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FORECASTING MOTORISTS LONG TERM BEHAVIOUR IN THE GREATER NOTTINGHAM AREA

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ABSTRACT

This report outlines work carried out to assess the factors that, in the medium and long term, may influence motorists' mode choice in the Greater Nottingham area. This work was based on four Stated Preference (SP) experiments that examined the choice between car and ordinary bus, car and bus-based park and ride, car and express bus and between departure times for car users.

Just over 6,000 self completion questionnaires were distributed at random to residents in 28 wards. Over 1,700 usable responses were returned, representing a response rate of 29%.

Despite a number of problems, a series of four strategic forecasting models were developed. These incoporated some important findings including that motorists value delay highly, value parking costs more highly than petrol costs and value adjusting their departure time less highly than in-vehicle time.

The four forecasting models were then used to examine five scenarios; the introduction of park and ride, the effect of projected 2001 road traffic speeds, the effect of petrol cost increases, the effect of parking cost increases and the effect of decreasing bus in-vehicle time. Although there were a number of technical difficulties, our forecasts suggest that decreases in speeds, parking costs and petrol costs will not halt the growth in road traffic but will slow it down. Where possible motorists are more likely to change the time of their journey than their mode. For dramatic changes in mode split both a big stick and big carrot are probably required. The big stick might be provided by some of parking control or road pricing, whilst the carrot might be some form of a high quality, fast bus network (or indeed other forms of public transport with a segregated right of way). The role of park and ride is likely to be relatively marginal but may be worth pursuing if part of an overall traffic management policy.

There was little evidence from our models of there being any critical "thresholds" or "trigger points". However, many of the processes we have examined seem to have cumulative impacts and our forecasts identified the doubling of car journey times as being a possible "catalyst" which is likely to be achieved in the early part of the next century.

GLOSSARY

ACPR	Access time (by car) to park and ride site
ACWK	Generic variable consisting of access time and walk time for park and ride users
ASC	Alternative specific constant
D15	15 minutes delay time for car users
D20	20 minutes delay time for car users
DTC	Delay time for car users
FTC	Free time for car users (ie in-vehicle time unaffected by delay)
IVTB	In-vehicle time for bus users
IVTC	In-vehicle time for car users
IVTPR	In-vehicle time for park and ride users
MIVT	Main mode in-vehicle time
SP	Stated preference
TP	Transfer price
TT	Transfer time
WKB	Walk time for bus users
WKC	Walk time for car users

1. INTRODUCTION

1.1 Background

The background to this research is increasing concern about traffic growth and congestion. Nationally, the Department of Transport have forecast that, if unchecked, traffic will increase (from 1988 levels) by between 83% and 142% by the year 2025. This represents an annual compound increase of between 1.6% and 2.4%.

Locally, road traffic in Nottingham has been estimated to have increased by about 18% since 1984/85. This represents a compound increase of between 3.4% and 4.2% per annum. Over the same period, journey runs carried out by the County Council indicate that mean speeds on the main arterials have reduced by about 30% in the morning peak, whilst junction delays have increased by about 120%.

The County Council have been concerned about these trends (see, for example, the report to the Environment Committee, 27 September 1989), particularly as providing large scale additional road capacity within Nottingham itself has been deemed unacceptable. With the exception of some orbital routes, a road building programme is not seen as an option. Instead, the County Council have drawn up an advanced traffic management package which consists of three main elements:

(1) Park and ride and bus priorities. This includes developing a system of park and ride sites, bus lanes, bus-only streets and bus priority at key junctions.

(2) Maximising the capacity of the existing road network. This includes improving the Urban Traffic Control (UTC) system, updating parking restrictions and improving enforcement, improving highway management, providing better information and guidance for the motorist and completing the orbital road system.

(3) Developing and assisting other transport modes/methods. This includes encouraging cycling and the use of rail services, supporting an LRT study and land-use policies which minimise transport problems and encouraging staggered working hours and multi-occupancy vehicles.

1.2 Proposed Research Approach

This research arises from discussions between the County Council and the Institute for Transport Studies carried out during January 1990. It follows previous work carried out by the Institute in assessing the demand for a new rail service between Nottingham, Mansfield and Worksop (Preston, 1989) and a Light Rapid Transit system between Nottingham and Hucknall/Babbington (Preston and Wardman, 1989).

The County Council's particular concern was whether there was a "trigger point" or "threshold level" of road congestion which could act as a "catalyst" in persuading motorists to change their behaviour. This research is exploratory in nature. As it is dealing with events that may occur sometime in the future due to dimensions of change that have not previously been observed (at least in the Nottingham area) this study makes use of hypothetical questioning techniques (see Nash, Preston and Hopkinson, 1990, for more details of these techniques).

This study was initially envisaged as consisting of four phases:

(1) Phase one consisted of in-depth interviews of a small number of motorists in order to determine the main determinants of travel choice.

(2) Phase two was to consist of a Stated Preference (SP) experiment to determine the choice between bus and car. It was proposed to distribute a total of 2,000 questionnaires in four corridors.

(3) Phase three was to consist of a Stated Preference experiment examining the choice between car and bus-based park and ride. Again, 2,000 households in four corridors would be contacted.

(4) Phase four would attempt to draw together the previous three phases in order to:

   (a) Give broad indications of the future level of the demand for bus travel.
   (b) Give estimates of the potential for bus-based park and ride and an assessment of the potential for rail based park and ride.
   (c) Assess whether "trigger points" exist which might reduce the attractiveness of private transport relative to public transport.

1.3 Revised Research Approach

The above proposed research approach was revised in the light of the findings from the in-depth interviews carried out in phase one (and reported in detail by Hopkinson, 1990). Overall, the single factor most likely to affect people's travel behaviour was an increase in parking charges. Most people felt they would be able to cope with more traffic on the roads largely by adjusting their departure times. Improvements to existing bus services in terms of frequency, fares and, to a lesser extent, journey times, were unlikely, in isolation, to affect peoples' use of buses. Generally, most people felt that they would be unlikely to use a park and ride scheme either because the existing sites are too close to the centre or they already have access to a good bus service. A literature review also indicated that to date, park and ride had only been successful in exceptional circumstances; either where congestion is heavy due to historic constraints on road capacity (eg Oxford) or there are severe central area parking shortages (eg Christmas shopping) (see Preston, 1990, for more details).

The in-depth interviews therefore identified a number of additional factors as being germane to motorists' behaviour. As a result, the proposed phases two and three of this research were revised so as to cgnrist of four SP designs:

(1) Motorists most important reaction to worsening conditions is, where possible, to modify departure time. As a result, one SP design is a within mode study focusing on departure time variation (both earlier and later).

(2) Motorists appeared to be most sensitive to parking charges and availability. As a result, a second SP design studies the choice between car and bus-based park and ride, with parking cost specified as a separate variable and set, in most instances, at higher than current levels.

(3) Motorists appeared most likely to switch to bus if journey times could be reduced. Therefore, a third SP design looks at the choice between car and express bus. Due to bus lanes and priority at signals, in some scenarios bus can have faster journey speeds than car.

(4) Our fourth, base SP design looks at the choice between conventional bus and car, particularly focusing on the effect of congestion by distinguishing between delay and free time.

The pilot survey involved giving the 19 respondents to the in-depth interviews an initial version of our base SP design. Respondents found the survey comprehensible but in some instances reported that the times and costs presented were unrealistic. As a result, using the information from the travel diaries, the questionnaires were customised so as to be more representative. This was done by developing different sets of times and costs for those people living in Nottingham itself (referred to as the inner zone) and those living outside the main built-up area (referred to as the outer zone). As a result the number of SP designs increased to eight.

Our pilot SP survey was based on presenting each individual with nine hypothetical scenarios. However, when we undertook detailed computer simulation tests along the lines of those recommended by Fowkes and Wardman (1988) it became clear that the design did not have sufficient variation to estimate with statistical significance all the effects we were interested in. As a result it was decided to expand the design to sixteen scenarios. However, it was felt that this would be too many scenarios for one individual to handle. Therefore, the design was split into two, with eight scenarios in each half. The number of SP designs therefore increases to 16.

1.4 Report Outline

In the next section, we go on to outline our research methodology in more detail. The extent of, and response to, the surveys is considered in detail and comparisons are made with Census data to determine the effects of possible biases.

Section three goes on to describe the development of models that might predict future changes. Separate models are developed for each of the four SP experiments. In addition, analysis is carried out of motorists' responses to Transfer Price (TP) and Transfer Time (TT) questions. An attempt is made to draw the, at times, disparate evidence together in order to develop a series of strategic forecasting models.

Section four goes on to assess future changes in the use of both public and private transport as a result of increases in congestion, increases in parking costs, reductions in bus journey times and the introduction of park and ride.

Section five attempts to draw some conclusions, particularly with respect to policy.

2. SURVEY METHOD

2.1 Extent of Surveys

The survey method used was that of postal self-completion questionnaires. Examples of the four types of questionnaires that were used are given in a separate Technical Appendix, along with the coding manual.

Ideally, in an exploratory study of this type, household interviews would have provided a better survey instrument. However, in order to achieve a sample of over 1,000 respondents such an approach would be prohibitively expensive. It was our view that self completion still represents the best value approach but we acknowledge that this particular study is pushing such an approach to its limits.

Overall 6,016 questionnaires were distributed to a total of 28 wards in four corridors (see Tables 1 and 2). These contact addresses were obtained, at random, from the electoral register. This compares with the 4,000 questionnaires we originally proposed to distribute (see Section 1.2). The sample size was increased due to the introduction of additional SP experiments and the decision not to send out reminders to non-respondents.

From the 1981 Census, it was estimated that the total population of the 28 wards was around 158,000, with the population aged 18 and above being around 117,000. We have, therefore, sampled around 5.1% of the target population.

2.2 Survey Response

Altogether, 1,857 questionnaires were returned (as of 01/08/90) of which:

(a) 41 were returned marked no longer at this address/not known at this address
(b) 64 were returned blank (mainly by, or on behalf of, the elderly and disabled)
(c) 32 were returned too late to be coded and processed
(d) 1,720 were coded and processed, of which 29 had incomplete details of the questionnaire number so that the identity of the respondent could not be detected.

Thus, altogether a response rate of 30.9% was achieved, declining to 28.8% if those questionnaires which were not coded are excluded. This was deemed satisfactory for a survey of this type and represents a sample of 1.5% of the targeted population.

Table 1 shows the geographical distribution of responses by ward. The highest response rate was achieved by Ravenshead ward (42%) and the lowest response rate was achieved by Portland ward (16%). The response rate was higher for those wards in the outer zone (31.1%) than for those in the inner zone (25.0%).

Table 1 also shows the difference response rates for each experiment. These exhibited less variance than for wards and were as follows:

- 29.8% for the departure time experiment
- 29.6% for the car v ordinary bus experiment

- 26.6% for the car v express bus experiment
- 26.6% for the car v park and ride experiment

The 28 wards considered in this study were grouped into four corridors:

(1) The North West corridor includes the Byron and Portland wards in Nottingham, the Nuthall, Eastwood North and South wards in Broxtowe and the Hucknall East and Woodhouse wards in Ashfield. The A610 and A611 are the main arterials serving the corridor and potential park and ride sites are at Southglade Drive and Wilkinson Street.

Table 1: Response Rate by Ward and Survey Type

SP Design:	Ordinary Bus		Park and Ride		Express Bus		Departure Time		TOTAL	
Ward:	out	in	out	in	out	in	out	in	out	in
Hucknall	48	14	48	10	48	6	43	9	187	39
Woodhouse	64	11	64	11	64	19	60	8	252	49
Eastwood N	64	17	64	18	64	10	60	21	252	76
Eastwood S	64	15	64	15	64	13	60	10	252	53
Nuthall	48	16	48	16	48	15	43	15	187	62
Bonington	48	8	48	7	48	12	43	9	187	36
Burton Joyce	64	38	64	16	64	20	60	26	252	100
Calverton	64	19	64	13	64	22	60	13	252	67
Cavendish	48	6	48	7	48	7	43	14	187	34
Conway	48	10	48	11	48	12	43	16	187	49
Gedling	64	14	64	24	64	12	60	14	252	64
Killisick	48	9	48	10	48	10	43	15	187	44
Netherfield	48	11	48	8	48	11	43	11	187	41
Oxclose	48	16	48	9	48	13	43	14	187	52
St Marys	64	22	64	22	64	15	60	20	252	79
Ravenshead	64	20	64	27	64	29	60	30	252	106
Lowdham	64	19	64	20	64	19	60	22	252	80
Bestwood Park	48	9	48	5	48	9	43	9	187	32
Byron	48	16	48	6	48	12	43	8	187	42
Greenwood	48	10	48	11	48	12	43	9	187	42
Portland	48	8	48	5	48	6	43	10	187	29
Wilford	48	18	48	21	48	13	43	9	187	61
Keyworth N	64	33	64	25	64	25	60	19	252	102
Keyworth S	64	25	64	28	64	21	60	25	252	99
Leake	64	21	64	24	64	15	60	16	252	76
Leys	48	19	48	14	48	16	43	17	187	66
Lutterell	48	16	48	14	48	19	43	14	187	63
Packman	48	14	48	12	48	16	43	16	187	58
TOTAL:										
Inner	768	200	768	166	768	189	688	195	2992	750
Outer	768	254	768	243	768	220	720	224	3024	941
TOTAL	**1536**	**454**	**1536**	**409**	**1536**	**409**	**1408**	**419**	**6016**	**1691**

Table 2: Response Rate by Corridor

SP Design:	Ordinary Bus		Park and Ride		Express Bus		Departure Time		TOTAL	
	out	in	out	in	out	in	out	in	out	in
N.West	384	97	384	81	384	81	352	81	1504	340
North	384	103	384	93	384	110	352	110	1504	416
South	384	146	384	138	384	125	352	116	1504	525
East	384	108	384	97	384	93	352	112	1504	410
TOTAL	**1536**	**454**	**1536**	**409**	**1536**	**409**	**1408**	**419**	**6016**	**1691**

(2) The North corridor includes the Bestwood Park ward in Nottingham and the Calverton, Bonnington, Killisick, Oxclose, Ravenshead and St Marys wards in Gedling. The A60(N) and A611 are the main arterials serving the corridor and the corridor can be served by park and ride sites at the Forest and Southglade Drive.

(3) The South corridor includes the Wilford ward in Nottingham and the Leake, Leys, Lutterell, Packman, Keyworth North and South wards in Rushcliffe. The A60(S) is the main arterial serving the corridor and park and ride can be provided at Queen's Drive.

(4) The East corridor includes the Greenwood ward in Nottingham, the Burton Joyce, Cavendish, Conway, Gedling and Netherfield wards in Gedling and the Lowdham ward in Newark. The A612 is the main arterial and Daleside Road the park and ride site serving the corridor.

Table 2 emphasises the geographical variation in response rate. The highest response rate (34.9%) was achieved in the South corridor and the lowest response rate was achieved in the North West corridor (22.6%).

2.3 Comparisons with the Census

Some useful comparisons can be made between the composition of our sample and the characteristics of the population as a whole. However, in doing so we are reliant on information from the 1981 Census which is now nine years out of date. Because of this, we only propose to make comparisons at a very general level.

In Table 3 we compare the age-sex profile of our sample with that of the relevant total population. In doing so, we have made the working assumption that the population of the 28 wards has remained static since 1981 at the 158,000 level. Taking into account that the total population is likely to have aged over the past nine years, the main discrepancies appear to be as follows:

(a) People in the age group 35-44 (both male and female) appear to be over represented.
(b) Elderly females (particularly those that are 65 and over) appear to be under represented.
(c) Young males (18-25) are under represented.

Comparisons of the socio-economic composition of the population and the sample are difficult as the Census only gives information on social class, whilst our surveys give information on household income. However, Table 4 does not suggest that there are any major discrepancies between the socio-economic composition of the sample and the population.

Table 5 shows the level of household car ownership for both the sample and the population. It should be noted that the mean household size for the population is 2.77 and for the sample is 2.82. If anything, one would expect that mean household size would have declined since 1981. This suggests that one person households are under-represented in our sample. Compared to the 1981 population, our sample indicates a massive increase in the number of cars owned so that there are an average of 1.37 cars per household. Of these 19.7% are company cars. In 1981, it is estimated that there were around 0.78 cars per household. Adjusting for the fact that our sample suggests that mean household size has also increased, this suggests that car ownership per head of population aged 18 and above has increased by around 73% since 1981. This seems likely to be an overstatement. Nationally, the number of private cars increased by 23% between 1981 and 1988 (Department of Transport, 1989A). This again reflects the under-representation of the young and the old in our sample and the corresponding over-representation of middle aged groups.

The rise in car ownership is reflected in the choice of mode for the journey to work. The 1981 Census indicated that around 52% of such trips were made by car, 27% by bus and 21% by other modes (principally walk, pedal- and motor-cycle). The results from our sample suggest that car's share has increased to 73%, whilst bus share has decreased to 16% and that of other modes to 11%. Our sample indicates that the mean occupancy per vehicle is 1.14 persons. Our sample also indicates that the number of people working has increased from 70,000 to almost 78,000. This is not implausible given the increased level of economic activity since 1981.

Altogether, for the journey to work our sample indicates that there has been a 56% increase in car trips and a 33% reduction in bus trips. Nationally, between 1981 and 1988 it has been estimated that for all journey purposes the use of car (measured in terms of passenger kms) has increased by 29% between 1981 and 1988 (DTp, 1989A) and that bus use (measured in terms of passenger journeys) decreased by 10% between 1982 and 1988/89 (DTp, 1989B). It is likely that these trends will be amplified in the dominantly suburban area that constitutes our population of interest but it seems likely that our sample has exaggerated these trends.

