

Chapter 1

Travel Demand Management and Road User Pricing: Success, Failure and Feasibility

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Traffic congestion and associated problems have become a major worry for transport planners, politicians and the public. These transport-related problems require immediate attention, particularly as many past policies have failed to deal with them adequately. The traditional approach of 'predict and provide' for dealing with traffic congestion is no longer viable. That is, it is no longer feasible that the forecasts of vehicle usage are accommodated by building more roads; it is widely accepted that unrestrained demand for travel by car cannot be sustained. Measures taken to address the problems have therefore shifted to 'predict and manage' or travel demand management (TDM).

TDM measures are sets of policies with the primary objective of influencing the travel behaviour of individuals through voluntary reduction or restriction on private vehicle use and ownership and the provision of travel alternatives. TDM measures are often referred to as 'push and pull' measures and can include regulatory, pricing, planning or persuasive policies. These policies attempt to modify the temporal and spatial dimensions of travel, mode choice and perhaps even the decision to travel. The objective of such measures is to encourage individuals to either make their trips outside peak times, by a different mode or to find another way of carrying out the trip purpose. Applying such measures can result in a more efficient transport system, improved environmental conditions and improvements in safety as well as revenue generation, which may be earmarked for investment in the transport system. TDM can generate positive effects on health and in the long term can also effect a change in spatial development of land use.

TDM can broadly be categorized as fiscal and non-fiscal measures. Non-fiscal measures that can be adopted by planners and policy makers include traffic calming and access controls and restrictions, parking management and control, public transport improvements, road space reductions, urban traffic management and control systems, traffic bans/restrictions, and travel awareness campaigns. Fiscal measures can include parking charges, workplace parking levies, fuel taxes, vehicle excise duty, car ownership permits, public transport subsidies, priority measures for walking and cycling and road-user charging.

During the 2005 symposium pricing measures, in particular road user pricing, dominated the research agenda. This is not unexpected since there is a growing interest in pricing measures, which gained a lot of popularity and support over

recent years for a number of reasons. Firstly, there is the growing level of traffic congestion combined with delays to public transport, and the failings of non-pricing measures and policies in achieving evident impacts on traffic congestion and other related urban problems. Secondly, the legislation, technological, implementation and political issues associated with pricing systems have been recognized and almost resolved. Moreover, there are now a number of pricing schemes implemented in the world and a growing number of interested cities and decision makers who are showing greater interest and willingness to adopt pricing policies in order to resolve transport problems. A lot of studies and research programmes have been devoted to studying the impacts of such pricing systems. Finally, pricing measures seem to be more attractive to decision makers since they are more effective in achieving their objectives and particularly in generating a stream of revenues, which could then help in the implementation of other TDM measures. All of these factors contributed to the fact that pricing measures are, and will continue to be in the near future, the most important TDM measures. But we should not forget that pricing measures are still not popular, therefore the implementation needs strong arguments to convince the public.

Theory and sociopolitical goals of pricing imply that the extent of the charges imposed on an individual should reflect the costs they impose on others and on the environment, thus helping to reduce negative externalities of traffic. Various terms have been used as well as road pricing, e.g. road user charging, congestion charging, congestion pricing, road tolling, variable pricing, etc., all of which generally reflect the same principle. The execution of the theoretical principles of congestion charging into practice however is complex and will hardly, if ever, be met in reality (Saleh 2005). This is because the pricing structure has to reflect the actual costs the motorists impose on the system according to time, distance and place and/or other applicable variables. In order to realize the theoretical framework, the system has to be flexible and easy to alter in the future as and where appropriate. Although that is theoretically possible to determine, it is political acceptance and practicality that might prove very difficult, if not unfeasible. The danger therefore is that pricing regimes might turn, in the majority of cases, into another imposed toll or fixed charge for travellers and a means of generating further revenues for the local authorities.

Therefore, the aim should be to develop, implement and monitor the performance of integrated TDM plans and policies, underpinned by a package of measures which aims to manage road congestion and improve the performance of the transport system. An integrated programme of TDM pricing and non-pricing measures should therefore be devised in order to assist local authorities and cities in developing appropriate schemes that meet their local objectives, solve the local transport problems and would be politically and publicly feasible. There shouldn't be more interest in pricing measures just because they generate revenues. With other complementary TDM measures, which try to avoid undesirable side effects, pricing might provide the optimum solutions to transport problems. The

research and investigations of non-pricing, as well as pricing measures should be continued.

