Road Use Pricing for Traffic Management

Dermot Geraghty BA BAI MSc, Margaret O'Mahony BE DPhil
Ivor Humphreys BA BAI MSc & Gerry Byrne

School of Engineering, Trinity College Dublin, Ireland

1. INTRODUCTION

Road use pricing for traffic demand management is currently the subject of serious debate at many levels. The recent UK White Paper on Transport[1] advocates road use pricing as a traffic demand management measure and a more recent discussion document[2] deals specifically with legal and institutional issues required before its introduction. Road use pricing has been implemented in four cities, Oslo, Trondheim, Bergen and Singapore although in the cases of the three Norwegian cities the aim has been revenue generation. More recently other cities including the Randstad region in the Netherlands, Rome, Bristol and Edinburgh, to name but a few, are considering road use pricing as part of their traffic demand management programmes. In Dublin, a study recently commissioned by the Department of the Environment (DOE) is evaluating its potential for management of peak period traffic congestion in the city. The project, on which this paper reports, is therefore timely as it will provide some indicators of the performance of road use pricing in Dublin and will supplement the findings of the DOE study.

The aim of the project is to evaluate the impact of road use pricing on energy consumption and its potential for use as part of an integrated traffic demand management programme. The project, entitled EUROPRICE, was partly funded by the EU SAVE II Programme. The primary objective was to run two pilot-actions to simulate road use pricing in Dublin and Athens. The paper describes instrumentation designed specifically for the project and some preliminary findings of the Dublin pilot-action.

The in-vehicle unit (IVU) is described in section 2 of the paper followed by a description of the Dublin pilot-action in section 3. Preliminary results are presented in section 4 and the conclusions and recommendations for future work are presented in section 5.

2. IN-VEHICLE UNIT (IVU)

The IVU is a programmable display and data logging instrument specifically designed to record 'trip data' and display road use costs to the participant. The IVU records details of car usage, such as number of trips, distance and duration of the trip and speed data relating to each trip, over an extended period (up to 3 months). In addition, it can calculate the cost for each trip according to a predetermined formula. The cost may include components related to congestion pricing as well as private cost elements such as fuel, wear and tear and depreciation, if required. The particular pricing mechanism may, with some restrictions, be chosen by the researcher. Feedback on cost is provided to the drivers by means of an LCD display. The recorded data are stored in non-volatile memory and may be uploaded to a spreadsheet package via a serial interface at any time. Windows software is provided to configure the IVU and to retrieve the experimental data.

2.1 Functionality

The basic functionality of the IVU is that of a trip-meter. It records the following information on a per trip basis:

- Time and date of the start and end of the trip.
- Duration of the trip
- Distance travelled
- The computed cost of the trip
- The number of stops during a trip (i.e. when the car is idling - this gives an indication of congested conditions where necessary).

The trip data are stored in chronological order and indexed so that, under certain circumstances, the data may be viewed by the researcher. Information on costs, trip lengths, budget remaining and charge rates are presented to the driver on a real-time basis by means of the LCD display.

2.2 Programmability

The IVU may be programmed either from the front panel keypad or by using a Windows compatible configuration program. Three levels of access, called tiers, to the instrument are provided.

The most basic level, Tier 1, is that available to the installation engineer and provides for:

(a) Calibration of the IVU for different tachometer types.
(b) Simple proofing and fault finding.

The next tier provides access for the researcher to the trial parameters. These parameters include:

(a) The costing regime to be applied
(b) Initial value parameters for the selected costing regime.
(c) Currency option e.g. drachmas, Euros, etc.
(d) Display parameters such as font, language, etc.
(e) Distance metric used i.e. miles or kilometres

Other participant tracking details may also be included such as:
(a) Vehicle identification information e.g. registration number, participant details, etc.
(b) Tachometer details for some models.

Tier II programmable options use the PC interface and should be done prior to installation. Since the IVU normally uses the car battery/charging system as the power source, a separate power supply is provided to power the instrument on the bench.

Tier III operations are only available to the developer. They include such functionality as:

(a) addition of a new costing function

(b) addition of a new display option

2.3 Description of IVU Hardware

The IVU is a microprocessor-based instrument with the following features:

- 1b bit microprocessor
- RS232 interface for communication with a host computer e.g. PC.
- Real time clock calendar
- 256K electrically programmable memory (flash)
- 2K battery backed RAM
- 128 x 128 backbit dot matrix LCD abd LCD controller

2.4 Costing Functions

Two costing functions are provided for each of Dublin and Athens. To address the distance and time based pricing method, used in the Dublin trial, the researcher can vary two rates of charging; one for the peak period and one for the off-peak period. In each case, a charge per km and a charge per minute are applied. The charges used are based on the marginal external costs of congestion, air pollution, noise and accidents calculated by the TRENEN calibration of Dublin[4]. These costs are normally referred to as the external costs of car use and are not normally paid by the car user. Road use pricing is a means of internalising these additional costs imposed on non-car users by enforcing in effect the 'polluter pays principle'. Large external costs are normally associated with the peak period due to the relatively high marginal costs of congestion. The charges applied in the peak period reflect these high costs whereas in the off-peak period nominal charges apply.