Table 3: Age-Sex Composition of Population and Sample (%)

Age:-		18-24	25-34	35-44	45-54	55-64	65+	TOTAL
Male	-P	7.4	9.7	8.3	7.9	7.5	7.6	48.4
	-S	5.0	8.4	12.0	7.0	8.2	8.9	49.5
Female	-P	7.1	9.5	8.2	7.8	7.7	11.2	51.5
	-S	7.3	9.3	13.4	6.3	6.8	7.2	50.3

P = Population
S = Sample

Table 4: Social Class/Income Level of Population and Sample (%)

	Social Class Managerial/ Professional	Skilled Non-Manual	Skilled Manual	Semi-Skilled/ Unskilled
Population	27.1	13.5	38.4	20.9

	Net Household Income (£pa)				
	<20k	20-15k	15-10k	10-5k	>5k
Sample	24.7	16.7	20.8	21.1	16.7

Table 5: Household Car Ownership (Grossing Factor = 33.19)

	Number of Cars per Household				(Total no. of households)
	0	1	2	3+	
Population	22,476 39.4%	26,918 47.1%	6,731 11.8%	966 1.7%	(57,091)
Sample	8,596 15.5%	24,062 43.3%	18,221 32.7%	4,678 8.4%	(55,560)

Table 6: Mode for the Journey to Work (Grossing Factor = 70.75)

	Bus	Car	Other	TOTAL
Population	18,800 26.8%	36,460 52.1%	14,770 21.2%	70,030
Sample	12,450 16.1%	56,810 73.1%	8,420 10.8%	77,680

Table 7: Mode for the Journey to Work to Central Nottingham (Grossing Factor = 70.75)

	Bus	Car	Other	TOTAL
Population	7,070 55.7%	5,200 40.9%	430 3.4%	12,700
Sample	6,510 24.7%	18,830 71.4%	1,030 3.9%	26,370

This point is re-emphasised by Table 7, which analyses the choice of mode for the journey to work to central Nottingham. For the population, the central area was defined as the Bridge and Park wards. For the sample the central area was defined by respondents. It is evident that this led to a liberal interpretation, which included much of the inner city, as well as the city centre. However, despite this it does appear that there has been an absolute decline in trips by bus and a large increase in trips by car.

2.4 Re-Weighting the Sample

The above analysis suggests that our sample has been affected by self-selectivity bias. In particular, it appears that car users are more inclined to respond than non car owners. This is not too surprising given that the main focus of our surveys is that of motorists' behaviour. An attempt to correct for this bias was made by re-weighting the sample so that its age-sex composition was identical to that of the total population given in Table 4. This only had a moderate effect in the expected direction, the percentage of non car owning households increased to 16.7%, the percentage of work trips made by bus increased to 17.3% and the mean number of cars per household decreased to 1.35.

An alternative scheme was based on re-weighting the sample so that the response rates were identical for each of the 28 wards. The justification for this was based on Table 1 which indicate that the lowest responses were from those wards closest to central Nottingham. These wards are likely to have relatively low levels of car ownership and high levels of bus usage.

Again, this approach only had a moderate effect, although greater than that of weights based on age-sex composition. The percentage of non car owning households increases to 17.2%, the percentage of work trips made by bus increases to 17.8% and the mean number of cars per household decreases to 1.31.

The use of weighting factors appears to reduce the impact of self-selectivity bias but only by a modest amount. However, a further adjustment may be made by incorporating the 64 questionnaires that were returned blank with comments to the effect that the member (or members) of the household were unable to make any trips. It may be assumed that these households are non car owners. If they are included in the data set, the percentage of non car owning households increases to 20.4%. Moreover, the total number of estimated work trips will be reduced to 74,880, and our estimates of the journey to work mode choice would become as shown by Table 8.

Table 8: Mode for the Journey to Work (revised) (Grossing Factor = 68.02)

	Bus	Car	Other	TOTAL
Population	18,800	36,460	14,770	70,030
	26.8	52.1	21.1	
Sample	13,330	52,940	8,610	74,880
	17.8	70.7	11.5	

Thus, our revised estimates indicate that there has been a 45% increase in the use of car for work trips and a 29% decrease in the use of bus since 1981. From this we estimate that our unadjusted results overstated car use by 7.3% and understated bus use by 6.6%. It is these revised figures that will be used as a basis for the forecasting results in section 4, although the models developed in the next section are based on unweighted responses.

3. MODEL DEVELOPMENT

In this section we shall develop a series of models that will predict travel behaviour in future periods. This section will consist of six parts. The first four parts analyse the Stated Preference (SP) data to assess the role of ordinary buses, park and ride, express buses and changing departure times. These models are based on binary logit and are estimated by maximum likelihood using the BLOGIT package (Crittle and Johnson, 1980). In a fifth sub-section, Transfer Price (TP) and Transfer Time (TT) data are used to estimate demand functions and values of time. This data is analysed using ordinary least squares regression using the Statistical Analysis System (SAS) package. Finally, in the sixth sub-section, an attempt will be made to draw together the, at times, disparate results.

3.1 Ordinary Bus SP Model

An initial model was developed based on a piecewise approach. This involved developing separate levels for each of the main attributes in the experiment. In this case the main attributes were:

(i) free-moving time in car (FTC)
(ii) delay time in car (DTC)
(iii) in-vehicle time in bus (IVTB)
(iv) bus fare (FARE)
(v) car petrol cost (PETROL)
(vi) car parking cost (PARK)

The aim of this approach was to determine if there were any thresholds at which attributes begin to have a greater effect on mode choice. Analysis of the values for FTC, IVTB, FARE and PARK suggested a linear relationship, whilst the values for PETROL were of the wrong sign. Only the value for DTC appeared to be non linear, in that the effect of a unit amount of delay at 20 minutes DTC appeared to be roughly double that of a unit amount of delay at 15 minutes DTC.

As a result, it was decided to develop a conventional linear additive model as shown by Table 9, Model 1. In models of this type the values are constant regardless of the levels of the variable, eg the unit value of DTC is the same for all levels of DTC.

The main features of Model 1 are that the ASC indicates a strong preference for car, all other things being equal, equivalent to 34 pence of bus fare. The value of DTC compared to FTC suggests that delay time is valued 69% higher than free time for car. Expressed in terms of parking charges, the value of delay time is 5.2 pence per minute and that of free time is 3.1 pence. The value of bus in-vehicle time is between these two values at 4.4 pence per minute (expressed in terms of bus fares). Model 1 also indicates that there is a high value for walking to/and from the car, equivalent to 7.5 pence per minute.

However, the value for walking to/and from the bus is much lower than we would have expected "a priori" and, moreover, is insignificant. In addition, the parameter value for petrol is of the wrong sign but, again, is insignificant. Furthermore, we were unable to include the effects of bus frequency as it was correlated with other variables. The result that petrol is perceived as having a value that is not significantly different from zero is not too suprising. It is well known that motorists underestimate the costs of travelling by car. The result for bus walk time is more difficult to explain but may again be due to misperceptions by motorists.

Further model runs were undertaken in an attempt to remove these problems. In model 2, the variable DTC is expressed in a piecewise manner with D15 representing a delay time of 15 minutes and D20 a delay time of 20 minutes, both compared to a base value of 10 minutes which is assumed to be valued as free moving time. Although this model results in a slight improvement in goodness of fit (as measured by both the rho-squared and percent right measures), the parameter values for the ASC and FTC become insignificant. Moreover, D15 and D20 have broadly similar values (0.145 and 0.110 per minute delay) suggesting that there is little support for a non linear expression for this variable when all other variables are expressed as being linear.

Models 1 and 2 are composed entirely of alternative specific variables. In model 3 a generic variable, COST is created. This consists of both parking and petrol costs for car and fare for bus. Although its parameter value is significant, its low value implies very high values of time; 12.1 pence per minute for DTC, 6.3 pence per minute for FTC and 14.3 pence for IVTB.

Lastly, in Model 4, the effect of non-traders is examined. These are respondents who consistently chose either car only or bus only in the eight SP experiments that were presented to them. There were 105 individual car non-traders and 20 bus non-traders. Compared to Model 1, the main features of this model are that the ASC is now insignificant, the values of DTC and FTC are higher, as is the value of WKB which becomes significant (although still less than the value of IVTB). By contrast, the values for PETROL and WKC become lower. Overall, the model only results in a moderate goodness of fit.

Table 9: Ordinary Bus SP Model (t-statistics in brackets)

	1	2	3	4
ASC-Car	0.357	0.0322	0.509	0.0754
	(2.056)	(0.163)	(3.041)	(0.355)
DTC	-0.0479	D15-0.724	-0.0462	-0.0706
	(-6.514)	(-6.217)	(-6.239)	(-7.685)
		D20-1.102		
		(-6.746)		
FTC	-0.0283	-0.0917	-0.0240	-0.0535
	(-3.554)	(-1.126)	(-3.055)	(-5.379)
IVTB	-0.0454	-0.0404	-0.0542	-0.0440
	(-7.244)	(-6.338)	(-9.585)	(-5.745)
WKC	-0.0691	-0.0707	-0.0724	-0.0320
	(-6.562)	(-6.659)	(-7.012)	(-2.040)
WKB	-0.0138	-0.0113	-0.0100	-0.0206
	(-1.548)	(-1.310)	(-1.177)	(-2.040)
PARK	-0.0092	-0.0092	COST-0.0038	-0.0049
	(-6.429)	(-6.442)	(-5.046)	(-2.827)
PETROL	0.0008	0.0007		0.0020
	(0.719)	(0.646)		(1.447)
FARE	-0.0104	-0.0107		-0.0141
	(-4.081)	(-4.133)		(-4.472)
Rho Squared	0.156	0.166	0.148	0.088
Percent Right	60.0	60.6	59.5	55.7
No of Obs	2847	2847	2847	1847
No of Indiv	424	424	424	299

Note:

ASC = Alternative Specific Constant
WKC = Walking Time for Car
WKB = Walking Time for Bus

3.2 Park and Ride SP Model

The starting point to this stage of model development was again the development of a piecewise model. However, none of the explanatory variables displayed plausible non-linearities (FARE and PETROL exhibited decreasing values). Therefore, a conventional linear additive model was developed as shown by Table 10, Model 1.

The main features of this model were as follows. There was a very large ASC in favour of car, equivalent to £1.70 of petrol or a parking charge of £0.50 per single trip (ie £1.00 for a round trip). The value for the parking cost parameter was 3.4 times that for the petrol cost parameter. The value for the park and ride fare (which covers parking and the ride on the bus) was between the two values, being 40% higher than the petrol cost parameter value. All other parameter values were insignificant, although at least the values of WKC and WKB seem reasonably plausible. By contrast, the value for IVTC is implausibly low, that of IVTPR is (in relation) implausibly high, whilst that of ACPR is of the wrong sign.

Further analysis indicated that the introduction of the ACPR variable had led to unforeseen correlations. In Model 2 these correlations were reduced by combining ACPR and IVTPR to produce a total in-vehicle time variable for park and ride. This was in turn combined with IVTC to produce the generic variable, TIME. However, the TIME parameter value remained insignificant and with an implausibly low value, whilst there was little change to all other parameter values.

In Model 3, the process of developing generic and combinational variables was taken a step further. MIVT is a generic variable consisting of IVTC and IVTPR. Similarly, ACWK consists of WKC and a combination of WKB and ACPR. COSTC is the parking and petrol costs of travelling by car. The ASC is dropped in this model as it was felt that its inclusion was overshadowing other effects. Some of the relationships in Model 3 seem sensible; ACWK is valued at 4.27 times that of MIVT (but this difference is not statistically significant). Park and ride FARE is valued as 75% greater than COSTC. However, MIVT still has an implausibly low value, whilst the poor performance of the model in general is reflected by the poor goodness of fit statistics.

In Model 4, non-traders are excluded from the calibration data set, consisting of 37 respondents who constantly chose car and 14 who constantly chose park and ride. This results in a much better model, as reflected by the rho squared and percent right statistics. However, the IVTC, ACPR, IVTPR and WKB parameter values are still insignificant, although the latter is only just so. Moreover, the value for IVTC is of the wrong sign.

Table 10: Park and Ride SP Models

	1	2	3	4
ASC-Car	1.430	1.231		0.733
	(3.428)	(4.196)		(1.345)
IVTC	-0.0065	TIME-0.0052	MIVT-0.0089	0.0038
	(-0.703)	(-0.596)	(-1.129)	(0.312)
ACPR	0.0103			-0.0278
	(0.619)			(-1.289)
IVTPR	-0.0476			-0.0317
	(-0.279)			(-1.371)
WKC	-0.0336	-0.0341	ACWK-0.0380	-0.0633
	(-1.562)	(-1.597)	(-3.790)	(-2.036)
WKB	-0.0475	-0.0457		-0.0970
	(-1.182)	(-1.141)		(-1.761)
FARE	-0.0118	-0.0113	-0.0241	-0.0218
	(-3.337)	(-3.289)	(-8.163)	(-4.367)
PETROL	-0.0084	-0.0087	COSTC-0.0138	-0.0166
	(-2.497)	(-2.709)	(-9.841)	(-3.494)
PARK	-0.0283	-0.0282		-0.0481
	(-12.887)	(-12.887)		(-14.462)
Rho squared	0.118	0.117	0.069	0.266
% right	57.8	57.1	54.5	66.4
No of obs	1318	1318	1318	910
No of indiv	203	203	203	152

Note:

ACPR = Access time by Car to Park and Ride site
IVTPR = In-Vehicle Time by Bus from Park and Ride site

3.3 Express Bus - SP Models

Yet again the starting point for this model was piecewise estimation but again few non linear effects were detected. The main non-linear effect appeared to be for IVTC, where a threshold of 30 minutes appeared to be important. This might be consistent with the delay time threshold of 20 minutes detected in 3.1. Attempts were made to incorporate this non linearity into a model that, in all other respects was linear additive, but the results were not encouraging.

Thus, emphasis was again placed on the development of straightforward linear additive models. The initial model is shown by Table 11, Model 1. This model indicates a very low value of IVTB (0.6 pence per minute, expressed in terms of FARE) but higher values for WKB (4.0 pence per minute) and FREQ (2.3 pence per minute). By contrast, the model indicates high values of IVTC (13.7 pence per minute if measured in terms of PETROL, 2.4 pence per minute if measured in terms of FARE) and even higher values of WKC (2.1 times IVTC). Parking costs are estimated to be valued at 2.8 times petrol costs. Perhaps, the most surprising result here is that there seems to be a strong preference for express bus, all other things being equal. This is indicated by the negative ASC for car which suggests that the preference for express bus is equivalent to a fare of 30.7 pence. This result is all the more surprising given the results in 3.1 and 3.2. The fact that the ASC favours bus and that the value of IVTB is low suggests that there may be some policy response bias in this experiment.

In model 2, the ASC is dropped but this leads to little improvement in the model. The parameter values for IVTB and PETROL remain insignificant and the discrepancy between the values for IVTC and IVTB widens.

In model 3, a generic variable IVT is created, combining IVTC and IVTB. This has a rather more plausible value of 2.05 pence per minute (expressed in terms of FARE). However, the effect of the ASC becomes stronger, being equivalent to 71.6 pence preference for express bus.

Lastly, in model 4, 49 car non-traders and 23 bus non-traders are dropped from the data set. Although the goodness of fit statistics appear reasonable, the ASC is still strongly in favour of bus and IVTC still has a much higher parameter value than IVTB. Furthermore, the IVTC parameter value now becomes greater than that for WKC whilst the value for PARK becomes insignificant and of the wrong sign. The parameter value for PETROL remains insignificant, although the value for IVTB has become significant.

Table 11: Express Bus SP Models

	1	2	3	4
ASC-Car	-0.741		-1.303	-2.370
	(-2.521)		(-5.271)	(-5.953)
IVTC	-0.0574	-0.0677	IVT -0.0388	-0.104
	(-5.815)	(-7.494)	(-4.750)	(-7.542)
IVTB	-0.0150	-0.0088		-0.0356
	(-1.399)	(-0.851)		(-2.553)
WKC	-0.120	-0.123	-0.126	-0.0519
	(-7.408)	(-7.679)	(-7.839)	(-2.450)
WKB	-0.0969	-0.0877	-0.0952	-0.155
	(-8.819)	(-8.450)	(-8.729)	(-10.513)
PARK	-0.0042	-0.0045	-0.0040	0.0015
	(-2.333)	(-2.506)	(-2.207)	(0.574)
PETROL	-0.0015	-0.0015	-0.0023	-0.0028
	(-0.960)	(-0.979)	(-1.547)	(-1.452)
FARE	-0.0241	-0.0226	-0.0189	-0.0370
	(-7.703)	(-7.408)	(-6.967)	(-8.324)
FREQ	-0.0483	-0.0387	-0.0484	-0.0773
	(-4.851)	(-4.229)	(-4.853)	(-6.171)
Rho Squared	0.129	0.126	0.124	0.193
% right	58.3	58.2	58.0	62.1
No of obs	1639	1639	1639	1063
No of indiv	229	229	229	157

FREQ = Frequency of express bus

3.4 Departure Time SP Model

The departure time experiment was the most successful of the four SP experiments and the results are shown by Table 12. Model 1 shows that car users value IVT at 3.8 pence per minute, expressed in terms of parking charges. Their valuation of departing early was linear and equivalent to 1.6 pence per minute. By contrast, departing late was valued in a non linear manner. Departing 30 minutes late was valued at around 0.8 pence per minute (although the result is not quite significant), but departing 60 minutes late was valued at 1.7 pence per minute.

