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ABSTRACT

MAY, A.D., F.O. MONTGOMERY and M.D. WHEATLEY (1980) Work journey rescheduling. Report of Surveys. Leeds: University of Leeds, Inst. Transp. Stud., WP 150 (unpublished).

In order to model the possible effects of rescheduling the work journey on city centre peak period traffic congestion, it was necessary to obtain information about the current employment position in the city centre, and about traffic conditions in the peak period. To this end, a series of surveys were designed and implemented to collect information from a stratified sample of centrally located employers; a sample of their employees; and about traffic conditions between the hours of 07.30 and 09.30 along selected routes leading into the city centre.

Problems in running the surveys were encountered and overcome, and the resulting information covered:

- Employee numbers, their permitted work hours, and the type of schedule worked per employer.

- The Standard Industrial Classification (SIC) of each employer.

- Car parking facilities provided by employer.

- Bus facilities provided by employer.

- Origin of employees' journey to work.

- Mode(s) used in employees' journey to work.

- Employees' actual arrival at and start work times, together with departure from work time, for the week preceeding the survey.

- Personal characteristics of employees.

- Structure of employees' households.

- Journey times and traffic flows along selected corridors.

The data thus collected was used to provide a base situation against which modelled alternative work hour strategies could be tested.

ACKNOWLEDGEMENTS

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1.   INTRODUCTION

1.1 Form of the Report

     This report is one of a series describing the results of a study of
the possible effects of Work Journey Rescheduling. Other reports will
include:

     1)   a review of the literature;

     2)   a detailed description of the modelling work; and

     3)   an examination of the model results and conclusions.
This report describes the surveys conducted; the following paragraphs
offer a brief description of the modelling process and provide a
context for the discussion of surveys.

1.2 Study Background

     The study is being carried out by the Institute for Transport
Studies, University of Leeds, and is funded by the Department of
Transport (D.Tp.), London. The objectives of the study are briefly:
to examine the present pattern of journey to work in the study area,
with respect to their distribution by location and by time; to
identify present levels of flexible/staggered work hours as an identification
of potential use; to construct a model to replicate the existing pattern of
traffic in the study area over the morning peak period; to develop suitable
strategies for rescheduling work journeys; to use the model to test the
likely effect of these strategies on traffic conditions over the peak.

1.3 Choice of the Study Area

     Wakefield was chosen as the study area for several reasons, as
follows: the town was identified as being likely to benefit from peak
spreading (WYTCONSULT, 1976); there is a fairly high proportion of
technical/clerical/administrative employment in the central area of the
town, thus rendering it suitable for the introduction of flexible working
hours; the Institute was already co-operating with West Yorkshire C.C.,
using the Wakefield traffic network as a test-bed for the SATURN model
(Simulation and Assignment of Traffic to Urban Road Networks). (See
Hall, Van Vliet and Willumsen, (1980).).

1.4 Study Methodology

     The subject of work journey rescheduling and other forms of peak
spreading is a very complex issue, involving a consideration of
individuals' decision making processes; the constraints imposed on
choice by transport, workplace and household schedules; modal split;

the effects on public and private transport work journeys; secondary effects on non-work trips.

A full study of these issues would require a much larger budget in terms of time and resources than was available to this project, and consequently it was necessary to adopt a less ambitious approach to the problem which would nevertheless provide useful results and perhaps form the basis of later studies.

The problem of modelling the effects of work journey rescheduling can be seen as falling into two sections:

1)   The response of individual employees to strategies.

2)   The effect of that response on traffic conditions.

In the simplified methodology adopted, only (2) above is actually modelled, i.e. the response to strategies is not modelled, but rather assumed responses are input to the model.   These assumed responses are however based on the surveyed arrival times of employees in similar firm types where flexible hours already apply.

The model is designed to enable an assessment to be made of the effects on traffic conditions of a given set of work hour patterns. Therefore by testing a range of strategies, from 'do nothing' through feasible to extreme, it will be possible to determine the nature and scale of their effects in terms of total traffic flows, their distribution by time during the peak and the resulting effects on speeds, delays and fuel consumption.   As far as we are aware no other studies   have modelled the effect of work journey rescheduling on total traffic conditions   or obtained the detailed disaggregation of flows, travel figures and delays which are anticipated from this study.

In modelling effects on traffic three simplifications have been adopted.   The first is to restrict the modelling procedure to private vehicles.   This is because : car is the main mode for the journey to work in Wakefield; bus schedules in Wakefield are not peaked, hence there is no possibility of reducing costs by reducing peak provision; the main savings to public transport passengers will therefore be from the same source as for all other traffic i.e. reduced delays; origin-destination data for bus passengers was not available and would have been too costly to collect.

The second simplification was the assumption that modal split would be unaffected by rescheduling strategies. The reasons for making this assumption are: the development of a modal split model sensitive to changes in the time of travel as well as (say) perceived costs of alternatives, would involve considerable effort amounting to a separate project; any changes in the modal split are likely in any case to be very small. (May, Montgomery and Wheatley, 1980a).

The last simplification is the decision to model the morning peak period only. Any attempt to model the interaction of changes in morning arrivals with changes in evening departures would necessitate examination of the individual's decision making process. The reasons for not modelling this have already been explained.

To summarise then, the methodology adopted consists of:

1)   Choice of strategies to be tested;

2)   Determination of response to the strategy on a firm by firm basis, based on existing responses in similar types of firm (based on SIC category);

3)   Use of responses as input to a model as described later; the model being restricted in the following ways: it does not model public transport specifically; it does not include a modal split model; it models the morning peak period only; it does not allow for possible re-timing of non-work trips (although re-routeing of all trips is allowed).

1.5 Choice of Strategies

In determining the strategies to be tested in the model, several factors have to be considered.

Firstly, what opportunities are there for introducing changes to working hours? The answer to this depends on the employment structure of the study area (principally what proportion of firms are amenable to the operation of flexible or staggered working hours), and the extent to which flexible/staggered working has already been implemented. These facts were obtained from the Stage 1 (employer) surveys described later.

Secondly, what are the constraints? Assuming that the implementation of any recommended strategy would be centrally organised, a balance would need to be struck between ease of organisation and effectiveness of the scheme. The greatest effects in terms of congestion relief will

be obtained by concentrating on the areas where employment is most concentrated and most amenable to change, and for these reasons the strategies have been restricted to firms in the central area of Wakefield (as defined later).   Ease of organisation dictates an upper limit to the number of firms involved in any scheme.   For this reason those firms employing less than 15 employees have been excluded from the strategies. North American experience suggests that firms in this size range tend not to respond to flexible/staggered hours schemes as they have problems covering absent staff, and in general do not perceive any benefits of peak spreading to themselves in terms of increasing employee morale (May, Montgomery and Wheatley, 1980a).   The second constraint lies in a consideration of how many employers are likely to co-operate, and to what extent.   It has not as yet been possible to approach employers for their reactions on this, so that the strategies remain hypothetical in that sense. However it is intended that at a later stage, interviews will be arranged with the management of several target firms to obtain their views on the acceptability of those schemes which produce the most promising results from the modelling process.

The third and final constraint concerns the individual's response to the strategies.   Where staggering of work hours (either within or between firms) is being contemplated, we are constrained in the amount by which employees should be asked to alter their arrival time, and will adopt the criteria established by Cohen in the Manhattan study (Cohen 1968).   Where flexible working is being considered, evidence suggests that employees tend after an initial period to settle into a weekly pattern, and that the factors determining their choice of hours are mainly connected with household commitments rather than transport (Jones 1978; May, Montgomery and Wheatley, 1980b).   However as previously stated the proper consideration of these factors is outside the scope of this study, and rather it will be assumed that the general form of arrival profiles of employees in firms already operating flexible working hours, are transferable.   In doing so only the shape of the profiles will be considered transferable;   their position on the time axis will depend on the limits imposed on flexible schemes at individual firms.

1.6   Modelling procedure
Reduced to its bare essentials, the modelling process adopted involves the assignment of O-D matrices to a network using a sophisticated simulation/ assignment program 'SATURN'   The use of SATURN allows the network to be

modelled in some detail, ensures that the assignment process emerges, and facilitates the comparison of different assignments in terms of either overall performance indicators or conditions at individual junctions.

The essential difference from normal traffic assignment is that, rather than assigning the peak 1½ hour matrix as a whole, it is disaggregated into 15 minute time slices, and the resulting component matrices assigned to the network sequentially. The two main problems raised by adopting this method are firstly how to disaggregate the peak period O-D matrix temporally, and secondly how to ensure that the conditions simulated at the end of one period are transferred to the beginning of the next. The solution adopted to these problems is now discussed briefly.

Prior to its disaggregation, it was necessary firstly to ensure that the total O-D matrix was consistent with the data which would be used to effect the disaggegation. The original O-D data was supplied by W.Y.C.C. from the WYTCONSULT study (1975 surveys) and was split by purpose (commercial vehicles (cv's), home based work (HBW), and all other trips (other)). These matrices were added together and the total O-D matrix updated to 1980 conditions by means of the UPDATE program. This program is a companion to the SATURN suite, and uses maximum entropy techniques to determine the O-D matrix which gives the best fit to a set of input turning movements/link flows; i.e. the base matrix is amended in such a way that, when assigned to the network, the assigned flows/turning movements will be a "best-fit" to the set of observed flows at those locations.

