Sustainable Road Transport
A Public Perspective Area

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INTRODUCTION

One of the major consequences of the increase in road transport in recent years has been the adverse affect it has on the environment. The amount of vehicles registered has consistently increased over the last century and this continued in the present century with rough estimates stating that over 22 million vehicles are on our road network today. Along with the increase in vehicle numbers, sprawling of the road network has taken place during this time period, with approximately 100,000 new kilometres of road been constructed during the second half of the last century.

These increases have put enormous strains on the environment and realistically cannot continue. This has been recognised by the government and relevant authorities and structures have been developed to try and combat the problems. The government's strategy (White Paper) outlines its plan for a sustainable transport system with respect to the environment; this is a basis for improvement

Vehicle emission legislation and new fuel quality directives has lead to a considerable decline in emissions from road transport in the UK over the last number of decades in spite of the continued growth of traffic over this period. This reduction is predicted to continue for near future, but eventually with no further action being undertaken to reduce vehicle emissions, the anticipated growth in traffic will offset the benefits of new vehicle and fuel technologies introduced by legislation and emissions will start to rise again towards the end of the second decade of this century.

Noise pollution can be said to be the greatest cited environmental problem due to road transport, and this problem isn't without difficulty in attempts to reduce it.

Legislation and standards have improved the situation in recent decades with the decline of power point noise sources, but these sources have exposed rolling noise as a key contributor to overall noise levels. Power point noise sources are now said to have reached a platform where further reductions isn't economically viable.

Limiting of rolling noise is more difficult to achieve with noise levels been dependant on the vehicle type and road surface along with other varying factors. The planned withdrawal of noisier road surfaces like concrete will reduce the impact further, but as with air pollution the major decrease can only be achieved with integrated planning. Segregation between the major sources of road noise and residential areas is the easiest way to achieve this for future developments. With existing road conditions, introducing traffic management schemes can have a major affect on surrounding noise levels

In comparison with the other environmental issues, visual intrusion is perhaps one of the least thought of impacts, but a well publicised and controversial concern. This is principally because of the adverse effect that a new scheme or development can have on natural or unspoilt landscape and the intense feelings of the public towards this subject (Road Traffic Statistics 2001). Visual intrusion which is a subjective factor and difficult to measure can be defined as:

> "*Traffic (composition, volume, whether parked or moving) and to the quality of the built environment (street furniture including traffic signs, materials, lighting sources) both in terms of quality and volume".* National Road Traffic Forecasts (1997).

Landscape is a concept that combines the physical characteristics of the land and the way in which these are perceived by people. The landscape we have today is the result of interactions between physical processes and the way people have managed and lived on the land over the centuries, it is more than just the view;

> *"Landscape is an important national resource, an outstanding natural and cultural inheritance which is widely appreciated for its aesthetic beauty and its important contribution to regional identity and sense of place. Although it is subject to evolution and change, the landscape is recognised as a resource of value to future generations"* Morris and Riki (2001). The affect this intrusion has on the general public can be measured both subjectively and quantitatively. Various studies have been undertaken in the past to try and evaluate or quantify visual intrusion; these studies however rely on subjective responses from the public and can be influenced by the respondent's characteristics, (Grigg.A.O and Huddart.L (1999) and Huddart.L (2000).

> *"An objective method of landscape evaluation is limited to the extent that it is based on subjective preferences and these vary considerably. Significant differences in scene preferences were found for rural and urban groups of subjects, and also between social groups.*

In summary, available data on visual intrusion is extremely limited and very outdated; this is due to the difficulty in attempting to evaluate the impact a scheme will have on an area. However the affect intrusion can have on the health of humans, should be investigated in greater detail, individual annoyance can act as a stressor and lead to other health affects like those present with noise annoyance.

In this paper a methods of investigating the publics overall perception of some of the major nuisances from road traffic is presented. As described in the earlier sections the environmental impacts of most concern to the public are air pollution, noise pollution and visual intrusion; these have been investigated in a survey. The survey was designed for the purpose of investigating the public's perception of various nuisances caused by road traffic.

