world to justify the assumed 7,7 % [5]. This is not surprising, because the 7,7 % have to be replaced by 50 % in the short run and 100 % in the long run. If 92,3 % of the induced travel are ignored, the model doesn't have any significance.

That highway engineers ignore the induced travel and don't care about the critics [10,13] is a good indication that the induced travel is of great importance.

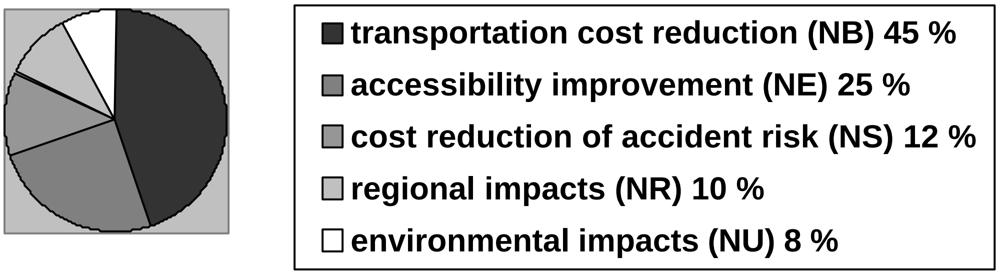
4 Economic Analysis of Transportation Projects

The evaluation methods for highway investments compare the benefits with the costs of the investment. With the so defined benefit cost ratio different projects can be compared.

The BVWP method defines projects with a benefit cost ratio that exceeds three as urgently needed. The financial requirements for all projects of urgent need are much higher than the public funds available. If the calculated benefit cost ratios were right, then the concept of slow vehicle traffic would lead to disbenefits. Therefore these calculations shall be checked.

Figure 6 shows the average contributions of the benefit components to the overall benefit of the BVWP method [2]. In Figure 6 the induced travel is ignored. Roadway improvements then lead to travel time savings, that form a major part of the benefits. The travel time savings of the freight traffic form the major part of the transportation cost reduction. The travel time savings of the passenger transport are taken into account by the so-called accessibility improvement. Since with a constant time budget there are no real travel time savings [10] it is obvious, that the BVWP method has to be modified, if the induced travel is taken into account.

Figure 6. Average contributions of the benefit components of the BVW-mehod to the total benefit [2]



The benefit components can be divided in user benefits and external benefits (negative external costs). User benefits like the transportation cost reduction and the accessibility improvement refer to the user. External benefits like the reduction of accidents, regional impacts and environmental impacts refer to the general public.

At first user benefits are looked at. The question is, how speed changes and cost changes have to be evaluated, if the induced travel is taken into account. To clarify the problem a very simple economic example is chosen.

It is assumed, that at the beginning 1 kg apples costs 3 Euro. The apples then get cheaper. There are two scenarios looked at:

Scenario A (elastic demand): All savings are reinvested to buy apples. The price goes down to 2 Euro per kg and 1.5 kg apples are bought.

Scenario B (fixed demand): No savings are reinvested to buy apples. Since the demand is lower than in scenario A the price is lower. The price goes down to 1 Euro per kg und 1 kg apples is bought.

It is now the question, how the price reduction of scenario A has to be evaluated. Since scenario A has to be evaluated, the price of 2 Euro per kg is called real price and the price of 1 Euro per kg is called fictious price. There are three evaluation methods:

Evaluation method 1: The total expenses for scenario A are compared. There are no savings at all. However one gets more apples for the same money.

Evaluation method 2: The expenditure is related to a constant amount of 1 kg and the real price of scenario A. In this case 1 Euro is saved.

Evaluation method 3: The fictious price of scenario B is used to evaluate scenario A. For a constant amount of 1 kg 2 Euro are saved.

In transport planning all three evaluation methods are discussed. Meaningful is the evaluation method 2 related to a fixed amount and the real price. This corresponds at least approximately to the consumer surplus theory and therefore has a scientific justification [7, 3]. In transport planning a fixed amount can be defined by a fixed trip table. Real prices are real travel times and real vehicle operating costs.

The BVWP method neglects induced travel largely. Therefore the evaluation is based essentially on fictious travel times [5]. Therefore the calculated values for the transportation cost reduction and the accessibility improvement are much too high.

It remains the question, how much the transportation cost reduction and the accessibility improvement change. Under congested conditions the predicted increase in speed can be reduced by the factor three [4]. Thus the transportation cost reduction and the accessibility improvement can be reduced by a factor three if one takes the induced travel fully into account.

Induced travel increases also external costs of automobile use. It can be seen in Figure 6 that roadway improvements reduce accident risk. The reason for that is, that freeways have a lower accident risk than arterials. This advantage is dramatically reduced, if not constant distances travelled but constant travel times are taken into account. Thus the benefit of the reduction of accident risk is changed significantly, if the induced travel is taken into account.

The regional impacts should be neglected, because they have neither a sound theoretical background nor a support by empirical findings.

Figure 6 shows that roadway improvements have positive environmental impacts. This is a very surprising result. Measurements including induced travel show, that environmental impacts are negative [1]. It follows that the benefit of environmental impacts is negative, if the induced travel is taken into account.

One can summarize the above assessments to the conclusion, that the induced travel can reduce the benefit cost ratios roughly by a factor three. It is therefore possible, that projects defined as urgently needed are not needed at all.

The neglect of the induced travel is not at all the only possibility to manipulate the evaluation methods. Some components of the BVWP method are not tested by consumers' willingness to pay. If only tested willingness to pay is taken into account the calculated benefit cost ratios decrease further.

One comes to the conclusion that the concept of the slow vehicle traffic can be justified by benefit-cost analysis, if the manipulations are eliminated.

The UBA does without an evaluation of the proposed scenario with slow vehicle traffic and roadway improvement [16]. This is very regrettable, since the UBA could have pointed out, that highway advocates largely manipulate the BVWP method.

In the case of the Mogridge Conjecture an increase of road capacity changes only the modal split. The speeds of vehicle traffic and public transport are not changed. Therefore most of the benefit components are zero ore negative. The transportation cost reduction is negative, because public travel has lower operating costs than vehicle travel. The accessibility improvement is zero, because the speed doesn't change. The cost reduction of accident risk doesn't change essentially, because the accident risk of freeways and public transport are not very different. The regional impacts are zero. The environmental impacts are negative. In the case of the Mogridge Conjecture a capacity expansion cannot be justified. The concept of slow vehicle traffic is modified to the concept of equal speeds in vehicle traffic and public travel.

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