In the case of Athens, charging for air pollution is the primary aim. Athens suffers from serious pollution from car traffic and the charging method used in the trial reflects this high cost to the community. If the car is used in the morning period the IVU clocks a fixed charge of 200 drachmas and in addition applies another charge for each km travelled. If the car has been used on the previous day, an additional increment of 20 drachmas per km is added so that the car user pays more per km than on the previous day. If the car was not used on the previous day the rate per km is reduced by 20 drachmas per km. The car user is rewarded in this case for not using the car on the previous day.

2.5 Enhancements

Presently the IVU is being upgraded to include a GPS facility, which will allow further road use pricing research to be conducted using virtual cordons.

3. PILOT ACTION DESCRIPTION

There were twenty five participants in the Dublin pilot action study. Where possible those selected in the sample had a feasible alternative mode of transport i.e. live and work within a ten minute walking distance of a bus/rail stop from their home and work place respectively.

The participants were a random/volunteer-based sample selected from the staff of Trinity College.

Each vehicle was instrumented with a calibrated IVU. In Phase 1, no feedback was provided to the participant. Data recorded in this phase was used to establish baseline driving characteristics for the participant. Following Phase 1, Phase 2 was initiated. The driver was then exposed, by means of the IVU, to the road use charges and allocated a 'real money' budget of IRL£55 (70∈) per week over a three week period. The participant could chose to spend the budget to pay their road use charges if they decided to continue using their car or keep the money if they did not use their car. The calculation of the budget was based on the findings of the TRENEN project where the marginal external costs of the average trip in the peak period in Dublin is about IRL£5 (6.35∈). The charge rates applied in the peak periods (7.30 - 9.30 and 17.00 - 19.00) were premium rates whereas the rates at all other times were nominal rates. No charges were applied at weekends. The distance and time based charges used in the Dublin trial were selected based on the time taken by each participant to travel to work and the distance between their home and work place. The rates used were such that the total charge applied for their work trip was IRL£5 (6.35∈). Trip information was logged by the IVU for the three weeks of Phase 2.

4. RESULTS

4.1 Impacts on Car Travel Demand

The data from 13 participants has been reviewed but not yet analysed in full. However, some interesting preliminary findings have been noticed from the data. Before the start of the project the participants were requested to provide detailed information on their public transport options. While investigating the alternative public transport possibilities one of the participants found a favourable option and has since used public transport for her journey to work. Another participant began to cycle to work when road use pricing was imposed and another limited use of the car during the peak period to only a couple of days per week. Two others tried to ensure their work trip in the morning had been completed before the peak period pricing commenced and waited until after the evening peak period to make their journey home. Some participants, particularly higher income individuals, were not noticeably influenced in that their trip making patterns did not change. Others suggested that if they had rail based transport available to them for their work trip they would use it. They considered the bus services currently available on their routes in Dublin to have a poor level of service and to be unattractive, particularly in terms of journey time, compared with car.

4.2 Modelling Results

Estimates of the possible energy savings if road use pricing were to be introduced in Dublin were examined using the network model of Dublin based in the Dublin Transportation Office[5]. Charge rates of those applied in the pilot-action were applied to all trips entering the city centre in the morning peak modelled hour. Energy savings of 38% were realised on the whole network (Dublin city and areas within commuting distance). This reduction is influenced by the lower traffic levels resulting from some trips not being made but also by reduced queuing and congestion.

5. CONCLUSIONS AND FUTURE WORK

- The IVU proved a useful tool for the pricing requirements and feedback information necessary for the EUROPRICE project.
- Preliminary findings from the project indicate that some reduced car travel demand in the peak period would result if road use pricing were to be introduced in Dublin.
- Impacts include reduced car use in the peak period, change of commuting trip start time and use of public transport and other low-energy modes such as cycling.
- Future work may include altering of the IVU platform to perform GPS based road use pricing, to log car speed and to log physical responses of drivers in congested conditions.

6. FURTHER INFORMATION

Further information can be obtained from Margaret O'Mahony, email: mmmahony@tcd.ie and Dermot Geraghty, email: tgerghty@tcd.ie

7. ACKNOWLEDGEMENTS

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