Model 1 also includes an ASC which indicates that there is a small preference (equivalent to 3.6 pence) for departing as now, but the value of the ASC is not statistically significant. In Model 2, this ASC is dropped. The main change is that the LATE30 parameter variable becomes statistically significant.

Models 3 and 4 re-run Models 1 and 2, but with the 32 respondents who persistently choose to travel as now omitted from the data set. In model 3 it can be seen that the ASC is (just) significant, but now indicates a preference for varying departure time equivalent to 33.2 pence. Omission of the ASC (Model 4) results in the LATE30 variable becoming, once again, insignificant.

Table 12: Departure Time SP Models

	1	2	3	4
ASC-as now	0.0583		-0.639	
	(0.219)		(-1.972)	
EARLY	-0.0258	-0.0267	-0.0371	-0.0277
	(-5.172)	(-8.742)	(-6.349)	(-8.357)
LATE30	-0.385	-0.428	-0.733	-0.268
	(-1.513)	(-2.525)	(-2.324)	(-1.305)
LATE60	-1.643	-1.684	-2.237	-1.777
	(-6.630)	(-10.198)	(-7.471)	(-9.628)
IVT	-0.0614	-0.0605	-0.0729	-0.0836
	(-6.380)	(-7.056)	(-6.306)	(-8.233)
PARK	-0.0162	-0.0161	-0.0208	-0.0219
	(-8.192)	(-8.461)	(-8.782)	(-9.579)
Rho squared	0.102	0.102	0.212	0.210
% right	56.7	56.8	63.7	63.5
No of obs	1635	1635	1379	1379
No of indiv	206	206	174	174

3.5 Transfer Price and Transfer Time Models

A series of questions were posed to motorists which asked:

- what increase in your car journey costs would be just enough to make you travel by bus instead?
- what decrease in the bus fare would be just enough to make you travel by bus instead?
- what increase in your car journey time would be just enough to make you travel by bus instead?
- what decrease in bus journey time would be just enough to make you travel by car instead?

The first two questions are examples of Transfer Price (TP), the last two of Transfer Time (TT). A value of journey time can be obtained by dividing TP by TT. This gave the following results:

- value of car journey time increase 5.45 p/min (S.D. = 5.10, obs. = 386)
- value of bus journey time decrease 3.47p/min (S.D. = 4.25, obs = 312)

This suggests that car users are either

- more sensitive to car journey time increases than bus journey time decreases, and/or
- more sensitive to bus fare decreases than car journey cost increases

The TP and TT data also provides useful insights into the elasticity of car users to increases in car journey time and cost (ie direct or own elasticity) and to decreases in bus journey time and cost (ie cross elasticity). The resultant arc elasticities are presented in Tables 13 and 14. It should be noted that car journey time and costs and bus journey time were based on reported values but bus journey cost (ie fare) was based on engineering values.

Table 13 shows that car users are more sensitive to car cost increases than journey time increases up to the 30% increase mark. For increases beyond that, car users are more sensitive to increases in journey time than increases in cost. For both journey time and cost, the arc elasticity achieves its greatest absolute value for a 100% increase, although its value is two-thirds greater for journey time than cost. Doubling of times or costs, therefore, appears to be the most important threshold, although rounding error may be important here.

Table 14 shows that car users are more sensitive to decreases in bus journey time than decreases in bus fare (although, of course, it is debateable to what extent bus journey times can be decreased). The arc cross-elasticity reaches its greatest level for bus journey time decreases of 40% and bus fare decreases of 80%. At free bus fares, our figures indicate that around 69% of car users would continue using that mode for trips to central Nottingham.

A word of explanation is required on how non-traders are treated in Tables 13 and 14. Only around half of car users gave responses to the TP and TT questions. A small number (around 45) of those who had failed to give answers to the TP and TT questions had failed to give answers to other questions and were therefore excluded from the analysis. In addition, a small number of respondents (between 62 and 77) claimed that their best alternative was not bus but was either travelling by another mode (bicycle, motorcycle, walk) or not travelling at all. These individuals were also excluded from our analysis in Table 13 but included as non traders in Table 14. In addition, a number of respondents gave information on their TP and TT but did not give information on their actual journey times and costs. This particularly occurred for car cost. Again these individuals were excluded from the analysis.

Table 13: Estimates of the Elasticity of Car Users to Increases in Car Journey Time and Cost

Journey time	No. of swit-chers	Elasticity exc non traders	inc non traders	Journey cost	No. of swit-chers	Elasticity exc non traders	inc non traders
+10%	0	0	0	+10%	2	-0.05	-0.03
+20%	9	-0.10	-0.06	+20%	10	-0.12	-0.07
+30%	19	-0.14	-0.08	+30%	17	-0.14	-0.08
+40%	53	-0.29	-0.17	+40%	28	-0.17	-0.09
+50%	96	-0.42	-0.25	+50%	47	-0.23	-0.13
+60%	112	-0.41	-0.24	+60%	61	-0.25	-0.14
+70%	137	-0.43	-0.25	+70%	79	-0.28	-0.15
+80%	177	-0.48	-0.29	+80%	95	-0.29	-0.16
+90%	193	-0.47	-0.28	+90%	108	-0.30	-0.16
+100%	276	-0.60	-0.36	+100%	156	-0.39	-0.21
+125%	313	-0.55	-0.32	+125%	187	-0.37	-0.20
+150%	362	-0.53	-0.31	+150%	214	-0.35	-0.19
+175%	374	-0.47	-0.28	+175%	235	-0.33	-0.18
+200%	405	-0.44	-0.26	+200%	272	-0.34	-0.18
+250%	422	-0.37	-0.22	+250%	302	-0.30	-0.16
+300%	445	-0.32	-0.19	+300%	312	-0.26	-0.14
TOTALS		458	784[1]			403	742[2]

1. Car essential for work 102, car needed for other purposes 131, no alternative 93
2. Car essential for work 102, car needed for other purposes 143, no alternative 94.

However, it was evident that the vast majority of non responses to the TP and TT questions were due to a belief that there was no alternative to the car. Around 100 people required the car for work, up to 150 people needed the car of other purposes (such as carrying shopping, physically unable to use other forms of transport), whilst a further 100 or so did not believe the car was essential but did not have a viable alternative. In the short term, it may be assumed that these people will use their cars come what may. They are termed non traders and are estimated to make up around 40% of motorists.

Inclusion of non-traders reduces the absolute value of the arc elasticities to what may be deemed as more plausible values. Car's direct elasticities for time and cost are estimated to be within the range of 0 to -0.36 and -0.03 to -0.21 respectively. Car's cross elasticity with respect to bus journey time is estimated as being in the range 0.16 to 0.98 and with respect to bus fare in the range 0.08 to 0.33. These values may seem high but it should be remembered that this analysis is based on trips to central Nottingham, where bus is at its most competitive. Except for small reductions in bus fare, there is strong evidence for non zero cross elasticities.

Table 14: Estimates of the Elasticity of Car Users to Decreases in Bus Journey Time and Fare

Journey time	No. of swit-chers	Elasticity exc non traders	inc non traders	Fare	No. of swit-chers	Elasticity exc non traders	inc non traders
-10%	13	0.33	0.16	-10%	0	0	0
-20%	96	1.22	0.58	-20%	13	0.19	0.08
-30%	233	1.98	0.94	-30%	31	0.30	0.13
-40%	323	2.06	0.98	-40%	58	0.41	0.18
-50%	367	1.87	0.89	-50%	107	0.61	0.26
-60%	379	1.61	0.77	-60%	145	0.69	0.29
-70%	385	1.40	0.67	-70%	180	0.73	0.31
-80%	387	1.23	0.59	-80%	216	0.77	0.33
-90%	389	1.10	0.53	-90%	229	0.73	0.31
-100%	392	1.00	0.48	-100%	252	0.72	0.31
TOTAL		392	822[1]			350	821[2]

1. Car essential for work 105, car needed for other purposes 149, bus not an alternative 176
2. Car essential for work 110, car needed for other purposes 153, bus not an alternative 208

The elasticities we have discussed so far are arc elasticities. Some additional work has been carried out in which attempts have been made to model the demand function itself and hence determine point elasticities. Use was made of regression, using the Statistical Analysis System (SAS) computer package. Four functions were tested:

(i) A linear function which implies constant arc elasticities from a given point on the demand curve.
(ii) A log-linear function which implies constant point elasticities.
(iii) A semi-log (or exponential) function which implies that the point elasticity increases in direct proportion to the magnitude of change.
(iv) A quadratic function which implies that the point elasticity initially increases as the magnitude of change increases but then declines.

This work was exploratory in nature but indicated that forms (i) and (ii) were the least appropriate and forms (iii) and (iv) the most appropriate. The quadratic function appeared to give the best fit (with an R^2 between 0.84 and 0.98 and with very high t-statistics), although it performs poorly at the extremes (especially as the magnitude of change tends to zero). The analysis was carried out for traders only and the following point elasticities for a 20% change were estimated:

		(Adjust for non-traders)
• Increase in car journey time	-0.144	(-0.084)
• Increase in car journey cost	-0.055	(-0.030)
• Decrease in bus journey time	0.816	(0.389)
• Decrease in bus journey cost	0.188	(0.080)

These results suggest that for a 20% change, decreases in bus journey times and costs have a greater effect on behaviour than increases in car journey times and costs, even if the results are adjusted for non traders. In particular, motorists appear to be sensitive to bus journey time. However, given that a large element of this consists of walk and wait time, it is debateable whether large reductions can be achieved even if priority measures reduce in-vehicle time.

3.6 Putting it All Together

Our modelling work has produced a large amount of revealing information on travel choice but the results of our modelling exercises have at times been contradictory with each other and a priori expectations. In part, this is due to the SP experiments not being as successful as we had hoped. It was felt that this might be due to the split design adopted and, in particular, the different times and costs presented to those living in the inner and outer zones. However, development of separate models for these two zones failed to produce significant improvements. A more realistic explanation for the problems we have experienced may be related to respondents' lack of familiarity with the choice contexts we presented them. Thus, the park and ride experiment was the least successful because this is a choice that few travellers consider. There were also problems in that the park and ride service was not described in sufficient detail eg exact location of the site and the bus stops served in the central area. The departure time experiment was the most successful because this is the choice that most motorists are likely to consider.

Despite these concerns, in this section we shall attempt to put together our results in order to develop a series of strategic forecasting models. The most important results of our modelling exercise may be summarised as follows:

(i) From the ordinary bus SP experiment (Table 9, Model 1), it was found that bus in-vehicle time has a value of around 3.1 pence per minute, expressed in terms of fare. For car, it was found that delay time was valued two-thirds more highly than free time, with values of 5.2 and 3.1 pence per minute respectively, expressed in terms of parking costs. This is consistent with previous findings (Wardman, 1988). Similarly, car walk time was valued at 7.5 pence per minute. In this experiment, the constant indicated a preference for car equivalent to 34 pence of fare. The parameter value for fare was 13% greater than that for petrol.

The main failings of this model were the insignificant and, to some extent, implausible parameter values for petrol costs (although it is well known that motorists tend to misperceive this cost) and walk time for bus.

(ii) From the park and ride SP experiment (Table 10, Model 1) the main findings were that the parameter value for fare was 58% less than that for parking which was in turn 226% greater than that for petrol. This indicates that motorists are more sensitive to parking charges than petrol costs, confirming the results of the in-depth interviews. The other main finding was that there was a very large constant in favour of car, equivalent to £1.21. This is indicative of a considerable interchange penalty for park and ride.

However, with the exception of walk time for bus (valued at 4 pence per minute) this model failed to produce plausible parameter values for the time variables. This was probably due to the dominance of the cost variables and the constant and presumably stems from the unfamiliarity of respondents to this choice context.

(iii) From the express bus SP experiment (Table 11, Model 1) it was found that the value of walk time for bus was 4 pence per minute (ie consistent with (ii) above). It was also found that the parking cost parameter value was 180% greater than that of petrol (again consistent with (ii) above) but the fare parameter value was, in turn, 470% greater than that for parking costs. Our experiments, therefore, failed to determine a consistent relationship between the values of bus fares and parking charges. However, if expressed in terms of fare, this experiment did produce plausible values for car in-vehicle time and walk time, at 2.4 pence and 5.0 pence per minute respectively. The value for bus frequency was also plausible at 2.3 pence per minute. The value of the constant indicated a preference for express bus equivalent to 31 pence. This reinforces the views expressed in the in-depth interviews that bus can only compete with the car if its quality is improved and its speed increased.

The main failings of the bus SP experiment was that the parameter value for in-vehicle time bus seemed implausibly low, even given the better quality vehicles being depicted in this experiment.

(iv) From the departure time SP experiment the main finding was that in-vehicle time for car was valued at 3.8 pence per minute (expressed in terms of parking costs). The values for departing early (1.6 pence per minute) and late (between 0.8 and 1.7 pence per minute) were considerably less than the value for car in-vehicle time. This confirms the in-depth interview findings that motorists are prepared to respond to worsening conditions by modifying their departure time.

(v) The main finding of the TP/TT experiments was a value of car journey time (including walk) of 5.5 pence per minute and for bus (including walk and wait time) of 3.5 pence per minute. The experiments also produced plausible values for direct and cross elasticities, particularly if the preponderance of non traders are taken into account.

From all the experiments, there was little evidence of significant thresholds but the TP/TT experiments were more successful in detecting non-linearities. Up to a certain limit, there does appear to be a cumulative (or snowballing) effect in that, for example, a 40% deterioration in conditions has a much greater proportionate effect than a 20% deterioration.

In order to develop strategic forecasting methods it was decided to transfer plausible parameter values from one SP model to another. However, this would have an effect on the constant term, ASC. To estimate this effect BLOGIT was used to restrict all parameter values, other than the constant, to pre-set values. In the main, these were based on the previously estimated values, with the following exceptions.

(i) In the ordinary bus SP model, bus walk time was given a value of 4 pence per minute (expressed in terms of fare) so as to be consistent with the park and ride and express bus SP experiments. Similarly, the absolute value of the petrol cost parameter was set at one third that of the parking cost parameter value.

(ii) In the park and ride SP model, car in-vehicle time was given a value of in-vehicle time of 3 pence per minute (expressed in terms of fare) so as to be consistent with the values found in the ordinary and express bus experiments. It was assumed that access time by car to park and ride has the same value as car in-vehicle time. Also based on the evidence from the ordinary and express bus experiments, it was assumed that car walk time had a parameter value double that of car in-vehicle time. Lastly, it was assumed that park and ride in-vehicle time was the same as the value of bus in-vehicle time derived from the TP/TT experiment. Assuming bus walk and wait time is valued at 4 pence per minute, it was estimated that bus in-vehicle time's value should be around 3.1 pence per minute in order to be consistent with an overall bus journey time value of 3.5 pence per minute.

(iii) In the express bus SP model it was also assumed that bus in-vehicle time was valued as for ordinary bus (ie 3.1 pence per minute).

(iv) The departure time model was based on Table 12, Model 2.

The resultant models used for forecasting are shown by Table 15. In Model 1, the ASC indicates a slightly reduced preference for car equivalent to 27 pence. Similarly, Model 2's ASC shows a reduced preference for car, being equivalent to £1.05. By contrast, Model 3's ASC indicates a much stronger preference for express bus, equivalent to 82 pence.

Table 15: Strategic Forecasting Models

	Ordinary Bus Model 1		Park and Ride Model 2		Express Bus Model 3		Departure Time Model 4
ASC-Car	0.283	ASC-Car	1.244	ASC-Car	-1.982		
	(6.701)		(20.622)		(-36.093)		
DTC	-0.0479	IVTC	-0.0354*	IVTC	-0.0574	EARLY	-0.0267
FTC	-0.0283	ACC	-0.0354*	IVTB	-0.0747	LATE	-0.428
IVTB	-0.0454	IVTPR	-0.0366*	WKC	-0.120	LATE60	-1.684
WKC	-0.0691	WKC	-0.0708*	WKB	-0.0969	IVTC	-0.0605
WKB	-0.0416*	WKB	-0.0475	PARK	-0.0042	PARK	-0.0161
PETROL	-0.0031*	FARE	-0.0118	PETROL	-0.0015		
PARK	-0.0092	PETROL	-0.0084	FARE	-0.0241		
FARE	-0.0104	PARK	-0.0283	FREQ	-0.0483		
Rho Squared	0.151		0.109		0.109		0.102
% Right	60.1		57.7		58.4		56.8

* Indicates transferred parameter value

4. FORECASTS

In this section we go on to apply the strategic forecasting models developed in the previous section to examine future changes. Firstly, we examine the models' abilities in explaining the base situation. Secondly, the demand for bus based park and ride is examined. Thirdly, the effect of dramatic increases in car traffic and congestion is examined using 2001 as a future reference year. Fourthly, the effect of doubling parking and/or petrol costs is examined. Fifthly, the effect of reducing bus journey times, both for existing buses and through the development of an urban express bus network, is examined.

A number of technical difficulties arise in this section. Firstly, our base forecasts are not totally accurate in replicating the existing situation. In order to get round this, our predictions examine changes relative to the forecast base situation, ie we adopt an incremental type approach. Secondly, our analysis is static in that we only look at first round effects. In other words, we concentrate on the short run effects of our five scenarios, ie the possible effect on travel tomorrow. Clearly, this is not appropriate for one of our options, namely the effect of congestion in 2001. Thirdly, there is the problem of dealing with non-traders. The strategic models that we developed in Table 15 included non-traders, defined on the basis of responses to the SP experiment, and hence in most of our subsequent work we have not made any further amendments. If, however, we classify respondents who only give time and cost information for one mode as non-traders, our results could exhibit important changes. Of course, there is also the issue of whether non-traders in the short term will remain so in the long term.