Following the production of an acceptable total O-D matrix, the next step is to disaggregate it by purpose (CV, HBW, OTHER). This is necessary firstly because the strategies to be tested apply to only one part of the total matrix - viz that part of the HBW with destinations in the central area: and secondly because the distribution of the different purpose matrices over time is not identical. Disaggregation by purpose is carried out by pro-rating each O-D element according to the 1975 purpose split.

Separate procedures are then followed for the temporal disaggregation of these matrices. Essential to the method used was the division of the study area into three by means of an inner and outer cordon. The

inner cordon, enclosing the central area, runs just inside the dual
carriageway inner relief roads (Ings Road, Marsh Way) and the main rail
line through Westgate Station (Figure 1). The outer cordon, enclosing
the intermediate area, defines the limit of the network modelled in
SATURN. As already mentioned, rescheduling strategies will only apply
to firms in the central area, however, in establishing the base
conditions, HBW trips to zones in both the central and intermediate
areas will be disaggregated on the basis of the arrival patterns of
employees at firms in those zones. These patterns, or profiles, are
obtained from the stage 2 (employee at work) surveys and consist of a
set of curves fitted to the surveyed cumulative arrivals at each firm.
Using information from the Stage 1 surveys and the 1976 census of employment
each firm in the central and intermediate areas was allocated a profile
based on its SIC and stated work patterns.

Thus by weighing the firm arrival patterns by the numbers of
employees arriving at each firm as a car driver, profiles of car arrivals
by zone are obtained, and these profiles are used in disaggregation of
that part of the HBW matrix with destination in the central or intermediate
areas.

The remaining parts of the matrix are disaggregated as follows:

1) The commercial vehicle matrix is disaggregated on the basis of the
    flows of C.V's across the inner and outer cordons, each destination
    being associated with the appropriate cordon.

2) Those parts of the HBW and OTHER matrices with external destinations,
    are disaggregated on the basis of the flows across the outer cordon
    outbound.

3) Those parts of the OTHER matrix with destinations in the central
    and intermediate areas are disaggregated on the basis of the flows
    across the inner cordon inbound, after subtracting the element of
    those flows attributable to the HBW trips.

Once all the disaggregated matrices are produced, they are summed
by time period, thus obtaining six "total" matrices each containing the
trips to be loaded on the network in a 15 minute period. These matrices
are then assigned to the network consecutively using an enhanced version
of SATURN, the enhancement consisting principally of the facility to pass
over the queues simulated at the end of one time period to the beginning
of the next.

1.7 <u>Data requirements</u>

1.7.1   There are three main requirements for data in the study:

    i)   Background data

    ii)   Data for input to the model

    iii) Data for validating the model output.

1.7.2   Background data involves collecting information which 'sets
the scene'. It includes determining the current extent of flexible or
staggered work hours, together with the mode used by employees when
travelling to work, the origin of their work trip and the time at which
they are permitted to start work.

    Further to the above, more personal details of employees were
required for a later stage of the study - since abandoned. These
details included age, sex, job category and household structure.
Analysis is presented in Appendix L , as the information is not critical
to the modelling process.

1.7.3   Data for input to the model involves: obtaining details of
the road network in Wakefield (link lengths, run times, junction
capacities and traffic signal timings) for creating the simulation-
assignment network used by SATURN; obtaining origin-destination data
for the peak period by purpose as previously described; obtaining
automatic and classified counts to compensate for daily variation in
flows; obtaining turning movement and link counts throughout the
network (149 counts collected by WYCC) for updating the O-D matrix;
obtaining classified cordon counts by time periods and details of
arrival times at work for a sample of employees stratified by the SIC
of the employer, both of which are used to split the O-D matrix into
time slices; obtaining details of the SIC of each firm, used to
aggregate data for individual employers of the same SIC category,
which in turn is used to expand the stratified sample of arrival times;
and finally obtaining zonal location and number of employees of each
firm, again used to expand the stratified sample of arrival times.

1.7.4   Data required for validation of model output involves
obtaining details of journey times (delays), along selected links by
time period, which will be used to check against delays output by the
model in response to various strategies under test.

1.8 Survey organisation

While there was some data available on the road network flows and O-D movements, it was necessary to collect the data required on employers, employees and traffic variations during the peak. Data which could not be collected within the study constraints had to be synthesised from the survey responses.

The surveys which have been carried out can be split into two subsections: i) employer and employee at work surveys; and ii) traffic surveys. Employer and employee surveys are discussed in detail in chapters 2 and 3 respectively, whilst the Traffic Surveys form chapter 4.

The employer and employee at work surveys form stages 1 and 2 of what was initially envisaged to be a four stage process, namely:

1) Survey a sample of employers in the Central and Intermediate areas of Wakefield, stratified by SIC, basically to obtain current details of employment figures and work hour arrangements, together with obtaining permission from employers to survey a sample of those employees at work.

2) Employee at work survey, which obtained details of individual employees' journey to work and household characteristics, and asked whether they would agree to being interviewed at home with their family.

3) Employee at home survey, which would obtain mainly qualitative data on how the family would re-schedule its activities in response to a change in work hours. This data would be used as a check on the realism of the strategies chosen to be tested in the model. It would not be used to identify individual strategies for testing.

4) Follow-up employer survey at a few locations, in the light of results of model runs, again obtaining mainly qualitative data on the acceptability of strategies tested in the model.

Only stages 1 and 2 have been carried out at this time, but it is intended to carry out stage 4 towards the end of the study.

The Traffic Surveys involved:

i) Delay times along selected links by time period, the data being collected by registration number matching surveys and floating car techniques, and used in validating model output.

ii) Classified counts of inbound and outbound traffic by five minute time periods at crossing points of the two cordons, the data to be used in temporally disaggregating the O-D matrices used in the modelling process (see 1.6).

1.9 Data base

The main source of data used for identifying potential stage 1, and thus also stage 2, survey sites was the 1976 Census of Employment produced by the Department of Employment. This document was the most recent comprehensive list of employers and employee numbers available to the study team (the Census having ceased publication after 1978). The Census was made available for use on the strict understanding that no employer would be mentioned by name in any reporting of study findings. This confidentiality has been retained.

It is inevitable that, during the intervening five years between the compilation of the Census and the stage 1 survey, a proportion of entries for 1976 will have changed either location or number of employees, if not both. The study team was very much aware of this inherent problem, and made efforts to update the list of central and intermediate area employers. Verification of the continuing existence of all employers listed in the census and identified as being of interest to the study, was carried out in a number of ways. The first step was to refer all entries to the current copy of the G.P.O. telephone directory and list of large users in the G.P.O. postcode directory. Any employer not found in either was then checked by contacting G.P.O. directory enquiries, as it was possible that a recent change in location might not have been recorded in the standard directory. A list of employers not found by either of the above methods was then made (8 in all).

As a secondary check on the continuing existence of employers in the central area only, lists of employers to be found in each street in the central area were drawn up according to the census data, and the study team personally walked each street checking employers existing against employers listed.

It should be noted that at this stage of the study, although a threshold for the stratified sample had been decided upon, all employers entered in the census (which itself has a lower threshold of 5 employees) were checked in this manner.

Thus, the effect of this checking procedure was twofold:
i)   to verify that all employers listed for 1976 were still in existence.
ii)   to add to the list any employers not entered in the census, but
      noted during the study team's visits to Wakefield.

However, the main problem with the above methods was that no verification of employee numbers could be carried out. In fact, it proved impossible to check employee numbers, and the 1976 figures were used in compiling the list of stage 1 sites. Any new firms noted during visits to Wakefield were surveyed unless they appeared from inspection to employ less than 15 people.

Any firms positively identified as no longer operating in the study area were removed from the list of potential survey sites, but any 'doubtfuls' were retained, which resulted in a number of employers no longer operating being sent questionnaires (see 2.5). It was decided to err on the side of caution when removing potential survey sites, and the only reason for removal was the demolition or obvious disuse of the listed address.

The checking procedure led to 14 employees being added to the list of survey sites, 8 identified as 'doubtfuls', and a further 4 removed from the list.

A further problem encountered in using the Census of Employment was that it is compiled on the basis of pay points, not individual locations. Thus, if, for example, there are a number of branches of a particular firm located in different places, they will all be entered as being in one location, i.e. the pay point. This problem is particularly evident when dealing with local authority offices; for example, people working in local authority schools and Technical Colleges will be listed under the Department of Education, from which they are paid. The way in which this problem was overcome was firstly to be aware of the existence of branches of firms or departments (identified from the study team's visits to Wakefield), and then to send individual locations a questionnaire stressing that it should be completed only for employees working at that location. Inevitably some questionnaires were passed on to central offices, but in these cases the organisations concerned contacted the study team, who were then able to explain what information was required. In all, such queries were encountered four times, and in each case were successfully dealt with.