The outcome of the 2005 TDM symposium has informed the debate on TDM, including road user charging, on what went right and what went wrong over the past decades (Saleh 2007). The researchers succeeded in obtaining a general acceptance that pricing mechanisms should play a role in TDM, but that this should be through the 'old' use of parking charges and tolls as well as the 'new' use of road user charging; we are doing things 'right' in developing useful new methods, and in creating a body of evidence which is beginning to consider what works and what doesn't. We had also been successful in persuading the public that induced traffic is a real phenomenon which is now genuinely believed.

Where had we gone wrong then? We went wrong in that some of the work we produced was too simplistic and/or too theoretical and ignored the dynamics of behavioural response, the undesirable impacts of TDM measures and the political acceptance and implementation processes. Many so called 'proofs' were flawed or were based on flawed assumptions with some questionable evidence being used as model inputs. There is a need for more research into practical applications and real cases and more emphasis to be directed towards empirical investigations. We haven't always shown sufficient understanding of 'the bigger picture' and lacked interest in and learning from the international experiences with TDM. We do not demonstrate that we appreciate future *needs* and *implications* on societies, equity issues, transport systems and the environment.

The symposium closing remarks recommended that transport academics should provide more encouragement and support to politicians in an attempt to reduce the gap between academics and politicians. The discussions of the symposium recommended in particular the need to carefully investigate both the desirable as well as the non-desirable impacts of TDM measures, to investigate further implications of all pricing measures and to validate the models we use to assess and test our policies. For example measures of parking pricing and public transport fare structures and subsidies could well be underutilized. Furthermore, recommendations included the need for further engagement with the international experiences in the area of TDM. Impacts of complementary measures such as high occupancy policies are also of relevance. Finally, more attention and research should be directed towards the future interventions such as provision of driver information and ITS and their wider impacts on transport systems and societies, including safety and the environment. These drawbacks are explored within this book, with each chapter offering a handling of one of the issues discussed.

The Chapters

The book contains a number of contributions which address some of the recommendations of the 2005 TDM symposium. Each of the chapters reports on

findings and results of theoretical and practical work in the area of travel demand management, including pricing measures.

The first part of the book focuses on investigations of the impacts of TDM measures. The chapter by Sammer (2008) argues that, in general, only short-term easy to observe effects are taken into account in the evaluation of TDM measures. These include for example, a move from car traffic to more environmentally friendly modes of transport, effects upon revenues, and time savings due to the decreasing number of traffic jams as well as short-term impacts on the environment. Long-term effects on the other hand such as land use problems, effects upon the local economy and value-added in the region, are methodologically difficult to determine. Other examples include the choice of a different destination, a switch to non-motorized traffic, the choice of a different route and rat running, reduced travel demand and boundary effects. The boundary effects, for example, due to a toll cordon, and a redistribution of effects with social, health and economic consequences are hardly ever covered.

There are three possible reasons for such oversight according to Sammer: Lack of knowledge of these side effects, difficulties with the methodology and the intentional omission of the undesirable results. Two case studies have been used to present the argument: an urban congestion pricing in Graz and a parking management scheme for private car parks in the Vienna region. The chapter concludes that measures of travel demand management have a considerable demand-managing effect, both on short-term and long-term positive effects on traffic environment etc.; but the analysis shows too, that such measures can have considerable side effects which are often neglected.

The third chapter by De Luca and Cantarella (2008) discusses the gap in research and development work in TDM investigations and predictions. The authors recognize that increases in travel demand can no longer be faced through a supply-side approach only, due to constraints on the available budget as well as natural resources. Hence, modern transport policies also follow a demand-side approach, trying to influence amount and pattern of demand flows. That is, the appraisal of TDM measures requires a travel demand analysis including careful segmentation of users into categories and trip purpose; estimates of demand elasticity through choice models, regarding for example, the number of trips, time of day, destination, mode and route, and their relationship with features of transportation supply as described by level of service attributes.

Moreover, the authors point to the increasing relevance of choice model assessment. For example travel demand analysis is commonly based on random utility theory and, over the years, most effort in literature has been devoted to generalized choice model formulations introducing more parameters, but less attention has been paid to choice model validation and comparison against real data. The chapter argues that it is evident that a very sophisticated choice model actually only slightly outperforms a simpler one. The authors propose a general procedure to validate a choice model against real data and to compare its effectiveness with

other models not necessarily specified through the same approach. Numerical examples referring to a real case are also reported.