4.1 The Base Situation

The base situation choice between bus and car is examined by Table 16A for all four SP experiments. 1263 out of 1720 (73.4%) respondents gave details of a recent trip to central Nottingham. Of these, 760 were people who gave details for both car and bus travel and therefore gave sufficient information to be included in the forecasting stage. The remainder might be considered as non-traders, with 113 only giving details for bus and 390 only giving details for car. In our forecasting data set, only 11.6% chose bus, but if non-traders are taken into account bus's share increases to 15.9%. Bus's market share is noticeably greater in the North and North West corridors than the South and East corridors. This may be explained by differences in car ownership and bus's level of service. Overall, it is estimated that on an average day (Monday to Saturday) around 67,000 trips are made into central Nottingham by bus and car from the four corridors studied.

The ordinary bus SP model (strategic model 1) was used to forecast the base bus share of the market. Two forms of forecast were produced:

(a) The deterministic forecast (DF) where bus is only chosen if its generalised cost is less than that of car.
(b) The probabilistic forecast (PF) is the sum of the probabilities of each individual choosing bus, calculated from the binary logit.

We might expect the actual market share to be between these two values. This is the case but the actual share is much closer to the DF than the PF. Use of the mean of the DF and PF would in this case overestimate bus demand by 59%. However, if non-traders are taken into account the overestimate is reduced to 25.9%.

The accuracy of strategic model 1 is further examined in Table 16B which is based on respondents to the ordinary bus SP experiment who gave time and cost information for bus and car. It can be seen that in this context the model is more accurate in that the mean value of the DF and PF only overestimates by 22%.

Table 16A: The Base Situation: All Experiments

	Bus market share				NON-TRADERS		Bus
	Actual	DF	PF	Obs.	Bus	Car	Revised Share
N.West	0.119	0.097	0.238	139	26	73	0.179
North	0.170	0.123	0.282	163	36	99	0.214
South	0.087	0.077	0.270	262	23	121	0.112
East	0.100	0.114	0.289	186	23	92	0.138
TOTAL[1]	0.116	0.101	0.267	760	113	390	0.159

1. Includes observations whose geographical location could not be identified.

Table 16B: The Base Situation: Ordinary Bus Experiment Only

	Bus market share Actual	DF	PF	Obs.
N.West	0.028	0.122	0.216	40
North	0.329	0.071	0.246	35
South	0.102	0.073	0.271	41
East	0.138	0.073	0.271	41
TOTAL	0.135	0.086	0.244	193

4.2 Park and Ride

In this section, strategic model 2 is applied to forecast the demand for bus based park and ride at five sites:

(i) The Forest
(ii) Queen's Drive
(iii) Daleside Road
(iv) Southglade Drive
(v) Wilkinson Street.

Access time to the park and ride site was derived from the questionnaire. Bus in-vehicle time was derived from Nottingham City Transport's timetables. Bus walk time was based on existing bus egress time, again derived from the questionnaire. It was assumed that the park and ride charge was based on the equivalent bus fare (ie the parking element is effectively free). It is assumed that each park and ride site is serviced by a bus service that departs at five minute intervals.

Initial results are shown by Table 17 it is clear that, despite a very attractive standard of service park and ride fails to capture more than 25% of those travellers that are prepared to trade between car and park and ride. An exception was provided by the North West corridor but further examination suggested that the majority of park and ride users in the sample for this corridor were abstracted from bus. Not too much should be read into this, it is probably a quirk of the small sample size. 38% of park and ride users were estimated to be commuters and 62% were estimated to be shoppers and leisure travellers. However, this result may also be affected by our small sample size.

Table 17: The Demand for Park and Ride

	ALL USERS			OF WHICH	
	DF	PF	Obs.	% from car	% from bus
N.West	0.444	0.489	16	38.7	61.3
North	0.166	0.284	23	100.0	-
South	0.183	0.288	54	100.0	-
East	0.024	0.148	33	100.0	-
TOTAL	0.193	0.292	126	76.6	23.4

Table 18: Estimates of Usage of Park and Ride Sites on an Average Weekday

	Forest	Queens Drive	Dale-side Road	Wilkin-son Street	TOTAL	Expansion Factor
N.West	380	60	-	80	520	86.7
North	100	-	-	20	120	40.0
South	-	320	20	-	340	62.4
East	-	-	60	-	60	38.4
TOTAL	480	380	80	100	1040	

NB Forecasts based on mean of DF and PF and figures rounded to nearest 10

It should, therefore, be made clear that here, and elsewhere, the results for specific corridors should be treated with caution given the small numbers of observations involved.

In Table 18, the results of Table 17 are transformed into an estimate of the mean daily usage (Monday to Saturday) of four of the park and ride sites. Southglade Drive was excluded from the analysis because although it was mentioned as a possibility by 4.6% of potential park and ride users, it was not the most preferred site for any of the respondents in our sample.

The daily usage figures were obtained by weighting responses by frequency of travel. The results were then expanded so as to give estimates of the total demand for the four corridors. The zoning system used is shown by Figure 1. It should be made clear that the population of inner Nottingham (broadly defined by the Ring Road and the River Trent) and of the Western part of the built-up area was not included. It was estimated that the total population of the four corridors studied was 462,000 whilst that of the study area was around 693,000. It should be evident that our results are heavily dependent on the expansion factors used and these are, in turn, dependent on the definition of zones.

Overall, it is estimated that the four park and ride sites would be used by around 1,000 people (including car passengers) on an average weekday. This compares with the 870 or so people who currently use the park and ride service provided at the Forest and Queens Drive on an average weekday. It should be noted that in computing our forecasts, we have been unable to take fully into account seasonality. We would though expect usage during the pre-Christmas period to be substantially above our average weekday prediction, whilst we would expect usage during the summer period to be below. It should also be noted that our park and ride estimates are only based on a mean occupancy of 1.1 per vehicle whereas the County Council estimates that the mean occupancy of vehicles currently using park and ride is 2.21. If, however, we assume that all those passengers travelling with a car driver also switch to park and ride our estimated mean occupancy per vehicle becomes 1.7 and our total estimate of demand for park and ride needs to be increased by 56%. The two most important park and ride sites would be the Forest (46% of park and ride demand) and Queens Drive (37%) whilst the two most important corridors affected would be the North West (50%) and the South (33%).

However, it should also be borne in mind that our coverage is only partial. Surveys carried out by the County Council in autumn 1989 suggested that around 42% of park and ride users at the Forest and Queens Drive came from beyond our survey areas. This might suggest that park and ride usage in our base situation might be around the 1,800 mark on an average weekday or around 2,800 if the adjustment for car occupancy is made. Furthermore, we have limited our analysis to bus-served park and ride sites. Our earlier work has indicated that over 1,000 people a day might make use of park and ride facilities at Babbington and Hucknall, related to the proposed LRT scheme (Preston and Wardman, 1989). In addition, a similar number of people were forecast to make use of park and ride at up to 11 sites on the proposed Robin Hood rail service, with the sites at Mansfield and Hucknall being the most used (Preston, 1989).

4.3 The Effect of Increased Congestion

In this section the effect of increased congestion is examined, by using the predicted vehicle speeds for the year 2001 provided by the County Council and shown in Table 19.

Table 19: Average Vehicle Speeds for Major Radial Routes in Greater Nottingham (mph)

Time period:	1989	2001
0700-0730	27	15
0730-0930	14	6
0930-1000	27	15
1000-1530	32	20
1530-1600	27	15
1600-1800	14	6
1800-1830	27	15
1830-0700	32	≥20

Source: Correspondence with County Council (28/02/90)

If these decreases in speed are applied to our data set we predict that mean car in-vehicle time increases from 14.7 to 27.0 minutes (up 84%) for those using car and from 16.9 to 31.7 minutes (up 88%) for those for whom car is the best alternative.

In Table 20, column B, the effect of these increased delays on bus usage is assessed using strategic model 1. It can be seen that bus usage is forecast to increase from a share of 0.184 to a share of 0.382 (ie up 105%) assuming that bus services are unaffected by delays. However, this result is difficult to interpret in that we would expect that between 1990 and 2001 car usage would grow substantially and that some of this would be at the expense of bus. For example, between 1985 and 1989 car usage in Nottingham was estimated to have grown by 18%. This is equivalent to 3.4% growth per annum. If this trend continued, it might be expected that car usage would increase by 44% between 1990 and 2001. Nationally, there has been a secular downward trend in bus usage estimated to be equivalent to 1.5% per annum. If this applied locally, bus usage might be expected to decline by 15%. Taking the total figure from column A of Table 20, this would mean that assuming a growing travel market (ie a variable trip matrix):

Bus usage declining from 0.184 to 0.126 units
Car usage increasing from 0.816 to 1.175 units.

This suggests that only a small amount of increased car usage (around 8%) would be due to switching from bus. The vast amount of this increase would be due to generated travel, although this result is dependent on our estimates of bus's share of the market being correct. Overall, travel demand might be expected to increase by 30%.

One interpretation might be that, de facto, much of this excess demand is catered for by bus. That is out of a total demand of 1.301 units:

Bus share is 30% (0.382/1.301)
Car share is 70% (0.919/1.301)

In other words, the increase in car usage is constrained to be around 12% (ie 0.919/0.816). However, this analysis is static. In reality, this less than expected growth in car use would lead to less than excepted increases in congestion which would in turn encourage greater car use and hence greater congestion. The processes by which traffic reaches equilibrium levels and speeds under conditions of capacity constraint require further study before they can be properly understood.

However, in Figure 2, we have attempted to assess the possible effects of re-congestion. Assuming that the change in car journey times is equivalent to 1.95 times the change in car traffic for each time period (derived from Table 19), we have been able to derive a cobweb equilibrium model. This was produced by re-running strategic model 1 a number of times. After 10 iterations a new equilibrium emerges that predicts that by the year 2001 car traffic will have increased by around a quarter and that car journey times will have gone up around one third.

The results from Figure 2 assume that bus journey times have been maintained at their 1990 levels without any restrictions on existing road space. This would clearly require the provision of new dedicated bus lanes and is tantamount to an increase in road capacity. This is why the supply curve in Figure 2 is depicted as shifting downwards from S_1 to S_2. A given level of car traffic can be more easily handled by the new system as reflected by the reduced journey time.

If it is assumed that buses are affected by congestion in a similar way to cars then our analysis changes dramatically. Analysis suggests that bus share of the travel market would decrease to only 7.5% (0.097/1.301) and that car traffic is estimated as having increased by 47.5% (1.204/0.816). Although we have no firm evidence of thresholds, the analysis presented in Table 13 did suggest that doubling of car journey times did represent a possible threshold at which demand for car travel might stagnate. Assuming a growth of car traffic of around 3.4% per annum this would be achieved in the year 2003. If a low growth of 1.6% is applied the corresponding year is 2017. If however, bus speeds could be maintained at current levels this threshold would not be achieved until around the year 2011 (high growth) and the year 2037 (low growth).

We are aware that major developments at 15 sites throughout the Greater Nottingham area are likely to lead to major increases in employment, estimated to involve up to 16,000 jobs. Of these 11,200 would be within the City of Nottingham itself, representing a 6.3% increase on estimated 1990 employment levels within the city (189,000 jobs). Assuming the same increase in car usage, this increase is equivalent to up to two years of high traffic growth and four years of low traffic growth, and would correspondingly bring forward the threshold years estimated in the previous paragraph. Our analysis has necessarily focused on a city wide scale. Over half of these new jobs would be concentrated in the central area and may lead to greater congestion problems. However, analysis of such problems would require detailed micro-scale traffic studies.

In Table 21, column B, the effect of increased delays for car on the demand for park and ride is assessed. Again it is assumed that the park and ride service is unaffected by delays. The results suggest that park and ride demand might increase by 35%. However, this figure does not take into account the effect of increased car usage by the year 2001. Given that (from Table 17) around 77% of park and ride demand is from people who would otherwise use their cars and that in unconstrained conditions car usage might go up by 44% and bus usage down by 15%, we estimate that the potential park and ride market would increase by around 30%. In this case the unadjusted total number of park and ride users from the surveyed areas might be expected to be over 1800; that is an increase of 75% on the base situation. In other words, park and ride might be expected to grow faster than car use in general but not in such a way that it had a dramatic constraining effect on car use.

Table 22 goes on to examine the possible effects of increased delays on departure time. This was done by examining whether, given the congestion levels that are forecast to occur in 2001, travelling 30 or 60 minutes earlier would be preferred to travelling at the same time as now. It should though be noted that 140 out of the 249 respondents (56%) included in these forecasts had fixed arrival times and therefore could, to some extent, be considered as non-traders, particularly as far as the departing later options are concerned. Moreover, it is apparent that our base forecasts do not accurately predict that all respondents travel "as now". This reflects the difficulties faced in applying a logit model to an extreme situation in which everybody chooses one option relative to another even though the utility difference between the two options is only quite small. The results from Table 22 suggest that the scope for modifying departure times by either 30 or 60 minutes is fairly limited, although 20% of those travelling "as now" may switch to travelling earlier by 30 minutes, and this represents nearly half of those who are unconstrained by fixed arrival times. Also, there does seem to be a preference for travelling earlier rather than later.

Table 20: The Demand for Travel by Bus: Sensitivity Analysis

	A Base	B 2001 Delays	C Petrol costs doubled	D Parking costs doubled	E Parking costs up £2
N.West	0.168	0.355	0.251	0.210	0.616
North	0.172	0.403	0.279	0.258	0.607
South	0.174	0.373	0.263	0.228	0.545
East	0.202	0.411	0.296	0.260	0.538
TOTAL	0.184	0.382	0.270	0.236	0.569

Forecasts based on mean of PF and DF

Table 21: Park and Ride Usage: Future Trends

	A Base	B 2001 Delays	C Petrol cost doubled	D Parking doubled	E Parking costs up £2
N.West	520	660	660	800	1220
North	120	120	160	160	480
South	340	440	440	480	940
East	60	180	100	80	600
TOTAL	1040	1400	1360	1520	3240

Forecasts based on mean of PF and DF

Table 22: Departure Time - Proportion Travelling "As Now"

	Base	2001 Alternative 30 mins earlier	DELAYS 60 mins earlier	30 mins later	60 mins later	Obs.
N.West	0.793	0.692	0.710	0.725	0.754	42
North	0.803	0.635	0.688	0.659	0.742	65
South	0.803	0.633	0.661	0.659	0.724	72
East	0.786	0.589	0.613	0.604	0.692	69

TOTAL	0.796	0.633	0.664	0.657	0.726	249

Forecasts based on mean of PF and DF

4.4 The Effect of Increased Petrol Costs

We have also been able to examine the effect of increased petrol costs on travel demand. Table 20, column C, shows that if petrol costs doubled we would expect bus's market share to increase from 0.184 to 0.270 ie up 47%. By definition this means that car's market share would decline from 0.816 to 0.730 ie down 10.5%. This implies a petrol price elasticity of around -0.1, which is consistent with existing empirical evidence.

In Table 21, column C, the effect of increased petrol costs on park and ride demand is estimated. From our four corridors it is estimated that park and ride demand would increase from 1040 to 1360 users per day, ie an increase of 31%. Hence, park and ride usage is forecast to increase but not at as great a rate as bus travel in general.

It is assumed that increased petrol costs would have little effect on departure time.

4.5 The Effect of Increased Parking Costs

The effect of doubling parking charges was also examined. Table 20, column D, shows that this was forecast to cause bus's market share to increase to 0.236 (ie up 28%) whilst car's share would decrease to 0.764 (ie down 6%). This result seems contrary to our evidence from the models developed in section 3 that motorists are more sensitive to parking costs than petrol costs. The reason for this is the large number of motorists with zero parking costs (678 out of 1084 for all motorists, 400 out of 704 for motorists who are prepared to consider bus).

As a result, in column E of Table 20 we estimated the effect of an increase in parking charges for all motorists of £2.00 per round trip. This led to dramatic changes. Bus's market share was estimated to increase to 0.569 (up 209%) whilst car's market share decreases to 0.431 (down 53%). The implied mean increase in car parking costs is from 36.4 pence to 136.4 pence (ie up 275%). This implies a parking cost elasticity of around -0.19.

Table 21 examines the effect of increasing parking charges for private motorists on the demand for park and ride, the costs of which remain unchanged. Column D shows that doubling parking charges leads to a 35% increase in park and ride demand, whilst column E shows that increasing parking costs by £2 per round trip leads to a 212% increase in park and ride demand. The percentage of park and ride users who are commuters is predicted to increase from 38% in the base to 44%. This is indicative of the fact that it is commuters who most often have access to free private parking. It does appear that park and ride demand is more sensitive to parking charge increases than bus travel in general and that, for the service to really take-off, draconian increases in central area parking charges may be required. The implication of such increases on the overall demand for travel to the central area and resultant relocation of economic activity, would, however, require detailed consideration.

We have not attempted to model the effect of parking charges on departure time, although clearly price discrimination on the basis of time will have an effect (ie relatively more expensive charges for cars parked during the peak hours).

4.6 The Effect of Reducing Bus Journey Times

In Table 23 we go on to examine the effect of increasing bus speeds. In Table 23A we apply strategic model 1 to assess the effect of reductions in bus in-vehicle time. A 10% reduction is estimated as causing bus's market share to increase from 0.184 to 0.204 (up 11%), whilst a 20% reduction leads to a bus market share of 0.223 (up 21%). This suggests an absolute bus direct elasticity in excess of unity. Car's cross elasticity with respect to bus in-vehicle time is estimated to be around -0.25. This is considerably less than the value estimated in Table 14 but it should be noted that Table 14 refers to total journey time not just in-vehicle time.