1.10 Survey Control Unit

Before embarking upon a discussion of the logistics and results of
the surveys, it should be mentioned that the surveys in principle had to
be passed as fit for circulation by the Government's Survey Control Unit
which, basically, is a watchdog body, whose brief is to check that any
surveys carried out in conjunction with government departments are necessary.
SCU also advises on the design and wording of questionnaires, interview
forms etc.

It was initially planned to begin stage 1 surveys in October/November
1980, with stage 2 running through November, and to this end a submission
to SCU was prepared in September 1980. Within the resource and time
constraints of the study, this timing would have given a further 5 months
for data analysis and implementation of stage 3 (Employee at Home).
However, SCU approval was not obtained for either stage 1 or stage 2 until
December 1980 and circulation had to be held back until January/February
1981. The implications of this setback were that it proved impossible to
implement stage 3 in the remaining time available,and that the final stage
2 responses were only ready for analysis one week before the scheduled
writing of this Report of Surveys. (Appendix P contains a copy of the
SCU submission form).

2. THE EMPLOYER SURVEY (STAGE 1)

2.1 Assumptions

A number of assumptions were made in deciding the stratification criterion and the threshold of size of firm for inclusion in the survey.

2.1.1 Stratification

It was assumed that data collected for a particular SIC group would be representative of all employers and employees in that SIC group, i.e. that differences in the distributions of types of work hour arrangement and arrival at work profile would be less between firms of the same SIC than they would between firms of different SICs. (Appendix A contains a list of SIC (Standard Industrial Classification) codes).

2.1.2 Threshold

In the initial stages of the study it was thought that a minimum threshold of 25 employees would be a satisfactory compromise between costs of data acquisition and the ability to gross up reliably, i.e. it was assumed that the percentage of employees working in firms of less than 25 people would be small. In fact, this threshold would have produced (from 1976 figures and for the central area only) 68 firms (16% of all central area firms listed in the Census of Employment), accounting for 5923 employees (62.4% of employees in the central area). It was felt that these figures gave too low a margin for error in the event of non-response, and the threshold was lowered to $\geqslant$ 15 employees, producing 130 central area firms (30.4%) accounting for 7121 employees (74.9%), a considerable expansion, particularly in the number of firms.

2.2 SIC Coverage

From the 1976 Census of Employment, together with the checking procedures described in 1.9, 140 workplace locations in the central area were identified as employing 15 people or more. The range of SICs covered by these locations is shown in Table 2.1, together with the range of SICs covered by the 80 firms identified in the intermediate area as employing 15 people or more.

The table shows that the majority of SICs to be found in one area can also be found in the other. Thus, as the study is concerned with modelling the central area in detail, all central locations were sent questionnaires, together with 7 in the intermediate area, included to provide extra SIC coverage should the response rate in the central area

turn out to be low. Thus, in effect, intermediate area data was intended to supplement central area data, particularly in cases where a low response rate would mean that no information would be obtained for some SICs. For example, SIC 3 (Food, Drink and Tobacco) has only 1 firm in the central area, and so 1 firm of SIC 3 was surveyed in the intermediate area also to provide a 'safety net' in the event of non-response from the central area firm.

Thus, 147 questionnaires were sent out, 140 to central area locations and 7 to intermediate area locations.

2.1 SICs Covered by central and intermediate area firms

SIC	Central	Intermediate
3	✓	✓
6		✓
7		✓
12		✓
13		✓
15	✓	✓
17	✓	
18	✓	
20	✓	✓
21	✓	✓
22	✓	✓
23	✓	✓
24	✓	✓
25	✓	✓
26	✓	✓
27	✓	✓

2.3   Questionnaire Design

Not only are there a large number of different types of work hour
arrangements in operation in many organisations, but the terminology
connected with these arrangements is not as yet standard.   3 examples
from the study will show the problems involved:

1)   Specific start times between 0800 and 0900 are chosen by employees,
     but once the time is chosen, the employee must have arrived at work
     by that time.   No day to day variation in start times is allowed.

2)   Start times are allowed at any time between 0900 and 0930, with day
     to day variation allowed within these limits.

3)   Start times are allowed at any time between 0800 and 1000, with day
     to day variation allowed within these limits.

The above three arrangements were each considered by the employer operating
them as 'flexible work hours'.   The study team would have regarded 1) as
employee chosen staggered hours;   2) as limited flexible hours;   and 3) as
flexible hours.

Thus, in designing the questionnaire (see Appendix B for a copy of the
questions asked), it was important to define what was meant when questions
relating to specific work hour types were asked.   Fixed and flexible hour
arrangements were defined at the top of the sheet, whilst the facility for
identifying staggered hours was built into the section relating to fixed
hours.   (See Appendix C for a discussion of how this was done, together with
explanations of other parts of the questionnaire).

A further aspect of questionnaire design, again applicable to both
stage 1 and 2 forms was the inclusion of space at the end for respondents to
'vent their feelings' about travelling conditions in Wakefield generally.
It was noticeable when completed forms were received from both stages that
approximately 50% of the forms had had comments written in this space.
The comments themselves have not been analysed, and the 'question' was
included simply to try to boost response rates by making the respondent
feel that his or her particular comment might be taken into account in
future alterations to the Wakefield transport system.   However, in looking
through completed forms, comments relating to the adoption of 'flexitime'
or alternative work schedules or strategies to spread the peak seemed to
appear regularly.   This in itself is interesting as it tends to show that
peak period travellers are aware of the benefits of peak spreading, and are
aware of the adoption of alternative work hours as a possible means of
achieving reduced peak period congestion.

The comments are presented in summary in Appendix D for stage 1 and Appendix E for stage 2.

2.3.2. The questions included in the Stage I questionnaire (See Appendix B) covered the following points:

1) Details of numbers of employees, broken down by job category and sex.
2) Details of numbers of employees, broken down by type of work hours and job category.
3) Details of permitted start and finish times for different types of work hours.
4) Details of on-site car parking facilities and the basis on which spaces were allocated.
5) Whether a works bus service was provided.
6) Whether the firm would agree to a number of their employees being surveyed at a later date.

The questionnaire, therefore, is concerned mainly with employee numbers, their job categories and the hours they work, with some background information about ease of parking also being sought.

2.3.3. Some time was spent considering how best to preserve the confidentiality of responses. It was eventually decided to use a sequential numbering system, thus obviating the need to write the name of each individual surveyed site on the actual questionnaire form. A master list of firms' names, addresses, zones and SICs was kept at I.T.S., each site having a unique identifying number (the master list remains at I.T.S. and will be destroyed at study completion in August 1981). The identifying number was printed on each respective questionnaire, so that the responses could be related to their sites on return. In all subsequent analyses firms are referred to by number only, but it was necessary for the study team to know which firms had responded for follow up purposes.

2.4 Questionnaire Testing

An important aspect of questionnaire design is the ability to elicit all required information from the respondent, whilst still preserving at least a superficial element of simplicity. The stage 1 questionnaire is not a long document, and has proved in all but the largest organisations to have been relatively easy to complete.

It was tested in two large organisations, one manufacturing and one administrative, before it was circulated. Both organisations operated a range of work hour types and employed over 150 people. In both tests the questionnaire was taken by a member of the study team to the Personnel Manager of the organisation, and completed in approximately 5 minutes. Comments received from the respondents were not unfavourable, and together with comments received from colleagues of I.T.S. involved in questionnaire design, this gave the study team confidence in the questionnaire's ability to collect the necessary information, whilst causing a minimum amount of disruption to the workings of the responding organisations.

2.5 Questionnaire Circulation

2.5.1 147 questionnaires were sent out, as explained in 2.2. Of these 147, 26 were returned by the G.P.O. as 'gone away' (all central area locations). These 26 included the 8 'doubtfuls' identified earlier (section 1.9) together with a further 18 which were considered 'suspect' but were included in the survey circulation.

Thus, the total circulation figure was reduced to 121 (147-26). Two firms had moved from central area locations to intermediate area locations between 1976 (Census of Employment) and 1981 (Survey), and so the circulation figures were again adjusted to take this into consideration. Thus, the figures were as follows:

Total sent out	=	147 - 26	= 121
of which : Central area	=	140 - 26 - 2	= 112
Intermediate area	=	7 + 2	= 9

2.5.2 Questionnaires were circulated by post, but with no preliminary warning letter. It was thought that by sending out questionnaires 'cold' in this way the chances of refusal might be reduced, since it would be almost as easy for a firm to complete and return the questionnaire as it would be to write a letter refusing to take part. In fact, only 5 firms responded protesting at inclusion in the survey, but it is impossible to assess how the response rate would have been affected by a preliminary letter.

Each questionnaire was accompanied by a covering letter (Appendix F), which explained the purpose of the survey, the need for the information and assured the confidentiality of replies. Also included with each questionnaire was a 1st class reply-paid envelope.