The next section of the paper presents an overview of the questionnaire design, followed by general analysis of the questionnaire design, followed by modelling respondents' attitudes of environmental impacts and finally the paper provides summary of the main findings and recommends further investigations.

SURVEY DESIGN

The survey was designed for the purpose of investigating the public's perception of various nuisances caused by road traffic, using a web-based survey. The questionnaire itself had two main sections, firstly questions were asked to identify general characteristics of the respondent and secondly actual questions based on their own opinions on the environmental impacts of road transport. Some attitudinal questions were included to investigate public perceptions of environmental issues.

The target response rate for the questionnaire was set at between 100 and 150 individuals; this was needed to give a good variation in the perceptions of the public been questioned. Respondents include mainly members of the School of Built Environment and Civil Engineering at Napier University and Edinburgh, staff at Amey Infrastructure Services Edinburgh.

The survey was carried out over a week in March. An email describing the questionnaire and the information been required was sent to members of the School of the Built Environment and Civil Engineering at Napier University. The information from the twenty-four questions being asked was then input into a Microsoft excel file, where filters were inserted to allow for easy cross examining of the data.

Information on the air quality level in Edinburgh was recorded for a weeklong period from when the first questionnaire was sent out. The information was recorded from the website www.airquality.co.uk this website gave the level of pollution in the Edinburgh region for each of the days. The level of pollution was described as low for all the days during the required time period. Monitoring stations throughout Edinburgh record at different intervals the concentrations of certain pollutants in the ambient air. These are then combined to give an overall level of air quality in Edinburgh.

ANALYSIS

Overall there were 120 respondents of which 81 were male and 39 female. The largest category was in the age group of 18-24 year olds which made up 50% of the respondents, with 43 being male and 17 being female. The age group of 25-34 year olds consisted of 33 respondents, with 13 and 14 respondents being categorised in the 35-44 and 45+ age groups respectively.

Individuals who reside in Cul de Sac areas seem to be less annoyed by traffic fumes, this could due to the fact that very little road vehicles flow in these areas. Only 6% of individuals in these areas cite it has a major annoyance, with another 12% citing it as an annoyance. Respondents who reside along urban roads or residential areas cite it as a major factor for annoyance, with 27% and 34% saying it causes them annoyance respectively. Males tended to be more annoyed by the levels of pollution compared to their female counterparts, with greater proportion of males stating they were annoyed while females stated to being not bothered.

On the contribution to negative impacts of transport, the results show that 45% of the total perceived car's to have the greatest contribution while 27% identified buses, and 23% heavy goods vehicles (HGV's) with only 5% citing motorcycles. The respondents were asked if they could hear noise from road traffic when indoor's at home, of the 120 respondents two-thirds replied yes to one third who replied no. This is consistent with previous studies carried out, but when the respondents are categorised by the area of their residence a clearer picture can be seen, (The National Noise Incidence Study 2000).

RESPONDENTS' ATTITUDES OF ENVIRONMENTAL IMPACTS

The respondents were asked to express their opinions, preferences and choices for a number of environmental issues. They were also asked to distribute 100 units to the three categories, with the highest allocation been used as their preferred option. Not all the questions asked in the questionnaire were used in the model, but only the perceived most relevant. The logit model is used to model the preferences of respondents of environmental issues. The probability of an individual choosing an option i, with a utility V_i from a number of available options j is as follows:

$$P_1 = \frac{\exp(V_1)}{\exp(V_1) + \exp(V_2) + \ldots \exp(V_n)}$$

The above logit model bases its computation by assigning to each existing alternative to the respondent, an attractiveness or utility. The higher the utility the more probable the option will be chosen. The model has been run successfully and the results obtained are presented in Table 1. Three models were calibrated, with different utility functions and variables; the first model was the base model (B1), the second was used to investigate the effect socio-economic characteristics on the results (B2) and the third to investigate the effects of respondent's health on the model (B3).