Kelly and Clinch (2008) investigate changes in parkers' profile for the argument of any (negative) impacts on a TDM scheme to increase on-street parking charges in Dublin City. In an ex-ante and ex-post real case study, which is rare in practice, the documentation of such social profile analysis for a case of significant change provides a vital reference in the literature. The study provides important evidence for understanding the impact of a new tariff and pricing structure on the characteristics or 'profile' of those parking in an area, for example, casual versus frequent users and users of varying social class, which are very crucial. These considerations are important as a given tariff may disproportionately price certain groups out of the service.

Using data from a large-scale study, utilizing revealed and stated preference survey data relating to on-street parking, Kelly and Clinch consider profiling data from two 1,000 plus face to face surveys in a central on-street parking area before and after an actual citywide change in the price of on-street parking in Dublin, Ireland. Following the 50% price increase in on-street parking zones in Dublin city, there was just over a 4% drop in parking events in the case study area, and a 16.5% drop in average parking duration. However, the survey data from the same case study site show little change in the characteristics of those parking in the area. The noticeable changes consisted of a slight reduction in the most infrequent parkers and a reduction in city and suburban commuters relative to those travelling from further afield. Overall, at this price change level the 'profile impact' in terms of changes in demand was expectedly small with no major shifts.

Stewart (2008) addresses the theoretical issue of extending the formulation for stochastic system optimisation (SSO) pricing schemes to include marginal user cost (MUC), such that total perceived network travel costs for all classes are minimised, and presents an objective function for MUCSSO. To achieve such a flow pattern under an MUCSSO assignment link tolls are applied, which may differ for each user class. Marginal social cost price tolling is examined for differing user classes, and then the possibility of reduced (or minimal) revenue tolling strategies to produce the same effect are investigated.

Stewart argues that it might be politically desirable to allow for toll exemption for one or more MUCs, and the possibilities of producing toll sets that apply to less than the total number of user groups, but still result in the MUCSSO flow pattern being achieved are considered. The chapter claims that the methods used to derive toll sets are equally applicable to any stochastic assignment method.

Axhausen et al. (2008) present an investigation into the relentless trend of the falling cost of travel; this trend has created a world in which travellers mix local and non-local interactions easily, be it face-to-face or mediated by the various forms of telecommunication. The implications of this change of scale have not yet been fully discussed, as the most relevant literature in sociology generally skirts around its practical implication. The chapter discusses the interaction between

social capital creation, travel and transport policy and outlines how transport policy has to overcome its limitations.

The discussions show that the current spatial distribution of social capital limits the speed with which citizens can adjust their behaviour in response to policy initiatives currently contemplated to achieve the policy goals of the reduced social exclusion, fewer greenhouse gas emissions and improved welfare. The expected impact on these structures may very well make the citizens unwilling to see these policies adopted in the first place. Transport policy makers will have to enlarge the scope of their policy making and find new partners if they want to be successful in their core mission: the provision of a transport system which provides the services needed for everyone at minimum social cost.

Weihong et al. (2008), provide a vision of future travellers' information systems (FTIS) by envisioning a link to pervasive computing technologies. A newly invented technique, immersive video, is applied to investigate user perceptions of the envisaged FTIS and the impact on individual travel choices. The design and development of immersive video are presented in detail. Initial results suggest that although the demand for such a vision of FTIS could be high, other travel demand management schemes must be considered as a coordinating tool to significantly influence individual mode choices.

The second part of the book presents a number of international experiences with TDM measures and their impacts. The chapter by Saleh et al. (2008) presents an investigation of the impacts of the provision of driver information using variable message signs (VMS), a specific type of ITS, on accident rates and severities on Scottish trunk roads. VMS alerts drivers to road works, weather conditions, accidents and expected delays as well as relaying generic road safety messages, and VMS signs are now present on many major roads in most countries. It had been claimed that the VMS have resulted in consistent reductions in speed and lowered accident rates, however not with much conclusive evidence. Furthermore, previous research suggested that while a reduction of speed was observed as a result of a sign that urges reduced speed, there was concern for an increase in speed thereafter, hence increased risk. The net safety effects of such message systems were rather inconclusive in the literature.