In Table 24B we go on to examine the effects of introducing a high quality express bus service by applying strategic model 3. Analysis of the base results shows a massive increase in bus usage due to the introduction of higher quality vehicles, with bus's usage increasing from a market share of 0.184 to a market share of 0.467, ie up 154%. However, the express bus service might be considered as a new mode and hence, to be consistent with our previous work, we should assume that non respondents are non users.

Overall, there were 1720 usable responses from 6016 questionnaires sent out. If we make the somewhat heroic assumption that for non respondents bus's market share was as for ordinary bus (0.184), we then estimate that the introduction of express bus increases bus's market share to 0.265, representing an increase of 44%. It seems evident that our express bus SP experiment is the one that has been most heavily affected by policy response bias. Market research has shown that the policy the public prefers for dealing with congestion is an improvement in public transport, even though this would appear to have little effect on motorists' behaviour (Hallett, 1990).

Table 23: The Effect of Reducing Bus Journey Times

(A) Ordinary Bus

	Base	10% reduction in IVT	20% reduction in IVT
N.West	0.168	0.193	0.208
North	0.172	0.221	0.242
South	0.174	0.192	0.212
East	0.202	0.217	0.238
TOTAL	0.184	0.204	0.223

Forecasts based on mean of PF and DF

(B) Express Bus

	Base	10% reduction in IVT	20% reduction in IVT
N.West	0.428	0.465	0.522
North	0.471	0.535	0.575
South	0.496	0.536	0.574
East	0.490	0.521	0.544
TOTAL	0.467	0.512	0.551

Forecasts based on mean of PF and DF

However, comparing the unadjusted market share figures in Table 23B highlights some interesting results. A 10% reduction in bus in-vehicle time leads to a bus market share of 0.512 (up almost 10%), whilst a 20% reduction leads to a bus market share of 0.551 (up 18%). These results give very similar estimates of bus's direct elasticity with respect to in-vehicle time to those of strategic model 1.

5. CONCLUSIONS

5.1 Background to this Report

5.1.1 Study Aims

The aim of this study was to assess the long term effect of increasing car use in Greater Nottingham given no major changes in the total supply of road space. In particular, it was hoped to identify the 'trigger point' or 'threshold level' of congestion which would act as a 'catalyst' in persuading motorists to change their behaviour. At the same time, a range of policies were to be examined and their ability to cater for increasing travel demand assessed. In particular, forecasts of the usage of bus-based park and ride at four sites were to be produced. The study ultimately consisted of three phases. Phase one involved a literature review and a small number (19) of in-depth interviews. Phase two drew on the finding of the in-depth interviews to develop a series of four Stated Preference (SP) experiments. Phase three drew the previous work together to give an assessment of the future level of travel demand in Greater Nottingham.

5.1.2 Previous Work (Phase One)

The in-depth interviews were reported in detail by Hopkinson (1990). It was found that the single factor most likely to affect people's travel behaviour was an increase in parking charges. Most people felt they would be able to cope with more traffic on the roads by adjusting their departure time. Improvements to existing bus services in terms of frequency and fares were unlikely to have a major impact on modal shares, although reductions in journey times would make the bus more attractive. Most people thought they were unlikely to use a park and ride service because the existing sites were too close to the city centre and/or they already had access to a good bus system.

The literature review showed these findings were consistent with those found elsewhere (Preston, 1990). Motorists responses to increasing congestion are more likely to be tactical (eg re-time the journey, choose a different route) than strategic (eg change mode). Attitudinal work carried out nationwide suggests that motorists are some way from their critical boundary but are, in many instances, close to what has been termed their comfortable boundary.

The literature review found that park and ride plays a relatively minor role in most cities but is increasing in importance. Park and ride appears to be most successful in historic cities such as Oxford where there are physical constraints on roadspace and parking provision in the central area. Elsewhere, bus-based park and ride tends to be temporary in nature and related to Christmas shopping. However, there have been a number of schemes that have been successfully extended to an all year round basis (eg Preston).

5.2 Study Results

5.2.1 Extent of Market Research (Phase Two)

As a result of the work carried out in phase one, four SP experiments were designed and piloted amongst the in-depth interviewees. These experiments focused on the choice between ordinary bus and car, express bus and car, bus based park and ride and car and the choice of departure time for car users. Over 6,000 self completion SP questionnaires were distributed at random to individuals in four corridors of the Greater Nottingham area. Over 1,700 usable responses were received, representing a response rate of around 29%.

Comparisons with the 1981 Census revealed some differences between the age-sex profile of the sample and the population from which the sample was drawn. More importantly, very large increases in car ownership (up 73%) and decreases in bus usage were detected. In part, this was due to the fact that car ownership had increased and bus usage had decreased but also reflected that car owners were over-represented in our sample. If the sample was re-weighted to reflect that the response rate was higher in wards with high car ownership, this problem was, to some extent, alleviated. However, unless more up to date information is available the extent of this self selectivity bias can never be properly assessed.

5.2.2 Development of SP Models

Although over 1,700 responses were received only just over 1,000 (62%) had completed the SP questions.

Four SP models were developed examining the choice between car and ordinary bus, car and bus based park and ride, car and express bus and between different departure times for car users.

The use of piecewise estimation techniques failed to highlight any important non-linearities. There was not much evidence of "thresholds" or "trigger points" existing in the SP data. Moreover, a number of problems were identified with the linear additive models that were developed, with the exception of the car departure time model.

In part, this may reflect the unfamiliarity for many of the respondents of the choice contexts presented to them. This may help explain why the departure time model was our "best" and the park and ride model our "worst" model.

A number of attempts were made to improve our SP models by excluding non traders, developing generic variables and segmenting the models by geographical area. None of these approaches produced the desired improvements in terms of totally plausible parameter values, although exclusion of non traders improved goodness of fit in most cases.

To some extent, relative failure in an exploratory project of this type was inevitable. One of the reasons for developing four different SP models was to avoid putting all our eggs in one basket. This diversification policy worked in that at least one of the four models gave a statistically significant and plausible estimate of the parameter values of the variables of interest.

By transferring parameter values, a series of strategic models were developed (Table 15). Expressed in terms of bus fare, they gave the following values of time:

- A value for car in-vehicle time of between 2.4 and 3.7 pence per minute. The value of time spent in a car that was being delayed was estimated to be 69% greater than for a car that was free moving.

- The value for car walk time was estimated as being between 5.0 and 6.6 pence per minute ie broadly double that of car in-vehicle time.

- Our best SP estimate of bus in-vehicle time was 4.4 pence per minute. This higher value than car might reflect the greater discomfort of travel by bus.

- Our best estimates of bus walk time were around 4 pence per minute.

- Based on evidence from the TP and TT experiments we estimated the value for total bus journey time to be 3.5 pence per minute. Assuming a value of 4 pence per minute for walking and waiting time, this implied a value for bus in-vehicle time of 3.1 pence per minute.

- The value for bus frequency was 2.0 pence per minute. Assuming random passenger arrivals, average wait time is half the headway and hence this result is consistent with a value of wait time of 4.0 pence per minute.

- We thus estimate that the value of bus out-of-vehicle time is only around 29% higher than that of bus in-vehicle time.

- For ordinary bus, the constant indicated a preference for car equivalent to 27 pence. For park and ride, this preference for car was equivalent to £1.05 pence. By contrast, for express bus there was a preference for bus equivalent to 82 pence (although we suspect this is affected by policy response bias).

In addition, there was evidence on the following:

- The (absolute) parameter value for parking costs was consistently higher than that for petrol costs by between 180 and 226%.

- There was no consistent relationship between the parameter values for parking cost and bus fare with the fare parameter value being between 470% greater and 58% less than that for parking cost.

- The departure time experiment gave the following values (this time expressed in terms of parking cost):

  - car in-vehicle time: 3.8 pence per minute
  - departing early: 1.6 pence per minute
  - departing 30 minutes late: 0.8 pence per minute
  - departing 60 minutes late: 1.7 pence per minute.

5.3 Results from Forecasts (Phase Three)

Overall, it was estimated that on an average day (Monday to Saturday) around 67,000 trips are made into central Nottingham by bus and car from the four corridors studied. This represents one trip per roughly seven inhabitants.

However, our forecasts are largely based on the results of applying the four strategic models to those respondents who gave information on travel by both bus and car.

Our base forecasts showed that strategic model 1 (ordinary bus) was reasonably accurate in replicating bus's market share in that the actual value fell between the probalistic (PF) and deterministic (DF) forecasts, although use of the mean of the PF and DF tended to overestimate bus usage by around 22%.

In our forecasting approach, we have implicitly adopted an incremental approach in that our forecasts of future scenarios examine the incremental change compared to our base forecasts. From these forecasts we draw the following conclusions concerning five policy scenarios.

5.3.1 Policy Scenario One: Introduction of Park and Ride

Assuming non respondents are non users, we estimate that extending park and ride provision from two to four sites, charging only for bus fares and increasing bus frequency to five minutes might at best lead to park and ride being used by around 2,800 people (including passengers) per day, of which around 1,600 might be from the four corridors we have studied. This compares with the 900 or so people who currently use park and ride at two sites. In the four corridors we have studied in detail, we estimate that bus-based park and ride might capture around 2% of trips to central Nottingham. Earlier work suggests that rail based park and ride serving the proposed LRT system and Robin Hood line might result in an additional 2,000 plus park and ride users on an average weekday. As such its role would seem to be fairly marginal.

We are wary of drawing too firm policy implications from our work, given our small sample sizes. However, our results would seem to suggest that it is worthwhile persevering with park and ride at both the Forest <u>and</u> Queen's Drive sites, which we estimate would cater for 83% of park and ride demand. We do not believe that there is much demand for a park and ride site at Southglade Drive. However, that might be because respondents do not know where it is. Our in-depth interviews indicated that improved publicity might increase usage of park and ride schemes. It may, though, be worth protecting sites in the Daleside Road and Wilkinson Street areas (particularly if the latter is affected by LRT), although there does not seem much scope for currently introducing a service.

Given the relatively low usage of a park and ride service with a five minute frequency, we do not see massive scope for major park and ride provision related to either existing or proposed rail services, with the exception of LRT. However, it was evident that small-scale parking improvements at existing stations, particularly on the Newark line, would be appreciated by some of our sample, whilst park and ride provision could be important on the Robin Hood line, particularly at Mansfield and Hucknall.

5.3.2 Policy Scenario Two: The Effect of Increased Congestion in the Year 2001

If congestion reduces car speeds on the main arterials in line with the projections made by the County Council and that, through the introduction of bus lanes, bus priority measures etc, bus speeds could be maintained at current levels, then by the year 2001 we estimate that bus usage might double. However, this is against a backdrop of rising car usage, due largely to generated trips and, more importantly, generated mileage (as motorists make longer trips). We would expect car usage to have increased by around 12%, despite the increased use of buses. This is, however, solely a first round effect. The car speeds for the year 2001 are based on an assumed increase in car usage of around 44%. As a result of the second round effects of recongestion, we would expect the equilibrium figure for increased car usage, therefore, to be around 25%.

Our static analysis does though highlight an interesting point in that much of the increased demand for travel to central Nottingham is likely to be catered for by public transport. This suggests that under saturated road conditions it is the quality (and particularly) speed of the public transport network that determines the quality (and speed) of private transport and hence the overall level of demand. It has been argued that this situation has pertained in central London for a large number of years (Mogridge, 1990). Our forecasts do not quite predict London style congestion in Nottingham by the year 2001 but do predict a trend towards it even if existing public transport is dramatically improved (at least in relative terms). Without investment in some major transport improvement, London-style congestion in the early part of the next century is likely.

Our analysis has concentrated mainly on demand but it should be clear that our assumption that bus speeds are maintained at their 1990 levels whilst car speeds decrease has supply-side implications. If bus and car speeds both decrease at similar rates (ie no increase in supply) and extrapolating from our forecasts between 1990 and 2001, we would predict that car traffic would reach a saturation level (at least in the peak periods) somewhere between the years 2003 and 2017 (mid point 2010). If, however, a policy of maintaining bus speeds at their current levels was undertaken saturation is not forecast to be achieved until somewhere between the years 2011 and 2037 (mid point 2024). The "catalyst" year in which the demand for car travel stabilises thus appears to be someway off. The major new developments proposed in the Greater Nottingham area do little to modify this conclusion, bringing the catalyst year forward by, at most, four years.

Despite improvements in public transport, we still predict that car usage would increase. This is, in part, because motorists can re-act to congestion by re-timing their journey. For example, we estimate that up to 20% of motorists could re-act to congestion in the year 2001 by travelling 30 minutes earlier.

Increasing road congestion might result in around a 75% increase in park and ride demand by the year 2001. It is, however, unlikely that this, on its own, would make extending park and ride to the two additional sites viable.

5.3.3 Scenario Three: Increasing Petrol Costs

We estimate that doubling petrol costs would lead to around a 50% increase in bus usage and around a 10% decrease in car usage. Such a result is consistent with a petrol price elasticity of -0.1.

Such an increase in petrol costs is estimated to lead to around a 30% increase in park and ride usage. This is again probably below the threshold level for the service to take-off.

5.3.4 Scenario Four: Increasing Parking Costs

Doubling car parking costs is predicted as leading to around a 30% increase in bus usage but only a 6% reduction in car usage, implying an elasticity of -0.06. This low elasticity is due to the fact that over 60% of motorists do not incur any parking charges.

Doubling car parking charges is estimated to have a greater effect on park and ride demand, which increases by 35% but this again seems likely to be below the product take-off threshold.

As an alternative, the impact of an across the board increase in parking costs by £2 (or £1 per single trip) was examined. This might be thought of as being similar to road pricing; in effect motorists are being charged £2 to enter the central area. This led to dramatic changes; bus usage was forecast to increase three-fold and car usage was predicted to decrease by more than half. The implied parking cost elasticity was around -0.2.

The effect on park and ride was even more dramatic with estimated usage from the four corridors at each of the sites as follows:

	(unadjusted)	(adjusted for car occupancy)
• Forest	1,290	2,010
• Queen's Drive	1,020	1,590
• Daleside Road	660	1,030
• Wilkinson Street	270	420

Under this scenario, a park and ride site serving the eastern corridor probably becomes feasible and the case for Wilkinson Street becomes border line. The four sites are, at best, estimated as catering for around 5,000 users per day, or over 7% of demand for travel to central Nottingham from the four corridors studied.

5.3.5 Scenario Five: Reducing Bus In-Vehicle Time

Using the ordinary bus model, it was estimated that a 10% reduction in bus in-vehicle time would lead to an 11% increase in bus usage and a 2.5% decrease in car usage. This is equivalent to a bus in-vehicle time elasticity of -1.0 and a car cross elasticity with respect to bus in-vehicle time of 0.25.

Assuming non respondents are non users, application of the express bus model suggested that improved quality of vehicles and marketing could increase bus patronage by 44% but we suspect that this value is affected by policy response bias or possibly a misperception of bus in-vehicle time. Nonetheless, it does illustrate the possible role of quality improvements on the demand for public transport.

A 10% reduction in express bus in-vehicle is estimated to lead to around a 10% increase in bus usage which is again indicative of an elasticity of -1.0 but, because of different market shares, the cross elasticity of car with respect to bus in-vehicle time is higher (at around 0.37 if the assumption of non respondents being non users is applied).

5.4 Overall Conclusions

Any conclusions we draw are affected by a number of caveats; including:

(a) The relatively small size of our sample.
(b) The relatively low statistical significance and poor goodness of fit of some of our models.
(c) Lack of up to date information on current population levels, car ownership and, most importantly, trip patterns. This has made validating our results difficult.

The main result of these caveats is that very broad confidence intervals ought to be attached to the forecasts produced in this report. Unfortunately, given the lack of data on current travel behaviour, we have been unable to statistically estimate such confidence intervals. However, we take some encouragement from the fact that our base park and ride forecasts (derived from, statistically, our "worst" model) were broadly consistent with current park and ride demand. Moreover, the level of park and ride demand predicted if a £2 flat rate parking charge increase was introduced was broadly consistent with the level of existing usage prior to Christmas. With the exception of the express bus model (where there seemed to be a bias in favour of bus), we do not believe that our forecasts are seriously biased even though we suspect that car users and car owners are over-represented in our sample.

Nonetheless, the SP models have provided a number of useful insights of which the most important are probably that:

(a) Car delay time is valued more highly than car free time.
(b) Car parking costs are valued more highly than petrol costs.
(c) Departing up to an hour earlier or later is valued, on a per minute basis, at less than car in-vehicle time.

Our forecasts provide a number of interesting results of which the following might be seen as the most important:

(a) Increasing congestion as a result of increasing (absolute) car use will continue to be a feature in Nottingham beyond the year 2001.

(b) Large increases in petrol costs and existing parking charges will have little effect on car usage.

(c) Car users are very reluctant to give up using their cars. This is related to a number of factors including the need of the use of the car for work and other purpose, employer financing of motoring and the ability of a substantial number of motorists to re-adjust their departure times. The first response of motorists to congestion is likely to be re-timing their journey. This would help explain the phenomenon of peak spreading currently being observed in Nottingham.

(d) If motorists are to switch to public transport, the main carrot would seem to be increases in speed and, possibly, comfort/image improvements, rather than reductions in price. However, the capital cost implications of an extensive system of bus lanes and priorities need to be considered. Allowing other multi-occupancy vehicles to use bus lanes might be worthy of consideration.