2.5.3 All Stage 1 questionnaires were sent out on Friday January 23rd
1981, the majority of responses arriving during the following fortnight
(January 26th - February 6th).   A series of follow-up phone calls were
made to non-responding firms on February 9th, and again on and after
February 13th, with the intention of obtaining responses particularly from
firms in SICs which were under-represented by the responses received so
far.   Additionally, follow-up letters (Appendix G) together with replacement
questionnaires, were sent out to 9 large employers in the central area on
February 9th.   The phone calls produced a further 8 responses, and the
letters a further 7.

2.6   Central Area Response Rates

2.6.1   Table 2.2 shows the response rate to central area Stage 1 circulation
in terms of numbers of firms by SIC.   In summary it shows that of the 112
firms sent questionnaires, 27 (24.1%) responded, filling in the questionnaire
and agreeing to discuss possible participation in Stage 2;   20 (17.9%)
responded filling in the questionnaire but not agreeing to discuss possible
Stage 2 participation;   5(4.5%) responded not having completed the
questionnaire (either objecting to having been sent a questionnaire or not
having sufficient time to complete it);   and 60(53.6%) did not respond at
all, despite follow-up letters and phone calls.

Table 2.3 shows corresponding figures to Table 2.2, but for the
numbers of employees that the firms represent.   Thus, the 112 firms circulated
with questionnaires represent 5432 employees;   the 27 firms agreeing to
discuss Stage 2 participation represent 2032 employees, which is 37.4% of
the original 5432;   the 20 firms not agreeing to discuss Stage 2 participation
represent 1463 employees (26.9% of the original 5432);   the 5 firms not wishing
to participate in Stage 1 represent 440 employees (8.1% of 5432); and the 60
firms not responding represent 1497 employees (27.6% of 5432).   Thus it can be
seen that although only 27 firms (24.1% of the original 112 firms surveyed)
agreed to potential Stage 2 participation, they represented more than one-
third of the total number of employees working in the 112 firms.

Overall, 47 central area firms responded to Stage 1 (42%), representing
3495 employees (64.3%).

TABLE 2.2   STAGE 1   RESPONSE   (FIRMS)

Central Area

1	2	3	4	5	6
SIC	Total No. firms with≽ 15 employees	No. firms agreeing to Stage 2 (%)	No. firms not agreeing to Stage 2 (%)	No. firms not wishing to participate in Stage I (%)	No. firms not responding to Stage I (%)
3	1				1 (100)
15	3		1 (33.3)		2 (66.7)
17	1				1 (100)
18	3		2 (66.7)		1 (33.3)
20	5	1 (20.0)			4 (80.0)
21	3	3 (100)			
22	7	2 (28.6)			5 (71.4)
23	27	4 (14.8)	7 (25.9)	4 (14.8)	12 (44.4)
24	17	3 (17.6)	1 (5.9)		13 (76.4)
25	11	1 (9.1)	3 (27.3)		7 (63.6)
26	12	4 (33.3)	1 (8.3)	1 (8.3)	6 (50.0)
27	22	9 (40.1)	5 (22.7)		8 (36.4)
Total	112	27 (24.1)	20 (17.9)	5 (4.5)	60 (53.6)

Notes

i)   All firms in col. 2 were sent Stage I questionnaires.

ii)   Percentages in cols 3 - 6 are of the total number of firms with 15 employees in each SIC.

iii) Cols. 3 and 4 represent firms for which we have up to date information.

iv)   Firms in cols. 5 and 6 did not provide any information, therefore 1976 employment figures are used.

TABLE 2.3   STAGE 1 RESPONSE (EMPLOYEES)

Central Area

1	2	3	4	5	6
SIC	Total No. employees in firms with$\geqslant$ 15 employees (%)	No. employees in firms agreeing to Stage 2 (%)	No. employees in firms not agreeing Stage 2 (%)	No. employees in firms not wishing to participate (1976) (%)	No.employees in firms not responding (1976) (%)
3	160 (3.0)				160 (100)
15	168 (3.1)		140 (83.3)		28 (16.7)
17	18 (0.3)				18 (100)
18	283 (5.2)		236 (83.4)		47 (16.6)
20	168 (3.1)	44 (26.2)			124 (73.8)
21	345 (6.4)	345 (100)			
22	465 (8.6)	239 (51.4)			226 (48.6)
23	973 (17.9)	260 (26.7)	368 (37.8)	295 (30.3)	50 (5.1)
24	490 (9.0)	88 (18.0)	28 (5.7)		374 (76.3)
25	347 (6.4)	25 (7.2)	230 (66.3)		92 (26.5)
26	488 (9.0)	106 (21.7)	88 (18.0)	145 (29.7)	149 (30.5)
27	1527 (2.8)	925 (60.6)	373 (24.4)		229 (15.0)
Total	5432 (100)	2032 (37.4)	1463 (26.9)	440 (8.1)	1497 (27.6)

Notes

i)   Percentages in cols 3 - 6 are of the total number of employees in each SIC

ii)   Col. 2 is a combination of 1976 and updated employment figures, and therefore cannot be taken as a definitive employment figure for 1981.

iii)   Cols. 3 and 4 contain employment figures from Stage 1 returns.

iv)   Cols 5 and 6 contain employment figures from the 1976 census of employment.

v)   Employee numbers for firms not responding are taken from the 1976 Census of Employment, and must therefore be treated with caution, being 5 years out of date (see 2.2).

2.7   Intermediate Area Response Rates

2.7.1   Tables 2.4 and 2.5 show response rates for the intermediate area
by SIC, and correspond to Tables 2.2 and 2.3 respectively. Intermediate area
response rates are based on a total surveyed population of 9 firms accounting
for 1,126 employees.

A comparison of Tables 2.2 and 2.4 shows the degree of success achieved
in obtaining Intermediate area data to supplement gaps in Central area data.
Intermediate area responses gave SIC coverage for groups 6, 7, 15 and 27
(metal manufacture, mechanical engineering, clothing and footwear, and
administration respectively), two of which were already covered by Central
area responses (15 and 27). Agreement to Stage 2 participation was received
for SICs 15 and 27 only, again duplicating Central area responses. (In
fact, the two firms involved were those that had relocated between 1976
and 1981, and were originally included in Central area circulation - see
2.5.1).

Tables 2.4 and 2.5 show in summary that 9 firms were surveyed in the
Intermediate area, accounting for 1,126 employees. Of these, 2 firms agreed
to discuss Stage 2 participation (22.2%) representing 521 employees (46.3%);
2 firms did not agree to discuss Stage 2 participation (22.3%), representing
378 employees (33.6%); and 5 firms did not respond (55.6%) accounting for
227 employees (20.2%).

2.8   Response Rates by SIC

2.8.1   Table 2.6 shows SICs identified in the Central area against responses
per SIC for both Central and Intermediate areas.

Table 2.6   Central Area SICs by SICs covered by Central and Intermediate
             Area Responses

SIC in Central area	SIC responding (Central and Intermediate areas)
3	—
15	✓
17	—
18	✓
20 - 27	✓

This general table shows that all SICs identified in the Central area have
been covered by either Central or Intermediate area responses, with the

TABLE 2.4   STAGE I   RESPONSE (FIRMS)

Intermediate area

SIC	Total no. firms with ⩾15 employees	No. firms surveyed	No. firms agreeing to stage 2	No. firms not agreeing to stage 2	No. firms not responding
3	2	1			1
6	7	3		1	2
7	7	3		1	2
15	1	1	1		
27	21	1	1		
Total	38	9	2	2	5

Note

Firms in the intermediate area were surveyed in order to expand the range of SICs available in the central area.

TABLE 2.5 STAGE I RESPONSE (EMPLOYEES)

Intermediate area

SIC	No. employees in firms with ⩾15 employees	No. employees in firms surveyed	No.employees in firms agreeing to stage 2	No.employees in firms not agreeing to stage 2	No. employees in firms not responding
3	135	119			119
6	863	375		301	74
7	815	111		77	34
15	357	357	357		
27	1350	164	164		
Total	3520	1126	521	378	227

exceptions of SIC's 3 and 17 (Food, Drink and Tobacco and Timber/Furniture respectively). Only 1 firm in each of these SICs was identified as employing $\geqslant$ 15 people in the Central area (160 in SIC 3 and 18 in SIC 17 according to 1976 figures).

Response figures by SIC are given in detail in Tables 2.2 to 2.5 (split by Central and Intermediate areas) but are presented in summary in Table 2.7 as overall percentages of firms and employees identified in the Central area.

The table shows that SICs 3 and 17 are not covered, but they have a low representation in the Central area anyway (Table 2.2); SICs 20, 22, and 24 (Construction, Transport and Communication, and Insurance, Banking etc. respectively) have low response rates for firms, but responses for SIC 22 cover more than half the employees identified in the Central area in that SIC, whilst SIC 20 has a low representation in the Central area (3.1% of employees - Table 2.3). SIC 24 is the only doubtful area in terms of both firm and employee responses.

Table 2.7   Overall response from Central and Intermediate areas
as a percentage of Central area firms and employees by SIC

SIC	% of firms in Central area	% of employees in Central area
3	–	–
15	66%	295.8% *
17	–	–
18	66%	83.4%
20	20%	26.2%
21	100%	100%
22	28.6%	51.4%
23	40.7%	64.5%
24	23.5%	23.7%
25	36.4%	73.5%
26	41.7%	39.8%
27	68.2%	95.7% **

* this high percentage is produced by a firm of SIC 15 being surveyed in the Intermediate area and employing more people than were employed in all Central area firms with 15 or more employees in SIC 15.