The base model included variables chosen from the results of the survey and which were deemed to be subjective, i.e. indicating the respondents perspective of certain environmental issues. The second model added two variables age and gender to try and investigate if these have a significant effect on the respondent's choice.

The third model (B3) added just one variable, illness to consider if an individuals health has a significant affect on the overall model. The coefficient estimates results of the models are shown below in Table 1 with the t-ratios are given brackets (Phelan, Brian (2005)).

Table 1 Results of ALOGIT models

Variables	Model B1	Model B2	Model B3
Air annoyance	0.1783 (0.7)	0.2296 (0.9)	0.1871 (0.7)
Air concern	-0.6397 (-2.3)	-0.6951 (-2.5)	-0.6779 (-2.3)
Air perception	-0.04023 (-0.4)	-0.04694 (-0.4)	-0.04815 (-0.4)
Air Information	0.8534 (1.4)	0.9945 (1.6)	0.8719 (1.4)
Noise can hear	-0.6092 (-1.1)	-0.7994 (-1.4)	-0.6152 (-1.1)
Noise annoyance	-0.4251 (-2.1)	-0.4687 (-2.3)	-0.4451 (-2.2)
Noise interference (a)	0.1099 (0.3)	0.4153 (0.4)	-0.09665 (0.3)
Noise interference (b)	-0.2719 (-0.9)	-0.3362 (-1.1)	-0.726 (-0.9)
Visual traffic	0.3751 (1.2)	0.3966 (1.3)	0.38 (1.2)
Visual bus shelters	-0.2017 (-0.7)	-0.1637 (-0.6)	-0.1943 (-0.7)
Visual bus HGV's	-0.4139 (-1.2)	-0.5066 (-1.4)	-0.4 (-1.1)
C1	1.049 (0.6)	1.391 (0.7)	1.321 (0.7)
C2	2.838 (1.8)	3.331 (2.0)	3.054 (1.9)
Socio- Economic			
Gender	-	0.1485 (0.3)	-
Age	-	-0.4139 (-1.9)	-
Illness	-	-	-0.7155 (-1.2)
ρ^2 (0)	0.3079	0.3221	0.313
ρ^2 (c)	0.0949	0.1135	0.1017
Final likelihood	-91.2454	-89.3712	-90.5676
Initial likelihood	131.8335	-131.8335	-131.8335

SUMMARY AND CONCLUSIONS

The main finding from the literature review shows that affect road transport has on the surrounding environment is improving, through technical advances and improved planning. Technical advances will be limited in the future, with more importance being placed on local authorities for planning and management to safeguard the quality of life for future generations. This has been recognised by the government who has transferred powers to local authorities to implement action plans to reduce the pollution caused by road transport. It is predicted that further increases in the quantity of vehicles and road networks will continue at even higher rates than currently at present, without proper planning and control this will cause significant problems in large urban areas where a build up of traffic is likely to occur.

Overall the performance of the models are reasonable, the achieved ρ^2 (zero) values of approximately 0.3 are statistically significant. Although in all the models, only two variables reached a level of significance ± 1.96, namely; air concern, noise annoyance and to a certain extent age in Model B2 (-1.9), the relatively small sample size could be responsible of that. The signs of the most

significant variables stated above are logical, air concern has a negative coefficient estimate this implies that as the respondents replies go closer to 1 (very high concern) their allocation of units to the improvement of air quality increases. The same can be implied for the results of noise annoyance due to road transport.

Air pollution was cited as the primary area where respondents would improve, followed by noise and visual pollution respectively. The environmental impacts are ranked below health, employment and financial security, but still important when considered to other aspects.

RECOMMENDATION FOR FURTHER RESEARCH

The main recommendations for future work on this topic would be to carry out more investigations on public perceptions of environmental impacts of transport in particular in urban areas in comparisons with rural areas. The comparisons could take into account the perceived levels of air, noise and visual pollution of the public to actual measurements taken on site.

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