(e) The main stick would seem to be an across the board increase in parking charges or some form of road pricing. However, the effect of this on overall travel to the central area needs to be considered ie we need to take into account trip generation and distribution as well as mode choice.

(f) The role for park and ride in alleviating congestion is relatively marginal but could cater for up to 7% of travel into Nottingham. It is worth pursuing provided it is part of an overall traffic management package. In particular, strict central area parking controls are required although, given the importance of private parking spaces, it may be difficult to produce an effective policy.

(g) We have failed to detect any significant "thresholds" or "trigger points" which may act as catalysts affecting mode choice. There is though some evidence of a cumulative effect in that large changes in key policy variables have, up to a certain level, greater proportionate influence than smaller changes. For example, we believe that, given existing capacity, car traffic might reach saturation levels in Nottingham early in the next century.

Given the above, we believe a basket of policies ought to be adopted. In terms of improving public transport, the priority appears to be increasing speed and overall image. Clearly, this may be achieved by an LRT system but a network of express urban services with dedicated rights of way and priority at signals should also be investigated. Modest provision of park and ride facilities may play an important role at the margins, particularly if it is accompanied by other favourable policies. We estimate that it will be around twenty years or so before congetion has a major effect on restraining car user. A more effective policy would be to increase parking charges and/or reduce parking supply. However, we estimate that only around a half of central area parking is under public control. The treatment of private non-residential (PNR) parking is likely to be problematic. Even if PNR parking could be brought under public control, a tough parking policy would have to be implemented throughout the region and/or accompanied by strict planning controls, otherwise major local changes in land-use might be expected.

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FIGURE ONE: MAP OF SURVEYED AREAS

KEY — SURVEYED WARD

— CORRIDOR BOUNDARY

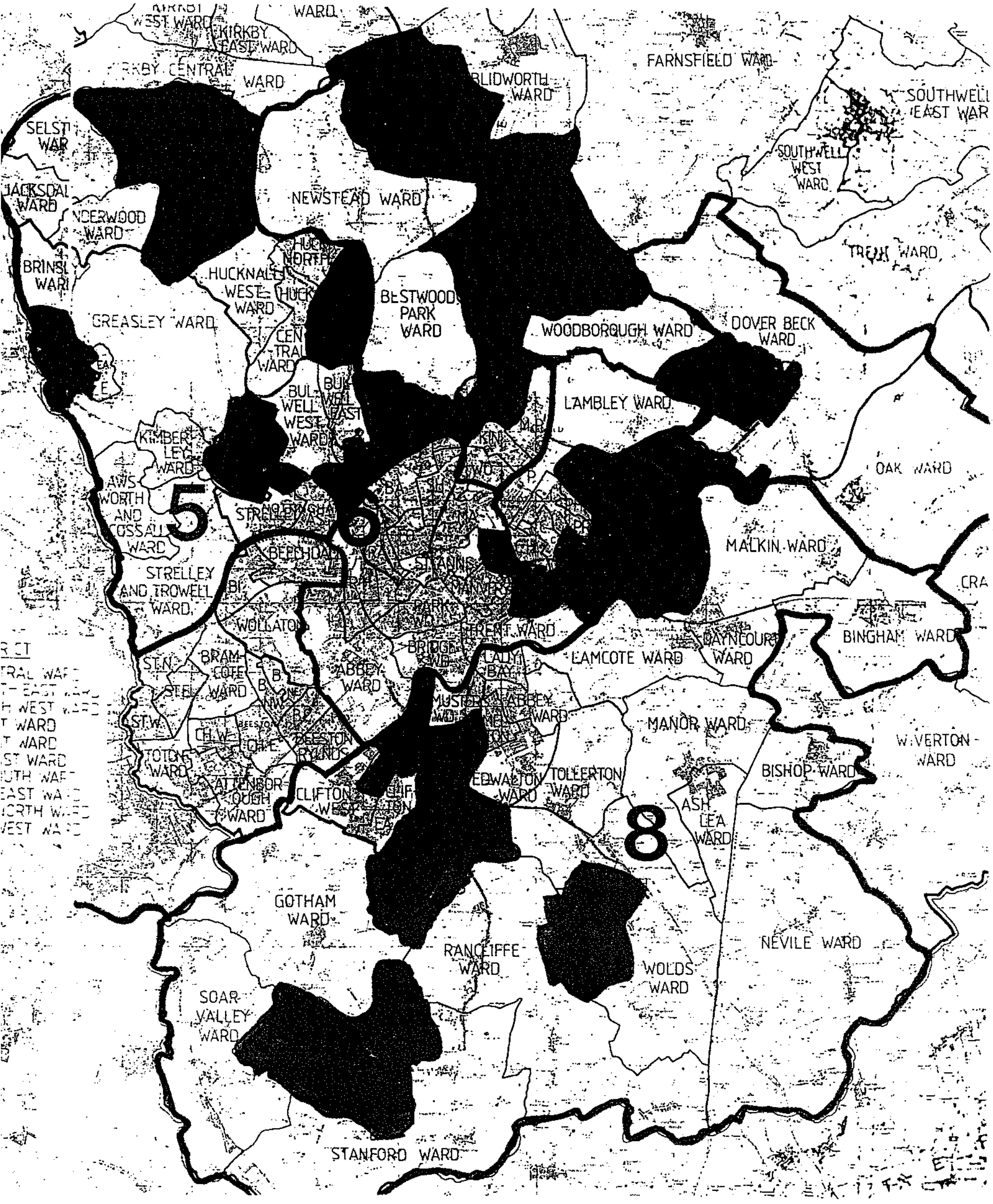
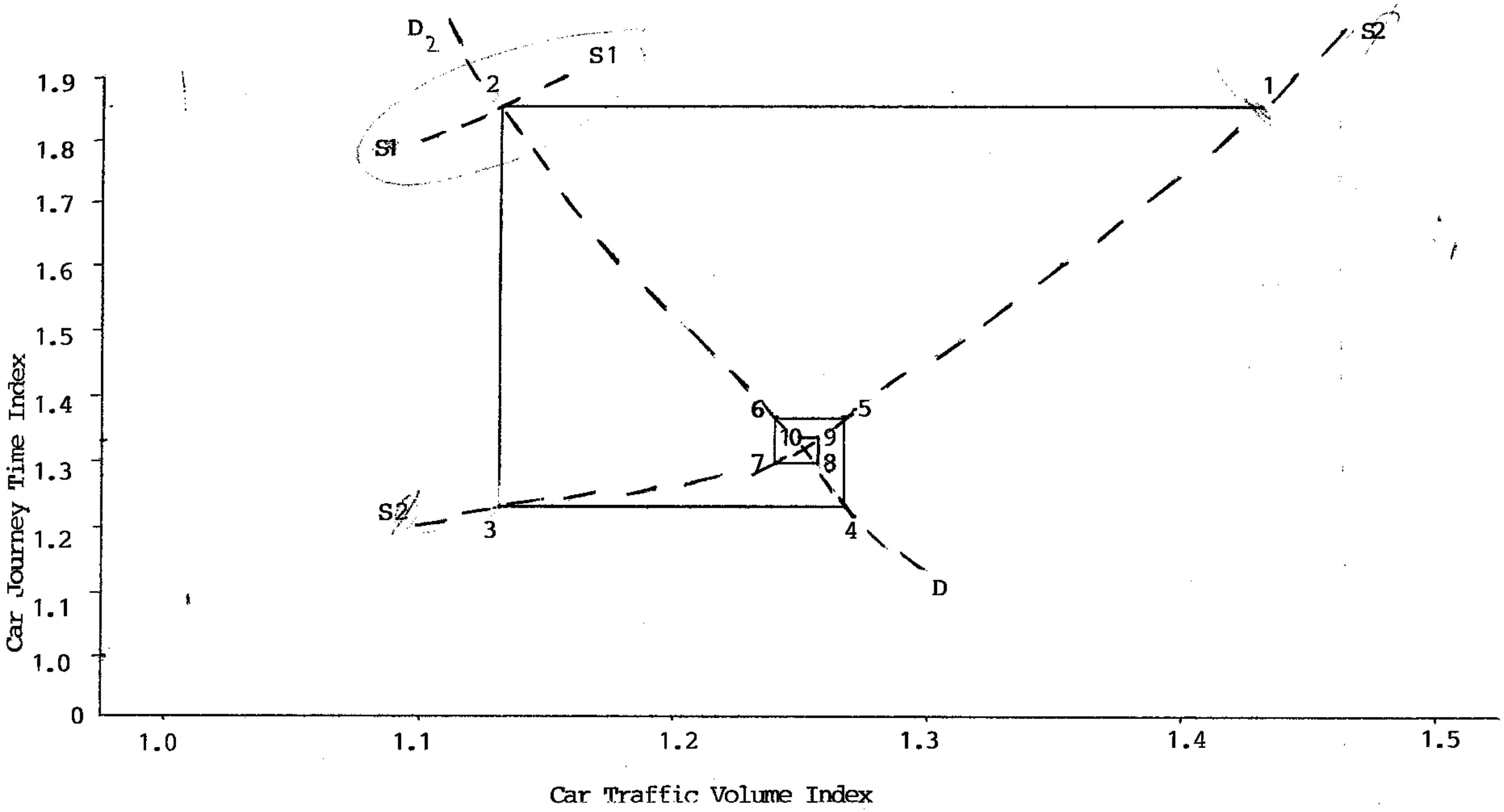


FIGURE 2 A MODEL OF CAR JOURNEY TIME/ TRAFFIC VOLUME EQUILIBRIUM IN THE YEAR 2001



TECHNICAL APPENDIX

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Nottinghamshire County Council

Institute for Transport Studies

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CHANGE OF TRAVEL MODE PROJECT: GREATER NOTTINGHAM AREA

The Institute for Transport Studies at the University of Leeds, on behalf of Nottinghamshire County Council, is investigating the factors that influence travel in the Greater Nottingham area.

We would therefore be grateful if you or a member of your household could complete the attached questionnaire and return it in the FREEPOST envelope provided AS SOON AS POSSIBLE. No stamp is required. All information provided will be treated as STRICTLY CONFIDENTIAL and will not be used for any other purpose. The success of this study is dependent on a good response from the public. PLEASE HELP!

****

WORK TRIPS

1. Do you work or study in central Nottingham? Yes [ ] No [ ] 1
2. How many days a week do you normally go to work/school/college? ..... days
3. At what time do you normally start? ...... and finish? ......
4. Do you have to be at work/school/college for a certain time? Yes [ ] No [ ]
5. How do you normally travel to work/school/college? Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

NON WORK TRIPS

6. How often do you travel to central Nottingham for shopping and leisure trips?

Never	Less than once a month	Once a month	Once a fortnight	Once a week	More than once a week
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

7. How do you normally travel to central Nottingham for shopping and leisure trips?

   Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

---

8. How many cars and vans are available for use by your household? ....
9. How many of these are company cars? 16

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WE WOULD NOW LIKE TO ASK YOU SOME QUESTIONS ABOUT YOUR MOST RECENT JOURNEY TO CENTRAL NOTTINGHAM. IF YOU DO NOT TRAVEL TO NOTTINGHAM PLEASE GO TO QUESTION 38.

10. What was the purpose of this journey?
Work/Education [ ] Shopping/Leisure [ ] 17

11. Was a car available to you for this journey?
Yes [ ] No [ ]

12. How long did it take you to get from your home to your final destination? ..... minutes, including time spent walking and waiting.

13. How much of this time was spent travelling in a car or bus at less than normal speeds (e.g. in slow moving traffic, stopped at traffic lights or bus stops etc.)? ..... minutes

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QUESTIONS 14 to 19 ARE FOR BUS USERS. IF YOU DID NOT USE BUS FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 23

14. How much of the time involved waiting for the bus? ..... mins

15. How much of the time involved walking to and from bus stops? ..... mins

16. How much did this journey cost you? ..... pence

17. What type of ticket did you use?
Adult single [ ] Child single [ ] OAP single [ ]
Adult return [ ] Child return [ ] OAP return [ ]
Travelcard [ ] Other (please specify) ....

18. How frequent are the buses to Nottingham at the time of day that you travel? Every ..... mins

19. If buses had not been available to make your trip what would you have done?
Travelled as car driver [ ] as car passenger [ ] by train [ ]
by other means [ ] not travelled [ ]

QUESTIONS 20 TO 22 REFER TO BUS USERS WHO COULD POSSIBLY TRAVEL BY CAR (EITHER AS THE DRIVER OR A PASSENGER). IF THIS DOES NOT APPLY TO YOU PLEASE GO TO QUESTION 37.

20. How much time would be spent travelling in the car? .... mins

21. How much time would involve walking, for example from where you parked your car to your final destination? ..... mins

22. How much would the journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer).
Parking charges .... pence
Petrol costs (one way journey) .... pence
If your employer would contribute to the costs of this journey, please state the amount ...... pence 46

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QUESTIONS 23 to 27 REFER TO TRAVEL BY CAR. IF YOU DID NOT USE CAR FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 37

23. How much of the time involved walking, for example from where you parked your car to your final destination? ..... mins 48

24. How many other people travelled with you? ..... people

25. How much did this journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer)

Parking charges .... pence
Petrol costs (one way journey) ..... pence
If your employer contributes to the cost of the journey, please state the amount: .... pence

26. Was it essential to use the car for this journey?

[ ] YES, needed the car for work.
[ ] YES, needed the car for other reasons (please specify ......)
[ ] NO.

27. If a car was not available to make your trip what would you have done?
Travelled by bus [ ] by train [ ] by other means [ ]
not travelled [ ]

QUESTIONS 28 to 36 REFER TO CAR USERS WHO COULD POSSIBLY TRAVEL BY BUS. IF THIS DOES NOT APPLY TO YOU PLEASE GO TO QUESTION 34

28. How long would it take you to get to the bus stop? ..... mins

29. During the main part of the day how frequent are buses to Nottingham? Every ...... mins

30. How long would you expect to wait until the bus arrived? ...... mins

31. How long would you expect to spend travelling on the bus? ...... mins

32. How long would it take you to get from the bus stop in central Nottingham to your final destination? ...... mins

33. What increase in your car journey time would be just enough to make you travel by bus instead? ...... mins

34. What increase in your car journey costs would be just enough to make you travel by bus instead? ...... pence

35. What decrease in bus journey time would be just enough to make you travel by bus instead? ..... mins

36. What decrease in the bus fare would be just enough to make this travel by bus instead? ...... pence 80

37. IF YOU ARE A CAR USER WHO COULD POSSIBLY TRAVEL BY BUS OR A BUS USER WHO COULD POSSIBLY TRAVEL BY CAR (EITHER AS A DRIVER OR A PASSENGER) PLEASE CONTINUE. IF NOT GO TO QUESTION 38.

We would now like you to reconsider your most recent journey to Nottingham and state whether you would travel by car or bus in each of the following eight situations.

You should assume that you are making the journey for the same purpose as the last journey you made and that everything else besides the features presented below would be the same as for the last journey you made. THE INFORMATION GIVEN BELOW IS IMAGINARY: IT DOES NOT MATTER IF IT IS VERY DIFFERENT FROM THAT WHICH YOU NORMALLY FACE.

THE THINGS YOU NEED TO CONSIDER ARE:

IN-VEHICLE TIME. This is the time, in minutes, spent travelling from home to central Nottingham in a car or bus. This time includes:

> **DELAY TIME.** This is the time spent in a car or bus during which you are travelling at very slow speeds or are stopped in a queue of traffic. This will be due to traffic congestion. For buses, it also includes the amount of time the bus spends at bus stops. Bus can have, in some situations, less delay time than car due to bus lanes.

WALK TIME. This is the amount of time spent walking to and from the bus or car. Assume that you spend the same amount of time walking to and from your car as you do now.

COST. This is how much you pay for a single journey. Car costs include those petrol costs and car parking charges that are paid by you (i.e. after contributions made to you by passengers or your employer). You should assume that these costs remain as they are now. Bus cost is the fare paid for a single journey.

YOU SHOULD ASSUME THAT THE FREQUENCY OF THE BUS SERVICE IS EVERY 10 MINUTES.

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USE ONLY

		IN-VEHICLE TIME (mins)	of which	DELAY TIME (mins)	WALK TIME (mins)	COST (pence)
A.	CAR	20		5	As Now	As Now
	BUS	20		5	5	60

In these circumstances I would travel by CAR [ ] BUS [ ]

B.	CAR	20		5	As Now	As Now
	BUS	20		5	15	40

In these circumstances I would travel by CAR [ ] BUS [ ]

C.	CAR	17		2	As Now	As Now
	BUS	30		5	15	40

In these circumstances I would travel by CAR [ ] BUS [ ]

D.	CAR	17		2	As Now	As Now
	BUS	15		5	5	25

In these circumstances I would travel by CAR [ ] BUS [ ]

E.	CAR	25		10	As Now	As Now
	BUS	20		5	15	25

In these circumstances I would travel by CAR [ ] BUS [ ]

F.	CAR	25		10	As Now	As Now
	BUS	20		5	5	40

In these circumstances I would travel by CAR [ ] BUS [ ]

G.	CAR	30		15	As Now	As Now
	BUS	15		5	5	40

In these circumstances I would travel by CAR [ ] BUS [ ]

H.	CAR	30		15	As Now	As Now
	BUS	30		5	15	60

In these circumstances I would travel by CAR [ ] BUS [ ]

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WE WOULD BE GRATEFUL IF YOU COULD PROVIDE US WITH SOME DETAILS ABOUT YOURSELF AND YOUR HOUSEHOLD. THIS INFORMATION WILL BE USED TO ENSURE THAT OUR SURVEY IS REPRESENTATIVE. IT WILL NOT BE USED FOR ANY OTHER PURPOSE.