** this figure also includes intermediate area responses.

2.9   Analysis of Response

2.9.1   In analysing Stage 1 responses, we are concerned with building
up as detailed a picture of Central area work hour patterns as possible.
To this end we apply the assumptions specified in 2.1, and assume that
responses obtained from the intermediate area are transferable to the Central
area.   Thus, the split between the two areas now becomes basically irrelevant,
and analysis is presented in terms of Central area only, but using data
collected from both areas.

Data from 2 firms in the Intermediate area, (one each in SICs 6 and 7, metal
manufacture and mechanical engineering respectively) are not included in
tables 2.8 and 2.9 or in the discussion concerning these tables, since there
are no firms in these categories in the Central area.

2.9.2   Analysis of Stage 1 responses in terms of the range of type of
work hours currently in operation is presented in tables 2.8 and 2.9.

Table 2.8 shows the numbers of firms surveyed per SIC working each of
the work hour combinations identified from the survey response.   From the
table it can be seen that fixed and staggered hours i.e. no variation in start
time from day to day, form the largest groups of work hours (36.7% and 38.8%
of the response respectively), whilst flexible hours are only worked by 4.1%
of the firms responding.   10 firms in total (i.e. 20.4% of the 51 firms
responding) have a combination of work hour arrangements.

In terms of variation by SIC, table 2.8 shows that SIC 27 (Administration)
has the largest variation in types of work hours, with a predominance towards
fixed and staggered hours, whilst the next largest variation is shared by
SICs 21, 24, 25 and 26 (Gas, Electricity and Water; Insurance and Banking;
Professional and Scientific Services; and Miscellaneous Services respectively).
SIC 23 (Distributive Trades) has a predominance of staggered hours, whilst
SIC's 15 and 18 (Clothing and Footwear, Paper Printing and Publishing) work
only staggered hours.

The size of the response rate means that for all SICs . with the exception
of 21 (Gas, Electricity and Water) where 100% of firms responded, the information
is incomplete, and the spread of work hour types can only be taken as indicative
not definitive.

SIC	Flexible Hours	Fixed Hours	Staggered Hours	Fixed and Flexible Hours	Staggered and Flexible Hours	Staggered Hours and Rotating Shifts	Fixed Hours and Flexible Hours and Rotating Shifts	Staggered Hours and Flexible Hours and Rotating Shifts	Total
15			2						2
18			2						2
20		1							1
21		1	1				1		3
22				1				1	2
23		8	3						11
24		1	2	1					4
25		1	2	1					4
26		3	1			1			5
27	2	3	6	1	2	1			15
Total	2 (4.1%)	18 (36.7%)	19 (38.8%)	4 (8.2%)	2 (4.1%)	2 (4.1%)	1 (2.0%)	1 (2.0%)	49 (100%)

2.9.3   Table 2.9 shows the split of work hours in terms of employee numbers
per SIC surveyed. The table shows that staggered hours are the most common
type of work hour arrangement, accounting for 49.6% of the employees in
the firms responding. Fixed hours account for 31.6% of employees; whilst
flexible hours account for 17.6%.

The variation in work hour types by SIC in summary shows that flexible
hours in general are less widely used, the highest occurrences being in SIC's
21, 27 and 22 (Gas, Electricity and Water; Administration and Transport/
Communication respectively). As would be expected, those services dealing
with offering services to the public, such as shops and banks (SICs 23
and 24) have a heavy reliance on fixed and staggered hours. Manufacturing
firms (e.g. SICs 15, 18 and 20) also have a reliance on fixed and staggered
hours. In terms of opportunities for altering work hours, SIC 27 (Administration)
would seem to present the most likely opportunity for further introduction of
flexible hours, through the combination of the type of work involved - mainly
office based and the high proportion of employees (65.2%) not currently working
flexible hours.

2.10   Grossing-up Procedure

2.10.1   The grossing-up of responses into the Central area base situation
was done in a relatively straightforward manner:

i)   the percentage split of employees working different work hour
types per SIC was calculated from the responding sample;

ii)   the percentage splits from i) were applied to the total number
of employees per SIC in the Central area identified from both
survey responses and 1976 Census of Employment figures for firms
not responding to the survey.

Thus, percentage splits were calculated on the basis of the combination of
Central and Intermediate area responses, but applied to the total employment
by SIC in the Central area only.

Table 2.10 presents the base situation as grossed up from survey responses
using the above method. In summary it shows the following overall percentage
split between work hour types:

Fixed Hours	Staggered Hours	Flexible Hours	Rotating Shifts
31.6%	49.6%	17.6%	1.2%

TABLE 2.9   SIC BY NUMBERS OF EMPLOYEES BY TYPE OF WORK HOURS
                    (STAGE 1 RETURNS)

TYPE OF WORK HOURS

SIC	Fixed Hours (%)	Staggered Hours (%)	Flexible Hours (%)	Rotating Shifts (%)	Total (%)
15		489 (98.4)	8 (1.6)		497 (100)
18		236 (100)			236 (100)
20	44 (100)				44 (100)
21	134 (38.8)	12 (3.5)	193 (55.9)	6 (1.7)	345 (100)
22	3 (1.3)	163 (68.2)	70 (29.3)	3 (1.3)	239 (100)
23	319 (50.8)	308 (49)		1 (0.2)	628 (100)
24	35 (30.2)	68 (58.6)	13 (11.2)		116 (100)
25	93 (36.5)	136 (53.3)	26 (10.2)		255 (100)
26	119 (61.3)	47 (24.2)	3 (1.5)	25 (12.9)	194 (100)
27	313 (39.2)	204 (25.5)	278 (34.8)	4 (0.5)	799 (100)
Total	1060 (31.6%)	1663 (49.6%)	591 (17.6%)	39 (1.2%)	3353 (100%)

Note

i) The total employee figure of 3353 represents all Stage 1 returns
    with the exception of 663 employees in SIC 27 for whom the type
    of work hour information was not given, and 378 employees in
    SIC's not found in the Central area. Thus 3353 + 663 + 378 = 4394,
    which is the total number of employees represented by firms responding
    to Stage 1 (Tables 2.3 and 2.5).

ii) Percentages given are of the total number of employees per SIC
    in responding firms in both Central and Intermediate areas, and form
    the basis of the grossing-up procedure.

The Central area, therefore, has as a base situation a predominance of staggered hours, closely followed by fixed hours. Flexible hours do not emerge as being widely used, and rotating shifts form an extremely small section of work hour types.

2.11   Analysis Technicalities

Analysis of the completed questionnaires was carried out on Leeds University's Amdahl V7A   computer, mainly using SPSS (Statistical Package for the Social Sciences) package programs, but also using some purpose written Fortran programs.

TABLE 2.10   BASE SITUATION FOR CENTRAL AREA FROM STAGE 1
                        SURVEY RESPONSES

TYPE OF WORK HOURS (Number of Employees)

SIC	Fixed Hours	Staggered Hours	Flexible Hours	Rotating Shifts	Total
15		165	3		168
18		283			283
20	168				168
21	134	12	193	6	345
22	6	317	136	6	465
23	494	477		2	973
24	148	287	55		490
25	127	185	35		347
26	300	118	7	63	488
27	599	389	531	8	1527
Total	1976	2233	960	85	5254

Note

The total figure of 5254 represents Central area employment figures
in firms with $\geqslant 15$ employees as on Table 2.3 with the exception of
SIC's 3 and 17, for which there is no survey data, thus 5254 + 160 +
18 = 5432.

3. THE EMPLOYEE AT WORK SURVEY (STAGE 2)

3.1 Objectives

The main aims of the Stage 2 surveys were to provide arrival at work profiles (see Section 1.6), and to obtain background data on individual employees (see Section 1.7).

3.2 Questionnaire Design

3.2.1 The questions included in the Stage 2 questionnaire (see Appendix H) covered the following points:

    i)   the origin of the journey to work;

    ii)   details of mode and elapsed time of the journey to work;

    iii)   details of bus service used in journey to work;

    iv)   details of type of car travel in journey to work;

    v)   details of where the car was parked at the destination;

    vi)   work hour arrangements;

    vii)   arrival at work, start work and leave work times;

    ix)   household structure;

    x)   whether the respondent would agree to an interview at home with his or her family.

3.2.2 Design points specific to the Stage 2 questionnaires revolved around not asking questions to which respondents might possibly object (particularly in the 'personal details' section). To this end, ages, for example, were grouped into categories, rather than asking the respondent to provide his or her exact age.