In Chapter 8, Saleh et al. use accident data, flow data location and accident rates at a number of VMS sites in central and north east Scotland before and after the installation of VMS to investigate effectiveness of VMS on accident reductions. The authors argue that there is evidence of some improvement in accident severities at VMS locations and also evidence of an increase in accident rates at these sites after installation of VMS.

Muñoz and Ortuzar and Gschwender (2008) investigate public transport management and operation and impacts on the performance of the bus system in Santiago de Chile. The system has been completely in private hands since the late 1970s, and in full deregulation during the 1980s, which eventually left the city with a very inefficient system, undignified treatment of passengers and a high accident rate. On top of all this the system is characterized by a high level of noise

and environmental pollution due to bad maintenance of petrol engines, and a high rate of accidents due to both careless driving and (less-often) failure of brakes due to poor maintenance.

The Chilean government decided to intervene, developing the entire public transport system, integrating the well-reputed but not heavily used underground (Metro, a public company) and the private buses, based on a structure of trunk and feeder services (purposely designed), a modern bus fleet, integrated fares-paid by touchless smart cards and a high-tech centralized control system. It also developed an entirely new industry structure that was franchised through an international call for tenders, with operating contracts awarded to ten national and international firms. The new, integrated public transport system, known as 'Transantiago', went into operation on 10 February 2007. The chapter attempts to provide an objective account of the project history and discusses what lessons can be learned from this traumatic process.

Siu and Lo (2008) consider both transportation supply and demand management (TS-DM) measures, to underpin the development of an effective transportation management strategy. The authors, using the transportation infrastructure provision as the supply and the travelling public as the demand, assess demand management policies. They argue that synergy can be achieved in solving congestion problems when TS-DM strategies are developed jointly in an integrated manner, utilising a bi-level formulation to determine the time-dependent TS-DM strategy.

In the model, the upper level contains the TS-DM strategy as the decision variable whereas the lower level problem captures the time-dependent equilibrium residential/ employment location choices of travellers in the form of a combined model. This study then compares the benefit of the optimal mixed TS-DM strategy versus the traditional strategy of pure demand management. Using a small network example, they demonstrate that the integrated TS-DM strategy is a promising way for designing and managing transportation network over time, creating win-win outcomes for both the network operator and road users.

Nebiyou and Levinson (2008) estimate differences in willingness to pay a toll on a current trip in a stated preference context based on people's actual previous experience. The analysis is based on the I-394 MnPASS High Occupancy/Toll (HOT) lane project recently implemented in the Minneapolis/St. Paul region. The subjects in the study had been assigned a trip to complete and recorded their experiences. Then, respondents were asked to choose between a free alternative and the use of HOT lanes under different travel time and toll combinations in a stated preference survey. The analysis groups the travellers into subscribers and non-subscribers of the MnPASS (electronic toll collection transponder) system and further groups them into categories based on trip departure time (AM peak, PM peak and off-peak) and their previous experience (delayed or not). The findings suggest an increased willingness to pay among subscribers who were late in the PM rush hour. They also found some evidence that individuals who were late during the AM peak have a lower willingness to pay as compared to their on-time counterparts.

Finally, Franklin, Eliasson and Karlström (2008), deal with the new congestion pricing systems in Stockholm, one of the most ambitious systems in the sense that the congestion charges apply to the entire urban core. The system is now in place long enough to measure some real effects of congestion pricing on daily travel patterns, particularly with regard to how they affected people of different income level and gender. The analysis also comprises the benefits and burdens of the congestion charges on those who adjusted travel behaviours and those who did not, using a welfare analysis.

The outcome shows for the travel pattern that route and mode changes were far from a simple adaptation strategy. The fact that hardly anyone of the discretionary trips was obviously not 'replaced' in a simple one-to-one fashion may be an important observation. The assumption cannot be kept up that there is a more or less fixed number of trips to be made, and that the effect of the charges can be categorized only into 'mode change', 'departure time change' and 'destination change'. For discretionary trips, the adaptations seem to be much more multi-faceted, to the point that it is hard to say what really happened. The welfare analysis of morning commute trips found that the distribution of benefits and burdens due to paying the toll, enjoying travel time savings, or adjusting to it by changing travel mode, did not show significant differences among income group. The un-tolled were the only group with a net benefit. However, this group represents nearly 90% of the population, an overwhelming majority.

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