90

38. What age group are you in?

Under 18 [ ]	25-34 [ ]	55-64 [ ]
18-24 [ ]	35-44 [ ]	65+ [ ]

39. Are you: Male [ ] Female? [ ]

40. Which of the following income groups (before tax) applies to your household?

£5,000 or less per annum/£100 or less per week [ ]
£5,001-10,000 per annum/£101-200 per week [ ]
£10,001-15,000 per annum/£201-300 per week [ ]
£15,001-20,000 per annum/£301-400 per week [ ]
Over £20,000 per annum/Over £400 per week [ ]

41. How many people live in your household? .....

94

42. If you have any comments about this questionnaire or about travel in Nottingham in general, please give them in the space below.

If you have any further comments about this survey you can contact Dr John Preston on Leeds (0532) 335345.

THANK-YOU VERY MUCH FOR YOUR HELP
Please fold the questionnaire and return it in the FREEPOST envelope provided.

Nottinghamshire County Council

ITS Institute for Transport Studies

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****

WORK TRIPS

1. Do you work or study in central Nottingham? Yes [ ] No [ ] 1
2. How many days a week do you normally go to work/school/college? ..... days
3. At what time do you normally start? ...... and finish? ......
4. Do you have to be at work/school/college for a certain time? Yes [ ] No [ ]
5. How do you normally travel to work/school/college?
   Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

NON WORK TRIPS

6. How often do you travel to central Nottingham for shopping and leisure trips?

Never	Less than once a month	Once a month	Once a fortnight	Once a week	More than once a week
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

7. How do you normally travel to central Nottingham for shopping and leisure trips?

   Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

---

8. How many cars and vans are available for use by your household? ....
9. How many of these are company cars? 16

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WE WOULD NOW LIKE TO ASK YOU SOME QUESTIONS ABOUT YOUR MOST RECENT JOURNEY TO CENTRAL NOTTINGHAM. IF YOU DO NOT TRAVEL TO NOTTINGHAM PLEASE GO TO QUESTION 40.

10. What was the purpose of this journey?
    Work/Education [ ] Shopping/Leisure [ ]

17

11. Was a car available to you for this journey?
    Yes [ ] No [ ]

12. How long did it take you to get from your home to your final destination? ..... minutes, including time spent walking and waiting.

13. How much of this time was spent travelling in a car or bus at less than normal speeds (e.g. in slow moving traffic, stopped at traffic lights or bus stops etc.)? ..... minutes

---

QUESTIONS 14 to 19 ARE FOR BUS USERS. IF YOU DID NOT USE BUS FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 23

14. How much of the time involved waiting for the bus? ..... mins

15. How much of the time involved walking to and from bus stops? ..... mins

16. How much did this journey cost you? ..... pence

17. What type of ticket did you use?
    Adult single [ ] Child single [ ] OAP single [ ]
    Adult return [ ] Child return [ ] OAP return [ ]
    Travelcard [ ] Other (please specify) ....

18. How frequent are the buses to Nottingham at the time of day that you travel? Every ..... mins

19. If buses had not been available to make your trip what would you have done?
    Travelled as car driver [ ] as car passenger [ ] by train [ ] by other means [ ] not travelled [ ]

QUESTIONS 20 TO 22 REFER TO BUS USERS WHO COULD POSSIBLY TRAVEL BY CAR (EITHER AS THE DRIVER OR A PASSENGER). IF THIS DOES NOT APPLY TO YOU PLEASE GO TO QUESTION 37.

20. How much time would be spent travelling in the car? .... mins

21. How much time would involve walking, for example from where you parked your car to your final destination? ..... mins

22. How much would the journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer).
    Parking charges .... pence
    Petrol costs (one way journey) .... pence
    If your employer would contribute to the costs of this journey, please state the amount ...... pence

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QUESTIONS 23 to 27 REFER TO TRAVEL BY CAR. IF YOU DID NOT USE CAR FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 37

23. How much of the time involved walking, for example from where you parked your car to your final destination? ..... mins [ ][ ] 48

24. How many other people travelled with you? ..... people [ ]

25. How much did this journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer)

    Parking charges .... pence [ ][ ][ ]
    Petrol costs (one way journey) ..... pence [ ][ ][ ]
    If your employer contributes to the cost of the journey, please state the amount: .... pence [ ][ ][ ]

26. Was it essential to use the car for this journey? [ ]

[ ] YES, needed the car for work.
[ ] YES, needed the car for other reasons (please specify ......)
[ ] NO.

27. If a car was not available to make your trip what would you have done? [ ]
    Travelled by bus [ ] by train [ ] by other means [ ]
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29. During the main part of the day how frequent are buses to Nottingham? Every ...... mins [ ][ ]

30. How long would you expect to wait until the bus arrived? ...... mins [ ][ ]

31. How long would you expect to spend travelling on the bus? ...... mins [ ][ ]

32. How long would it take you to get from the bus stop in central Nottingham to your final destination? ...... mins [ ][ ]

33. What increase in your car journey time would be just enough to make you travel by bus instead? ...... mins [ ][ ]

34. What increase in your car journey costs would be just enough to make you travel by bus instead? ...... pence [ ][ ][ ]

35. What decrease in bus journey time would be just enough to make you travel by bus instead? ..... mins [ ][ ]

36. What decrease in the bus fare would be just enough to make this travel by bus instead? ...... pence [ ][ ][ ] 80

37. IF YOU ARE A CAR USER WHO COULD POSSIBLY TRAVEL BY BUS OR A BUS USER WHO COULD POSSIBLY TRAVEL AS A CAR DRIVER PLEASE CONTINUE. IF NOT GO TO QUESTION 40

We would now like you to reconsider your most recent journey to Nottingham and state whether you would travel by car or by park and ride in each of the following eight situations. By park and ride, we mean that you would drive to a site close to the route you currently use to travel to Nottingham and **park** your car there. You would then **ride** into Nottingham on a specially provided bus service. The car park provided would be of high quality and emphasis would be placed on providing security both for yourself and your vehicle. There would always be a bus waiting in the park and ride site for you to board and these buses would depart every five minutes.

You should assume that you are making the journey for the same purpose as the last journey you made and that everything else besides the features presented below would be the same as for the last journey you made. THE INFORMATION GIVEN BELOW IS IMAGINARY: IT DOES NOT MATTER IF IT IS VERY DIFFERENT FROM THAT WHICH YOU NORMALLY FACE.

<u>THE THINGS YOU NEED TO CONSIDER ARE:</u>

<u>FOR CAR</u>

PETROL COST. This is the amount of money you would spend on petrol for a one-way journey (i.e. after contributions made to you by passengers or your employer).

PARKING COST. This is the amount of money you would spend for parking your car for the duration of your visit to Nottingham (i.e. after contributions made to you by passengers or your employer).

WALK TIME. This is the amount of time spent walking from where you parked your car to your final destination.

IN-VEHICLE TIME. This is the amount of time that you spend travelling in your car. You should assume that this remains as it is now.

<u>FOR PARK AND RIDE</u>

COST. This is the amount of money spent on petrol driving to the park and ride site <u>plus</u> the bus fare from the park and ride site to central Nottingham.

WALK TIME. This is the amount of time spent from the stop where you get off the bus to your final destination.

IN-VEHICLE TIME. This is split into two parts:

CAR ACCESS TIME. This is the amount of time that you spend in your car driving from your home to the park and ride site. You should assume that this always takes 12 minutes.

BUS TIME. This is the amount of time that you spend travelling on the bus from the park and ride site to central Nottingham.

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	IN-VEHICLE TIME (mins)	of which BUS TIME (mins)	WALK TIME (mins)	COST (pence)			
A. PARK AND RIDE	17	5	2		10		
CAR	As Now	-	2	PARKING	0	PETROL	25

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

B. PARK AND RIDE	17	5	5		30		
CAR	As Now	-	5	PARKING	0	PETROL	60

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

C. PARK AND RIDE	22	10	5		30		
CAR	As Now	-	2	PARKING	40	PETROL	25

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

D. PARK AND RIDE	22	10	2		10		
CAR	As Now	-	5	PARKING	40	PETROL	60

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

E. PARK AND RIDE	22	10	2		45		
CAR	As Now	-	2	PARKING	100	PETROL	60

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

F. PARK AND RIDE	22	10	5		45		
CAR	As Now	-	5	PARKING	100	PETROL	25

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

G. PARK AND RIDE	17	5	5		30		
CAR	As Now	-	2	PARKING	150	PETROL	60

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

H. PARK AND RIDE	17	5	2		45		
CAR	As Now	-	5	PARKING	150	PETROL	25

In these circumstances I would travel by PARK AND RIDE [ ] CAR [ ]

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38. Would you consider using any of these park and ride sites and if so how long would it take to drive from your home to the site?

The Forest	[ ] NO [ ] YES, it would take ... mins	9
Queens Drive, Wilford	[ ] NO [ ] YES, it would take ... mins	
Daleside Road, Colwick	[ ] NO [ ] YES, it would take ... mins	
Southglade Drive, Bulwell	[ ] NO [ ] YES, it would take ... mins	
Wilkinson Street, Basford	[ ] NO [ ] YES, it would take ... mins	

39. Are there any other locations that you think would make a good park and ride site?

[ ] NO [ ] YES, please give details ....

WE WOULD BE GRATEFUL IF YOU COULD PROVIDE US WITH SOME DETAILS ABOUT YOURSELF AND YOUR HOUSEHOLD. THIS INFORMATION WILL BE USED TO ENSURE THAT OUR SURVEY IS REPRESENTATIVE. IT WILL NOT BE USED FOR ANY OTHER PURPOSE.

40. What age group are you in?

Under 18 [ ]	25-34 [ ]	55-64 [ ]
18-24 [ ]	35-44 [ ]	65+ [ ]

41. Are you: Male [ ] Female? [ ]

42. Which of the following income groups (before tax) applies to your household?

£5,000 or less per annum/£100 or less per week	[ ]
£5,001-10,000 per annum/£101-200 per week	[ ]
£10,001-15,000 per annum/£201-300 per week	[ ]
£15,001-20,000 per annum/£301-400 per week	[ ]
Over £20,000 per annum/Over £400 per week	[ ]

43. How many people live in your household? .....

44. If you have any comments about this questionnaire or about travel in Nottingham in general, please give them in the space below. 110

If you have any further comments about this survey you can contact Dr John Preston on Leeds (0532) 335345.

THANK-YOU VERY MUCH FOR YOUR HELP

Please fold the questionnaire and return it in the FREEPOST envelope provided.

Nottinghamshire County Council

ITS Institute for Transport Studies

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CHANGE OF TRAVEL MODE PROJECT: GREATER NOTTINGHAM AREA

The Institute for Transport Studies at the University of Leeds, on behalf of Nottinghamshire County Council, is investigating the factors that influence travel in the Greater Nottingham area.

We would therefore be grateful if you or a member of your household could complete the attached questionnaire and return it in the FREEPOST envelope provided AS SOON AS POSSIBLE. No stamp is required. All information provided will be treated as STRICTLY CONFIDENTIAL and will not be used for any other purpose. The success of this study is dependent on a good response from the public. PLEASE HELP!

****

WORK TRIPS

1. Do you work or study in central Nottingham? Yes [ ] No [ ] 1
2. How many days a week do you normally go to work/ school/college? ..... days
3. At what time do you normally start? ...... and finish? ......
4. Do you have to be at work/school/college for a certain time? Yes [ ] No [ ]
5. How do you normally travel to work/school/college? Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

NON WORK TRIPS

6. How often do you travel to central Nottingham for shopping and leisure trips?

Never	Less than once a month	Once a month	Once a fortnight	Once a week	More than once a week
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

7. How do you normally travel to central Nottingham for shopping and leisure trips?

   Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

---

8. How many cars and vans are available for use by your household? ....
9. How many of these are company cars? 16

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WE WOULD NOW LIKE TO ASK YOU SOME QUESTIONS ABOUT YOUR MOST RECENT JOURNEY TO CENTRAL NOTTINGHAM. IF YOU DO NOT TRAVEL TO NOTTINGHAM PLEASE GO TO QUESTION 38.

10. What was the purpose of this journey?
    Work/Education [ ] Shopping/Leisure [ ] 17

11. Was a car available to you for this journey?
    Yes [ ] No [ ]

12. How long did it take you to get from your home to your final destination? ..... minutes, including time spent walking and waiting.

13. How much of this time was spent travelling in a car or bus at less than normal speeds (e.g. in slow moving traffic, stopped at traffic lights or bus stops etc.)? ..... minutes

---

QUESTIONS 14 to 19 ARE FOR BUS USERS. IF YOU DID NOT USE BUS FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 23

14. How much of the time involved waiting for the bus? ..... mins

15. How much of the time involved walking to and from bus stops? ..... mins

16. How much did this journey cost you? ..... pence

17. What type of ticket did you use?
    Adult single [ ] Child single [ ] OAP single [ ]
    Adult return [ ] Child return [ ] OAP return [ ]
    Travelcard [ ] Other (please specify) ....

18. How frequent are the buses to Nottingham at the time of day that you travel? Every ..... mins

19. If buses had not been available to make your trip what would you have done?
    Travelled as car driver [ ] as car passenger [ ] by train [ ] by other means [ ] not travelled [ ]

QUESTIONS 20 TO 22 REFER TO BUS USERS WHO COULD POSSIBLY TRAVEL BY CAR (EITHER AS THE DRIVER OR A PASSENGER). IF THIS DOES NOT APPLY TO YOU PLEASE GO TO QUESTION 37.

20. How much time would be spent travelling in the car? .... mins

21. How much time would involve walking, for example from where you parked your car to your final destination? ..... mins

22. How much would the journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer).
    Parking charges .... pence
    Petrol costs (one way journey) .... pence
    If your employer would contribute to the costs of this journey, please state the amount ...... pence 46

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QUESTIONS 23 to 27 REFER TO TRAVEL BY CAR. IF YOU DID NOT USE CAR FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 37

23. How much of the time involved walking, for example from where you parked your car to your final destination? ..... mins [|] 48

24. How many other people travelled with you? ..... people [ ]

25. How much did this journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer)

    Parking charges .... pence [| |]
    Petrol costs (one way journey) ..... pence [| |]
    If your employer contributes to the cost of the journey, please state the amount: .... pence [| |]

26. Was it essential to use the car for this journey? [ ]

[ ] YES, needed the car for work.
[ ] YES, needed the car for other reasons (please specify ......)
[ ] NO.

27. If a car was not available to make your trip what would you have done? [ ]
    Travelled by bus [ ] by train [ ] by other means [ ]
    not travelled [ ]

QUESTIONS 28 to 36 REFER TO CAR USERS WHO COULD POSSIBLY TRAVEL BY BUS. IF THIS DOES NOT APPLY TO YOU PLEASE GO TO QUESTION 34

28. How long would it take you to get to the bus stop? ..... mins [|]

29. During the main part of the day how frequent are buses to Nottingham? Every ...... mins [|]

30. How long would you expect to wait until the bus arrived? ...... mins [|]

31. How long would you expect to spend travelling on the bus? ...... mins [|]

32. How long would it take you to get from the bus stop in central Nottingham to your final destination? ...... mins [|]

33. What increase in your car journey time would be just enough to make you travel by bus instead? ...... mins [|]

34. What increase in your car journey costs would be just enough to make you travel by bus instead? ...... pence [| |]

35. What decrease in bus journey time would be just enough to make you travel by bus instead? ..... mins [|]

36. What decrease in the bus fare would be just enough to make this travel by bus instead? ...... pence [| |] 80

37. IF YOU ARE A CAR USER WHO COULD POSSIBLY TRAVEL BY BUS OR A BUS USER WHO COULD POSSIBLY TRAVEL BY CAR (EITHER AS A DRIVER OR A PASSENGER) PLEASE CONTINUE. IF NOT PLEASE GO TO QUESTION 38.

We would now like you to reconsider your most recent journey to Nottingham and state whether you would travel by car or a new express bus service in each of the following eight situations. The express bus service would make use of modern, luxury coaches and would operate as a limited stop service. In order to be competitive with the car, the express bus service would make use of bus lanes and would be given priority at traffic signals.

You should assume that you are making the journey for the same purpose as the last journey you made and that everything else besides the features presented below would be the same as for the last journey you made. THE INFORMATION GIVEN BELOW IS IMAGINARY: IT DOES NOT MATTER IF IT IS VERY DIFFERENT FROM THAT WHICH YOU NORMALLY FACE.

<u>THE THINGS YOU NEED TO CONSIDER ARE:</u>

IN-VEHICLE TIME. This is the time, in minutes, spent travelling from home to central Nottingham in a car or bus.

WALK TIME. This is the amount of time spent walking to and from the bus or car. For car assume you spend the same amount of time walking as you do now.

COST. This is how much you pay for a single journey. Bus cost is the fare paid for a single journey. Car costs include those petrol costs and car parking charges that are paid by you (i.e. after contributions made to you by passengers or your employer). You should assume that these costs remain as they are now.

FREQUENCY. This is the time between buses departing for Nottingham.