3.2.3 One of the initial aims of the Stage 2 survey was to identify a sample of employees willing to take part in a Stage 3 survey (Employee at Home – see Section 1.8). In order to do this details of household structure were collected, together with information which would be used to identify the head of the household. This was to be done based on a 'HATS' – type life-cycle basis (Jones, 1978; Carpenter, Clarke and Dix, 1980) which

necessitates identifying the ages of all household members, their educational or employment status, and the head of household. Thus, the household section of the questionnaire was included to obtain details of the potential Stage 3 sample. However, study constraints, retimetabling of the major tasks involved and low response rates to Stages 1 and 2 have meant that the Stage 3 survey has had to be abandoned, and so the household structure data can now only be used as background information.

However, at the design stage of the Stage 2 survey, attention was paid to the inherent problems of identifying not only the household structure in general, but the head of household in particular. It was felt in the latter case that simply asking who was the head of the household was insufficiently precise in definition since the term 'head of household' could have been perceived differently by different respondents. To avoid this, filter questions were included identifying the main wage earner of the household together with his or her age group, and that person was then assumed to be head of household.

3.3   Questionnaire Testing

3.3.1   The questionnaire was tested amongst a number of employees of West Yorkshire County Council, and no problems emerged either in design or in the coding of responses. Secondary tests were carried out amongst colleagues at ITS experienced in questionnaire design, and again no difficulties were perceived.

3.4   Sampling

3.4.1   Initially it was thought that the stage 1 response would be large enough to enable a selective sample of potential of Stage 2 participants to be drawn up. However, as Chapter 2 shows, Stage 1 responses were not large enough to enable selective sampling, and in the event all employers who agreed to potential Stage 2 participation were surveyed, unless their workforce arrived outside the peak period (e.g. night clubs, cinemas).

Within individual firms questionnaires were circulated to all employees.

3.5   Survey Implementation

3.5.1   The Stage 2 surveys were implemented as Stage 1 responses were still being received. The sequence of events once a firm had agreed to discuss Stage 2 participation was as follows:

i) a member of the study team contacted a management representative by phone to arrange a date for a meeting to explain what would be involved in the survey.

ii) At the meeting, copies of the questionnaire and covering letter were shown to the management representative, and any difficulties perceived by the firm were dealt with. (In only one case did this involve a slight restructuring of the questionnaire, where job categories were replaced by codes more familiar to the employees, but which corresponded to the 'professional-marginal, technical-clerical, manual-shop floor' categories on the original questionnaire).

iii) The management representative agreed to allow the survey to take place either at the meeting, or at a later date after consultation with trade union representatives. No firms refused to take part at this stage.

iv) The questionnaires and covering letters (see Appendix J for a copy of the covering letter) were either delivered or sent to the firm, and circulation details were arranged by the firm.

v) Completed questionnaires were either sent back to the study team, or collected from the firm.

3.5.2   There was only one occurrence of a firm subsequently refusing to allow Stage 2 to proceed after it had initially agreed to discuss participation in the Stage 1 questionnaire. No reason for refusal was given.

3.6   Response Rates

3.6.1   The response rates between individual firms varied quite markedly (Table 3.1), and it is thought that this was due to the ways in which the survey was regarded by the person in the firm responsible for internal circulation of questionnaires. It was noticeable that those firms whose management representative appeared interested in both the survey and the overall aims of the study provided a relatively high response rate. Table 3.1 also shows the date on which the questionnaires went to the firms, and the date on which they were received by the study team after completion. In some cases the elapsed time was as long as 2 months.

The responses from firm no. 117 were sent back to the study team but never received, despite attempts to track them down.

TABLE 3.1   RESPONSE RATES TO STAGE 2 BY FIRM

Firm Number	SIC	Zone (See Fig 1)	Employees	Responses (%)	Date Sent	Date Received
*6	21	1	12	8 (66.7)	5/3	25/3
18	20	2	44	13 (29.5)	11/2	17/2
22	23	3	66	30 (45.4)	17/2	24/2
30	24	4	16	14 (87.5)	5/3	16/3
44	27	10	38	26 (68.4)	19/2	26/2
50	26	6	18	3 (16.7)	25/2	16/3
57	25	5	25	10 (40)	11/2	13/2
62	27	6	20	7 (35)	24/3	29/4
63	27	6	34	9 (26.5)	24/3	29/4
64	27	16	120	11 (9.2)	24/3	29/4
65	27	16	20	3 (15)	24/3	29/4
66	27	6	117	24 (20.5)	23/2	16/3
67	27	6	469	283 (60.3)	24/3	29/4
83	24	7	40	36 (90)	11/2	17/2
84	26	7	54	9 (16.7)	20/2	14/4
86	24	7	32	26 (81.3)	20/2	25/3
88	27	Inter-mediate area	164	54 (32.9)	10/2	19/2
96	15	"	357	42 (11.8)	10/2	23/3
113	22	9	234	129 (55.1)	19/2	16/3
114	21	9	288	85 (29.5)	2/3	25/3
117	23	10	38	response gone missing	26/2	response gone missing
121	21	10	45	12 (26.7)	24/2	19/3
127	23	11	142	15 (10.6)	10/2	14/4
136	27	16	63	37 (58.7)	20/2	8/4
Total			2456	886 (36.1)		

*This firm has <15 employees, but according to the 1976 Census of Employment it had >15 it was therefore included in the Stage 1 survey, and agreed to Stage 2. It is, in fact, a subsidiary of a larger employer which also agreed to Stage 2, and although it was not individually surveyed, the parent firm circulated questionnaires to it and marked them as being from a different location.

3.6.2   Of the 51 firms responding to the Stage 1 survey, 27 in the Central area and 2 in the Intermediate area agreed to discuss the possibility of having their employees surveyed at work.

Table 3.2 shows Central area response figures for firms by SIC, and Table 3.3 shows the same information for employees.

A comparison of tables 3.2 and 3.3 shows the respective proportions of firms and employees involved in Stage 2. For example, if SIC 27 is considered, it can be seen that 9 firms agreed to participate, accounting for 40.1% of all firms of SIC 27 with 15 or more employees in the Central area (Cols. 2 and 3 of table 3.2). These 9 firms represent 925 employees, which account for 60.6% of all employees in firms of SIC 27 with 15 or more employees in the Central area (cols. 2 and 3 of table 3.3). 8 firms of SIC 27 were surveyed in Stage 2, which is 36.4% of all firms of SIC 27 with 15 or more employees in the Central area, and 88.9% of firms of SIC 27 with 15 or more employees in the Central area agreeing to take part in Stage 2 (cols. 4, 5 and 6 of table 3.2). The 8 firms surveyed represent 881 employees, which is 57.7% of all employees in firms of SIC 27 with 15 or more employees in the Central area, and 95.2% of employees in firms of SIC 27 with 15 or more employees in the Central area agreeing to take part in Stage 2 (cols. 4, 5 and 6 of table 3.3). All 8 firms responded to Stage 2, but not all employees in these 8 firms did so. Thus, whilst the percentage response remains the same as the percentage surveyed in table 3.2, it does not do so in table 3.3. It can be seen from col. 7 of table 3.3 that 400 employees responded to Stage 2, representing 25.4% of the total number of employees in firms of SIC 27 with 15 or more employees in the Central area, 43.2% of employees in firms of SIC 27 with 15 or more employees in the Central area agreeing to Stage 2, and 45.4% of employees in firms of SIC 27 with 15 or more employees in the Central area actually surveyed. (cols. 8, 9 and 10 respectively of Table 3.3).

3.6.3   The 2 firms surveyed in the Intermediate area together represented 2.5% of the total number of firms in the Intermediate area with 15 or more employees. One of the firms was of SIC 15, and was the only firm of that SIC in the Intermediate area. The other was of SIC 27, and represented 4.8% of firms of SIC 27 with 15 or more employees in the Intermediate area.

The response from the firm of SIC 15 was as follows: it employed 357 people, and 42 responded, an 11.8% response rate.

TABLE 3.2   STAGE 2   RESPONSE (FIRMS)

Central Area

1	2	3	4	5	6	7	8	9
SIC	No. firms agreeing to Stage 2.	% of total number of firms ⩾15 in each SIC	No. firms Surveyed	% of total number of firms⩾15 in each SIC	% of firms agreeing to Stage 2 in each SIC	No. firms responding to Stage 2	% of total number of firms in each SIC	% of firms agreeing to Stage 2 in each SIC
20	1	20.0	1	20.0	100	1	20.0	100
21	3	100	3	100	100	3	100	100
22	2	28.6	1	14.3	50.0	1	14.3	50.0
23	4	14.8	3	11.1	75.0	2	7.4	50.0
24	3	17.6	3	17.6	100	3	17.6	100
25	1	9.1	1	9.1	100	1	9.1	100
26	4	33.3	2	16.7	50.0	2	16.7	50.0
27	9	40.0	8	36.4	88.9	8	36.4	88.9
Total	27	24.1	22	19.6	81.5	21	18.8	77.8

TABLE 3.3   STAGE 2   RESPONSES   (EMPLOYEES)

Inner Area

1 SIC	2 Employees in firms agreeing to Stage 2	3 % of total number of employees per SIC in firms $\geqslant$15	4 Employees in firms surveyed	5 % of total employees per SIC in firms $\geqslant$15	6 % of employees in firms agreeing to Stage 2	7 Employees responding	8 % of total no. of employees per SIC in firms $\geqslant$15	9 % of employees in firms agreeing to Stage 2 in each SIC	10 % of employees in firms surveyed per SIC
20	44	26.2	44	26.2	100	13	7.7	29.5	29.5
21	345	100	345	100	100	105	30.4	30.4	30.4
22	239	51.4	234	50.3	97.9	129	27.7	54.0	55.1
23	260	26.7	246	25.3	94.6	45	4.6	17.3	18.3
24	88	18.0	88	18.0	100	76	15.5	86.4	86.4
25	25	7.2	25	7.2	100	10	2.9	40.0	40.0
26	106	21.7	72	14.8	67.9	12	2.5	11.3	16.7
27	925	60.6	881	57.7	95.2	400	25.4	43.2	45.4
Total	2032	37.4	1935	35.6	95.2	790	14.5	38.9	40.8

The firm of SIC 27 employed 164 people, which was 12.1% of employees in firms of SIC 27 with 15 or more employees in the Intermediate area. 54 responses were received, which was 32.9% of the employees surveyed, and 4% of the number of employees in firms of SIC 27 with 15 or more employees in the Intermediate area.

3.6.4   In terms of SIC coverage provided by the responses, Intermediate and Central areas together provide information for SICs 15 and 20 to 27.

Referring back to table 2.6, it can be seen that Stage 2 responses have been obtained for all SICs identified in the Central area, with the exceptions of SICs 3 and 17 (Food, Drink and Tobacco and Timber/Furniture respectively), and, as discussed in Section 2.8.1, those SICs represent a very small proportion of Central area employment (3.3% of employees).

Table 3.3 shows the percentage responses by SIC for the Central area only, in terms of percentage of total employees, percentages of employees in firms agreeing to Stage 2 and of employees in firms surveyed (cols. 8, 9 and 10 of table 3.3 respectively). It can be seen from these percentages that SICs 25 and 26 (Professional and Scientific Services, and miscellaneous Services respectively) are sparsely covered by Stage 2 responses (2.9% and 2.5% of all employees in firms of SIC 25 and 26 with 15 or more employees), whilst the highest percentage coverage was obtained for SIC 21 (Gas, Electricity and Water) responses accounting for 30.4% of all employees in SIC 21 in firms with 15 or more employees.

3.7   Analysis of Background Data

3.7.1   Table 3.4 shows a breakdown of the main modes used in the journey to work. The main mode was taken to be that which took the longest time. The table shows a predominance of car travel (66.7%), followed by public transport bus (20.2%). Of the other modes identified, Walk and Works Bus feature most strongly, although it must be noted that although 3.3% of respondents travelled by Works Bus – they all travelled to the same firm (No. 96).

Tables 3.5 and 3.6 show main mode broken down by SIC of Employer and job category of respondent respectively.

Table 3.5 presents the data as collected, and whilst it cannot be generalised or grossed up to be representative of all firms in particular SICs due to the low representation in the sample, it shows that amongst the survey responses

car travel predominates (66.7%) followed by public transport bus (20.2%).

Table 3.6 shows the low proportion of manual-shop floor employees surveyed - 9.7% (which does not necessarily imply that there is a low proportion of manual-shop floor employees in the Central area). Overall, the table shows that a high percentage of Professional-Managerial employees travelled by car (83.9%) and 60.5% of Technical-Clerical employees travelled by car. The majority of manual-shop floor employees travelled by public transport bus (39.3%), 26.5% of technical-clerical employees travel by bus.

3.7.2   Table 3.7 shows the distribution of arrival at work times for the sample of 877 employees giving the necessary information. Arrival times are split into 15 minute bands from 0700 to 1014. The data is taken for information supplied for Monday arrival time (no significant weekly variation emerging either from arrival times over the week, or traffic flows - see Chapter 4 and Appendix K). The table shows that the largest number of arrivals occur between 0815 and 0829, with a noticeable peak arrival hour of 0800 - 0859.

Table 3.8 shows arrival times by job category of employee (in this case the total is 859 as 19 respondents did not complete the job category section of the form). The table shows that there is no difference in the pattern of arrival between Professional-Managerial and Technical-Clerical employees, the majority of both arriving between 0800 and 0859 (87.9% and 83.8% respectively). The peak 15 minute arrival period for both categories is 0815 to 0829 (29.2% and 25.8% respectively).

Manual-shop floor employees have a different arrival profile. The largest proportion (30.1%) arrive between 0715 and 0729, with a secondary 'peak' between 0815 and 0844 (21.6%).

Table 3.9 shows arrival times by SIC, and again shows the main peak arrival of 0815 - 0829. The main feature of note is that over 70% of SIC 15 employees are at work by 0729, all other SICs having their main arrivals in the hour between 0800 and 0859.

TABLE 3.4   MAIN MODE TO WORK   (STAGE 2 RESPONSES)

Mode	Number	%
Car	591	66.7
Motor-cycle	10	1.1
Cycle	8	0.9
Walk	59	6.7
Bus	179	20.2
Train	10	1.1
Works Bus	29	3.3
Total	886	100

TABLE 3.5   MAIN MODE BY FIRM'S SIC

	CLOTHING SIC 15 (%)	CONSTR. SIC 20 (%)	GAS ETC SIC 21 (%)	TPT SIC 22 (%)	RETAIL SIC 23 (%)	BANKS SIC 24 (%)	PROF. SIC 25 (%)	OTHER SIC 26 (%)	ADMIN SIC 27 (%)	TOTAL (%)
CAR	5 (11.9)	7 (53.8)	83 (79.0)	67 (51.9)	23 (51.1)	55 (72.4)	7 (70.0)	5 (41.7)	339 (74.7)	591 (66.7)
MOTOR-CYCLE	0 (0.0)	1 (7.7)	2 (1.9)	1 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (1.3)	10 (1.1)
CYCLE	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (8.3)	7 (1.5)	8 (0.9)
WALK	2 (4.8)	2 (15.4)	7 (6.7)	6 (4.7)	2 (4.4)	6 (7.9)	1 (10.1)	0 (0.0)	33 (7.3)	59 (6.7)
BUS	6 (14.3)	3 (23.1)	12 (11.4)	53 (41.1)	19 (42.2)	15 (19.7)	2 (20.0)	6 (50.0)	63 (13.9)	179 (20.2)
TRAIN	0 (0.0)	0 (0.0)	1 (1.0)	2 (1.6)	1 (2.2)	0 (0.0)	0 (0.0)	0 (0.0)	6 (1.3)	10 (1.1)
WORKS BUS	29 (69.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	29 (3.3)
TOTAL (%)	42 (4.7)	13 (1.5)	105 (11.9)	129 (14.6)	45 (5.1)	76 (8.6)	10 (1.1)	12 (1.4)	454 (51.2)	886 (100.0)

TABLE 3.6   MAIN MODE BY JOB CLASSIFICATION

	Prof-Man. (%)	Tech-Cler. (%)	Man-Shop. (%)	Other (%)	Total (%)
CAR	292 (83.9)	260 (60.5)	21 (25.0)	3 (75.0)	576 (66.5)
MOTOR-CYLCE	6 (1.7)	4 (0.9)	0 (0.0)	0 (0.0)	10 (1.2)
CYCLE	4 (1.1)	3 (0.7)	1 (1.2)	0 (0.0)	8 (0.9)
WALK	11 (3.2)	43 (10.0)	5 (6.0)	0 (0.0)	59 (6.8)
BUS	29 (8.3)	114 (26.5)	33 (39.3)	1 (25.0)	117 (20.4)
TRAIN	6 (1.7)	3 (0.7)	0 (0.0)	0 (0.0)	9 (1.0)
WORKS BUS	0 (0.0)	3 (0.7)	24 (28.6)	0 (0.0)	27 (3.1)
TOTAL (%)	348 (40.2)	430 (49.7)	84 (9.7)	4 (0.5)	866 (100.0)

Number of missing observations = 20

TABLE 3.7   ARRIVAL TIME AT WORK BY 15 MINUTE PERIODS (ALL RESPONDENTS)

Time period	Number Arriving	%
0700 - 0714	2	0.2
0715 - 0729	32	3.6
0730 - 0744	7	0.8
0745 - 0759	25	2.9
0800 - 0814	201	22.9
0815 - 0829	225	25.7
0830 - 0844	176	20.1
0845 - 0859	102	11.6
0900 - 0914	33	3.8
0915 - 0929	10	1.1
0930 - 0944	10	1.1
0945 - 0959	3	0.3
1000 - 1014	1	0.1
Non-Peak	14	1.6
Not at work	36	4.1
Total	877	100