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		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
A.	CAR	15	As Now	As Now	-
	BUS	10	30	5	Every 5 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
B.	CAR	15	As Now	As Now	-
	BUS	15	50	5	Every 20 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
C.	CAR	20	As Now	As Now	-
	BUS	10	50	15	Every 10 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
D.	CAR	20	As Now	As Now	-
	BUS	15	30	15	Every 10 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
E.	CAR	30	As Now	As Now	-
	BUS	10	65	15	Every 20 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
F.	CAR	30	As Now	As Now	-
	BUS	15	50	15	Every 5 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
G.	CAR	20	As Now	As Now	-
	BUS	10	50	5	Every 10 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

		IN-VEHICLE TIME (mins)	COST (pence)	WALK TIME (mins)	FREQUENCY
H.	CAR	20	As Now	As Now	-
	BUS	15	65	5	Every 10 mins

In these circumstances I would travel by CAR [ ] BUS [ ]

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WE WOULD BE GRATEFUL IF YOU COULD PROVIDE US WITH SOME DETAILS ABOUT YOURSELF AND YOUR HOUSEHOLD. THIS INFORMATION WILL BE USED TO ENSURE THAT OUR SURVEY IS REPRESENTATIVE. IT WILL NOT BE USED FOR ANY OTHER PURPOSE.

[ ][ ] 90

38. What age group are you in?

Under 18 [ ]	25-34 [ ]	55-64 [ ]
18-24 [ ]	35-44 [ ]	65+ [ ]

39. Are you: Male [ ] Female? [ ]

40. Which of the following income groups (before tax) applies to your household?

£5,000 or less per annum/£100 or less per week	[ ]
£5,001-10,000 per annum/£101-200 per week	[ ]
£10,001-15,000 per annum/£201-300 per week	[ ]
£15,001-20,000 per annum/£301-400 per week	[ ]
Over £20,000 per annum/Over £400 per week	[ ]

41. How many people live in your household? .....

[ ] 94

42. If you have any comments about this questionnaire or about travel in Nottingham in general, please give them in the space below.

If you have any further comments about this survey you can contact Dr John Preston on Leeds (0532) 335345.

THANK-YOU VERY MUCH FOR YOUR HELP

Please fold the questionnaire and return it in the FREEPOST envelope provided.

5986

Nottinghamshire County Council

ITS Institute for Transport Studies

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CHANGE OF TRAVEL MODE PROJECT: GREATER NOTTINGHAM AREA

The Institute for Transport Studies at the University of Leeds, on behalf of Nottinghamshire County Council, is investigating the factors that influence travel in the Greater Nottingham area.

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****

WORK TRIPS

1. Do you work or study in central Nottingham? Yes [ ] No [ ] 1

2. How many days a week do you normally go to work/school/college? ..... days

3. At what time do you normally start? ...... and finish? ......

4. Do you have to be at work/school/college for a certain time? Yes [ ] No [ ]

5. How do you normally travel to work/school/college?
   Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

NON WORK TRIPS

6. How often do you travel to central Nottingham for shopping and leisure trips?

Never	Less than once a month	Once a month	Once a fortnight	Once a week	More than once a week
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

7. How do you normally travel to central Nottingham for shopping and leisure trips?

   Car Driver [ ] Car Passenger [ ] Bus [ ] Other [ ]

---

8. How many cars and vans are available for use by your household? ....

9. How many of these are company cars? 16

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WE WOULD NOW LIKE TO ASK YOU SOME QUESTIONS ABOUT YOUR MOST RECENT JOURNEY TO CENTRAL NOTTINGHAM. IF YOU DO NOT TRAVEL TO NOTTINGHAM PLEASE GO TO QUESTION 38.

10. What was the purpose of this journey?
    Work/Education [ ] Shopping/Leisure [ ] 17

11. Was a car available to you for this journey?
    Yes [ ] No [ ]

12. How long did it take you to get from your home to your final destination? ..... minutes, including time spent walking and waiting.

13. How much of this time was spent travelling in a car or bus at less than normal speeds (e.g. in slow moving traffic, stopped at traffic lights or bus stops etc.)? ..... minutes

---

QUESTIONS 14 to 19 ARE FOR BUS USERS. IF YOU DID NOT USE BUS FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 23

14. How much of the time involved waiting for the bus? ..... mins

15. How much of the time involved walking to and from bus stops? ..... mins

16. How much did this journey cost you? ..... pence

17. What type of ticket did you use?
    Adult single [ ] Child single [ ] OAP single [ ]
    Adult return [ ] Child return [ ] OAP return [ ]
    Travelcard [ ] Other (please specify) ....

18. How frequent are the buses to Nottingham at the time of day that you travel? Every ..... mins

19. If buses had not been available to make your trip what would you have done?
    Travelled as car driver [ ] as car passenger [ ] by train [ ]
    by other means [ ] not travelled [ ]

QUESTIONS 20 TO 22 REFER TO BUS USERS WHO COULD POSSIBLY TRAVEL BY CAR (EITHER AS THE DRIVER OR A PASSENGER). IF THIS DOES NOT APPLY TO YOU PLEASE GO TO QUESTION 37.

20. How much time would be spent travelling in the car? .... mins

21. How much time would involve walking, for example from where you parked your car to your final destination? ..... mins

22. How much would the journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer).
    Parking charges .... pence
    Petrol costs (one way journey) .... pence
    If your employer would contribute to the costs of this journey, please state the amount ...... pence 46

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QUESTIONS 23 to 27 REFER TO TRAVEL BY CAR. IF YOU DID NOT USE CAR FOR YOUR MOST RECENT TRIP TO NOTTINGHAM PLEASE GO TO QUESTION 37

23. How much of the time involved walking, for example from where you parked your car to your final destination? ..... mins [ ][ ] 48

24. How many other people travelled with you? ..... people [ ]

25. How much did this journey cost you? (Give the total cost after deducting any contributions made to you by passengers or your employer)

    Parking charges .... pence [ ][ ][ ]
    Petrol costs (one way journey) ..... pence [ ][ ][ ]
    If your employer contributes to the cost of the journey, please state the amount: .... pence [ ][ ][ ]

26. Was it essential to use the car for this journey? [ ]

[ ] YES, needed the car for work.
[ ] YES, needed the car for other reasons (please specify ......)
[ ] NO.

27. If a car was not available to make your trip what would you have done? [ ]
    Travelled by bus [ ] by train [ ] by other means [ ]
    not travelled [ ]

QUESTIONS 28 to 36 REFER TO CAR USERS WHO COULD POSSIBLY TRAVEL BY BUS. IF THIS DOES NOT APPLY TO YOU PLEASE GO TO QUESTION 34

28. How long would it take you to get to the bus stop? ..... mins [ ][ ]

29. During the main part of the day how frequent are buses to Nottingham? Every ...... mins [ ][ ]

30. How long would you expect to wait until the bus arrived? ...... mins [ ][ ]

31. How long would you expect to spend travelling on the bus? ...... mins [ ][ ]

32. How long would it take you to get from the bus stop in central Nottingham to your final destination? ...... mins [ ][ ]

33. What increase in your car journey time would be just enough to make you travel by bus instead? ...... mins [ ][ ]

34. What increase in your car journey costs would be just enough to make you travel by bus instead? ...... pence [ ][ ][ ]

35. What decrease in bus journey time would be just enough to make you travel by bus instead? ..... mins [ ][ ]

36. What decrease in the bus fare would be just enough to make this travel by bus instead? ...... pence [ ][ ][ ] 80

37. IF YOU ARE A CAR USER PLEASE CONTINUE. IF NOT GO TO QUESTION 38.

We would now like you to reconsider your most recent journey to Nottingham and state whether when travelling by car you would prefer to set off at the time you do now or whether you would prefer to set off earlier or later. There are eight choices over the page which we would like you to consider.

You should assume that you are making the journey for the same purpose as the last journey you made and that everything else besides the features presented below would be the same as for the last journey you made. THE INFORMATION GIVEN BELOW IS IMAGINARY: IT DOES NOT MATTER IF IT IS VERY DIFFERENT FROM THAT WHICH YOU NORMALLY FACE.

THE THINGS YOU NEED TO CONSIDER ARE:

DEPARTURE TIME This is the time at which you leave your house for your journey to Nottingham. You may either leave your home at the time you do now or may leave up to an hour earlier or later. By leaving home earlier or later you may be able to avoid traffic congestion and take advantage of lower parking charges for less busy times of the day.

IN-VEHICLE TIME. This is the time, in minutes, spent travelling in your car from home to central Nottingham. Because of traffic congestion this time varies at different times of the day.

PARKING COST. This the amount you pay for parking your car for the duration of your visit to central Nottingham (i.e. after any contributions by passengers or your employer). You should assume that parking charges vary at different times of the day.

YOU SHOULD ASSUME THAT ALL OTHER FEATURES OF YOUR JOURNEY REMAIN UNCHANGED. FOR EXAMPLE THE AMOUNT OF TIME SPENT WALKING TO AND FROM YOUR CAR AND THE AMOUNT OF MONEY YOU SPEND ON PETROL IS AS NOW.

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		DEPARTURE TIME	IN-VEHICLE TIME (mins)	PARKING COST (pence)
A.	AS NOW	As Now	30	50
	EARLIER	30 minutes earlier	15	50

In these circumstances I would travel AS NOW [ ] EARLIER [ ]

B.	AS NOW	As Now	35	30
	EARLIER	30 minutes earlier	15	0

In these circumstances I would travel AS NOW [ ] EARLIER [ ]

C.	AS NOW	As Now	35	100
	EARLIER	30 minutes earlier	25	50

In these circumstances I would travel AS NOW [ ] EARLIER [ ]

D.	AS NOW	As Now	30	75
	EARLIER	30 minutes earlier	25	0

In these circumstances I would travel AS NOW [ ] EARLIER [ ]

E.	AS NOW	As Now	30	0
	LATER	60 minutes later	25	0

In these circumstances I would travel AS NOW [ ] LATER [ ]

F.	AS NOW	As Now	35	80
	LATER	60 minutes later	25	50

In these circumstances I would travel AS NOW [ ] LATER [ ]

G.	AS NOW	As Now	35	50
	LATER	60 minutes later	15	0

In these circumstances I would travel AS NOW [ ] LATER [ ]

H.	AS NOW	As Now	30	125
	LATER	60 minutes later	15	50

In these circumstances I would travel AS NOW [ ] LATER [ ]

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WE WOULD BE GRATEFUL IF YOU COULD PROVIDE US WITH SOME DETAILS ABOUT YOURSELF AND YOUR HOUSEHOLD. THIS INFORMATION WILL BE USED TO ENSURE THAT OUR SURVEY IS REPRESENTATIVE. IT WILL NOT BE USED FOR ANY OTHER PURPOSE.

90

38. What age group are you in?

Under 18 [ ]	25-34 [ ]	55-64 [ ]
18-24 [ ]	35-44 [ ]	65+ [ ]

39. Are you: Male [ ] Female? [ ]

40. Which of the following income groups (before tax) applies to your household?

£5,000 or less per annum/£100 or less per week	[ ]
£5,001-10,000 per annum/£101-200 per week	[ ]
£10,001-15,000 per annum/£201-300 per week	[ ]
£15,001-20,000 per annum/£301-400 per week	[ ]
Over £20,000 per annum/Over £400 per week	[ ]

41. How many people live in your household? .....

94

42. If you have any comments about this questionnaire or about travel in Nottingham in general, please give them in the space below.

If you have any further comments about this survey you can contact Dr John Preston on Leeds (0532) 335345.

THANK-YOU VERY MUCH FOR YOUR HELP

Please fold the questionnaire and return it in the FREEPOST envelope provided.

NOTTINGHAMSHIRE COUNTY COUNCIL

- CHANGE OF TRAVEL MODE PROJECT -

CODING MANUAL AND INSTRUCTIONS

* *

*** * IMPORTANT NOTE TO DATA PUNCHERS * ***

Enter four characters before box 1. This should be the questionnaire number on the top right hand corner of page 1. Where less than four characters right justify by preceding code with 0s e.g. questionnaire number 1, punched as 0001.

* *

GENERAL INSTRUCTIONS

Right justify by preceding code with 0 e.g. if journey time (question 12, box 19-20) is 5 minutes code as 05. Where a value is missing, fill the coding boxes with 9s. Where a response is not applicable fill the coding boxes with 8s (except box 30 - leave blank).

(A) QUESTIONNAIRES 1 - 1600 (Yellow)

Question №	Box №	Code		
1.	1	Work Trips?	1. Yes	2. No
2.	2	Number of days worked		
3.	3-6	Start time (use 24 hour clock)		
	7-10	Finish time (use 24 hour clock)		
4.	11	Fixed start time?	1. Yes	2. No
5.	12	Mode used		
		1. Car Driver	3. Bus	
		2. Car Passenger	4. Other	
6.	13	Frequency of non work trips		
		1. Never	4. 1 a fortnight	
		2. Less than 1 a month	5. 1 a week	
		3. 1 a month	6. More than 1 a week	
7.	14	Mode used		
		Code as in Question 5		
8.	15	Number of cars and vans		
9.	16	Number of company cars		
10.	17	Purpose of journey		
		1. Work/Education	2. Shopping/Leisure	
11.	18	Car availability		
		1. Yes	2. No	
12.	19-20	Journey time (in minutes)		
13.	21-22	Delay time (in minutes)		

Question №	Box №	Code
14.	23-24	Bus wait time (in minutes)
15.	25-26	Bus walk time (in minutes)
16.	27-29	Bus cost (in pence)
17.	30	Ticket type 1. Adult single 4. Child single 7. OAP return 2. Adult return 5. Child return 8. Other 3. Travel card 6. OAP single
18.	31-32	Bus frequency (in minutes)
19.	33	Alternatives 1. Car driver 2. Other 2. Car passenger 5. Not travelled 3. Train

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Question №	Box №	Code	
20.	34-35	Car as an alternative:	In-vehicle time (in minutes)
21.	36-37		Walk time (in minutes)
22.	38-40		Parking charges (in pence)
	41-43		Petrol costs (in pence)
	44-46		Employer's contribution (in pence)

Question №	Box №	Code
23.	47-48	Car - walking time (in minutes)
24.	49	Number of passengers
25.	50-52	Car - Parking charge (in pence)
	53-55	- Petrol cost (in pence)
	56-58	- Employer's contribution (in pence)
26.	59	Car essential? 1. Yes - needed it for work 2. Yes - needed it for other reasons 3. No
27.	60	Alternative 1. Bus 2. Train 3. Other 4. Not travelled

Question №	Box №	Code	
28.	61-62	Bus as an alternative:	access time (in minutes)
29.	63-64		frequency (in minutes)
30.	65-66		wait time (in minutes)
31.	67-68		in-vehicle time (in minutes)
32.	69-70		egress time (in minutes)

Question №	Box №	Code
33.	71-72	Car journey time increase (TP - in minutes)
34.	73-75	Car journey cost increase (TP - in pence)

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*** * IMPORTANT NOTE TO DATA PUNCHERS * ***

Line break here (column 79).

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Question Nº	Box Nº	Code
35.	76-77	Bus journey time decrease (TP - in minutes)
36.	78-80	Bus journey cost decrease (TP - in pence)

Question Nº	Box Nº	Code
37.	81	0. Car 1. Bus
	82-88	As box 81
	89	Reason for no completion of SP questions (question 37) 1. Do not travel to Central Nottingham 2. Neither choice used as a means of travel to Nottingham (e.g. walk rather than use bus or car) 3. Neither (or only one) choice considered as a possible alternative for travelling to Nottingham (e.g. do not have a car available) 4. No reason given
38.	90	Age 1. Under 18 3. 25-34 6. 55-64 2. 18-24 4. 35-44 7. 65+ N.B. Age group 45-54 missing. Code as 5 where occurs.
39.	91	Sex 1. Male 2. Female
40.	92	Income 1. <5k 4. 15-20k 2. 5-10k 5. >20k 3. 10-15k
41.	93	Household size
42.	94	Comments? 1. Yes 2. No

(B) <u>QUESTIONNAIRES 1601 - 3200</u> (Pink)

Code as for questionnaires (A) up to question 36 (Box 80)

Question Nº	Box Nº	Code
37.	81	0. Park and ride 1. Car
	82-88	As box 81
38.	89	Park and ride at the forest? 1. Yes 2. No
	90-91	Access time to forest (in minutes)
	92	Park and ride at Queen's Drive? 1. Yes 2. No
	93-94	Access time to Queen's Drive (in minutes)

Question Nº	Box Nº	Code
	95	Park and ride at Daleside Road? 1. Yes 2. No
	96-97	Access time to Daleside Road (in minutes)
	98	Park and ride at Southglade Drive? 1. Yes 2. No
	99-100	Access time to Southglade Drive (in minutes)
	101	Park and ride at Wilkinson Street? 1. Yes 2. No
	102-103	Access time to Wilkinson Street (in minutes)
39.	104	Other park and ride locations 1. Yes - details given 2. Yes - no details given 3. No

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Question Nº	Box Nº	Code
40.	105	Age 1. Under 18 3. 25-34 6. 55-64 2. 18-24 4. 35-44 7. 65+ N.B. Age group 45-54 missing. Code as 5 where this occurs.
41.	106	Sex 1. Male 2. Female
42.	107	Income 1. <5k 4. 15-20k 2. 5-10k 5. >20k 3. 10-15k
43.	108-109	Household size
44.	110	1. Comments given 2. No comments given

(C) QUESTIONNAIRES 3201 - 4800 (Blue)

Code as for questionnaires (A)

(D) QUESTIONNAIRES 4801 - 6400 (Green)

Code as for questionnaires (A) up to question 36 (Box number 80)

Question Nº	Box Nº	Code
37.	81	0. As Now 1. Earlier 2. Later
	82-88	Code as box 81
38 to 42	89-94	Code as for questionnaire (A)