Number of missing observations = 9

TABLE 3.8   ARRIVAL TIME BY 15 MINUTE PERIODS
BY JOB CATEGORY

	Prof.Man. (%)	Tech.Cler. (%)	Man.Shop. (%)	Other (%)	Total (%)
0700 – 0714	0 (0.0)	0 (0.0)	2 (2.4)	0 (0.0)	2 (0.2)
0715 – 0729	1 (0.3)	4 (0.9)	25 (30.1)	0 (0.0)	30 (3.5)
0730 – 0744	1 (0.3)	5 (1.2)	0 (0.0)	0 (0.0)	6 (0.7)
0745 – 0759	6 (1.7)	17 (4.0)	1 (1.2)	1 (33.3)	25 (2.9)
0800 – 0814	80 (23.1)	108 (25.4)	4 (4.8)	1 (33.3)	193 (22.5)
0815 – 0829	101 (29.2)	110 (25.8)	9 (10.8)	1 (33.3)	221 (25.8)
0830 – 0844	75 (21.7)	90 (21.1)	9 (10.8)	0 (0.0)	174 (20.3)
0845 – 0859	48 (13.9)	49 (11.5)	5 (6.0)	0 (0.0)	102 (11.9)
0900 – 0914	13 (3.8)	16 (3.8)	3 (3.6)	0 (0.0)	32 (3.7)
0915 – 0929	3 (0.9)	4 (0.9)	3 (3.6)	0 (0.0)	10 (1.2)
0930 – 0944	6 (1.7)	4 (0.9)	0 (0.0)	0 (0.0)	10 (1.2)
0945 – 0959	2 (0.6)	1 (0.2)	0 (0.0)	0 (0.0)	3 (0.3)

TABLE 3.8 (Cont/d.,)

	Prof.Man. (%)	Tech.Cler. (%)	Man.Shop. (%)	Other (%)	Total (%)
1000 – 1014	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Non Peak	2 (0.6)	5 (1.2)	6 (7.2)	0 (0.0)	13 (1.5)
Not at work	7 (2.0)	13 (3.1)	16 (19.3)	0 (0.0)	36 (4.2)
Total (%)	346 (40.3)	426 (49.7)	83 (9.7)	3 (0.3)	858 (100.0)

Number of missing observations = 28

TABLE 3.9

ARRIVAL TIME BY 15 MINUTE PERIODS BY FIRMS' SIC

	Clothing SIC 15 (%)	Constr. SIC 20 (%)	Gas etc. SIC 21 (%)	Tpt. SIC 22 (%)	Retail SIC 23 (%)	Banks SIC 24 (%)	Prof. SIC 25 (%)	Other SIC 26 (%)	Admin. SIC 27 (%)	Total (%)
0700 - 0714	1 (2.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (8.3)	0 (0.0)	2 (0.2)
0715 - 0729	29 (69.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.7)	32 (3.6)
0730 - 0744	0 (0.0)	0 (0.0)	0 (0.0)	3 (2.3)	0 (0.0)	0 (0.0)	1 (12.5)	1 (8.3)	2 (0.4)	7 (0.8)
0749 - 0759	1 (2.4)	0 (0.0)	4 (3.8)	7 (5.4)	2 (4.5)	0 (0.0)	1 (12.5)	0 (0.0)	10 (2.2)	25 (2.9)
0800 - 0814	0 (0.0)	0 (0.0)	25 (24.0)	30 (23.3)	7 (15.9)	1 (1.3)	2 (25.0)	0 (0.0)	136 (30.3)	201 (22.9)
0815 - 0829	1 (2.4)	1 (7.7)	47 (45.2)	38 (29.5)	8 (18.2)	9 (11.8)	1 (12.5)	2 (16.7)	118 (26.3)	225 (25.7)
0830 - 0844	1 (2.4)	3 (23.1)	19 (18.3)	25 (19.4)	11 (25.0)	23 (30.3)	2 (25.0)	0 (0.0)	92 (20.5)	176 (20.1)
0845 - 0859	1 (2.4)	6 (46.2)	1 (1.0)	7 (5.4)	5 (11.4)	25 (32.9)	0 (0.0)	1 (8.3)	56 (12.5)	102 (11.6)
0900 - 0914	3 (7.1)	3 (23.1)	1 (1.0)	8 (6.2)	0 (0.0)	7 (9.2)	0 (0.0)	0 (0.0)	11 (2.4)	33 (3.8)

TABLE 3.9 (Cont/d.,)

	Clothing SIC 15 (%)	Constr. SIC 20 (%)	Gas etc. SIC 21 (%)	Tpt. SIC 22 (%)	Retail SIC 23 (%)	Banks SIC 24 (%)	Prof. SIC 25 (%)	Other SIC 26 (%)	Admin. SIC 27 (%)	Total (%)
0915 - 0929	2 (4.8)	0 (0.0)	1 (1.0)	1 (0.8)	1 (2.3)	1 (1.3)	0 (0.0)	0 (0.0)	4 (0.9)	10 (1.1)
0930 - 0944	0 (0.0)	0 (0.0)	2 (1.9)	0 (0.0)	0 (0.0)	4 (5.3)	0 (0.0)	1 (8.3)	3 (0.7)	10 (1.1)
0945 - 0959	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.6)	0 (0.0)	1 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.3)
1000 - 1014	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Non Peak	0 (0.0)	0 (0.0)	1 (1.0)	7 (5.4)	1 (2.3)	1 (1.3)	0 (0.0)	1 (8.3)	3 (0.7)	14 (1.6)
Not at work	3 (7.1)	0 (0.0)	3 (2.9)	1 (0.8)	9 (20.5)	3 (3.9)	1 (12.5)	5 (41.7)	11 (2.4)	36 (4.1)
Total (%)	42 (4.8)	13 (1.5)	104 (11.9)	129 (14.7)	44 (5.0)	76 (8.7)	8 (0.9)	12 (1.4)	449 (51.2)	877 (100.0)

Table 3.10 shows arrival times by whether the respondent is able to vary his or her work hours from day to day. It would be expected that employees able to vary their work hours from day to day would have a wider distribution of arrival times than those unable to do so. In fact, the table shows that this is not the case. There is no great difference between percentage arrivals in the different time periods, and this might well suggest that the ability to vary work hours is either not being fully utilised, or that respondents have settled into a set pattern of arrival times similar to that used by respondents not able to vary their work hours. This is an interesting and perhaps unexpected finding, and would seem to merit further research. The Stage 3 surveys were intended, among other things, to investigate the reasons behind patterns of travel behaviour, but, as stated previously, they have been abandoned due to study constraints.

3.7.3   Analysis of personal characteristics of respondents is included in Appendix L, as it is not of direct relevance to the study.

3.7.4   Analysis of modal split of respondents is included in Appendix O for the same reason.

3.8   Grossing Up

3.8.1   The base situation in terms of work arrival profiles per SIC and destination zone was grossed up partly from Stage 2 returns, partly from Stage 1 returns and partly from estimations using a claibrated curve fitting technique. The way in which this was done does not form part of this report, and for detailed discussions see May and Montgomery, 1981.

3.8.2   Table 3.11 shows results of the grossing up process by SIC. It shows percentage arrivals over the peak period (0745 - 0915). Table 3.12 shows percentage arrivals for each Central area destination zone over the same period (see fig. 1 for location of zones).

It will be noticed in both tables that 0745 starts with 0.0%, and 0945 finishes with 100% arrivals. This is not saying that all employees arrive between these times, it is saying that the $1\frac{1}{2}$ hour period is taken in isolation and that we are looking at patterns within this period (see Montgomery, 1981).

3.8.3   Briefly, as the implications of the profiles shown on Tables 3.11 and 3.12 are discussed in a later report (May and Montgomery, 1981), Table 3.11 shows

TABLE 3.10   ARRIVAL TIME BY ABILITY TO VARY WORK
               HOURS FROM DAY TO DAY

	YES (%)	NO (%)	TOTAL (%)
0700 - 0714	1 (0.3)	1 (0.2)	2 (0.2)
0715 - 0729	2 (0.7)	30 (5.2)	32 (3.7)
0730 - 0744	4 (1.4)	3 (0.5)	7 (0.8)
0745 - 0759	16 (5.5)	9 (1.5)	25 (2.9)
0800 - 0814	70 (23.9)	129 (22.2)	199 (22.8)
0815 - 0829	81 (27.6)	144 (24.8)	225 (25.7)
0830 - 0844	58 (19.8)	117 (20.0)	175 (20.0)
0845 - 0859	20 (6.8)	82 (14.1)	102 (11.7)
0900 - 0914	14 (4.8)	19 (3.3)	33 (3.8)
0915 - 0929	5 (1.7)	5 (0.9)	10 (1.1)
0930 - 0944	7 (2.4)	3 (0.5)	10 (1.1)
0945 - 0959	3 (1.0)	0 (0.0)	3 (0.3)

TABLE 3.10 (Cont/d.,)

	YES (%)	NO (%)	TOTAL (%)
1000 - 1014	1 (0.3)	0 (0.0)	1 (0.1)
Non Peak	3 (1.0)	11 (1.9)	14 (1.6)
Not at work	8 (2.7)	28 (4.8)	36 (4.1)
Total (%)	293 (33.5)	581 (66.5)	874 (100.0)

Number of missing observations = 12

TABLE 3.11   Grossed up arrival profiles by SIC for the
period 0745 - 0915

Cumulative arrival (%)

Time Period ending

SIC	0745	0800	0815	0830	0845	0900	0915
3	0.0	0.0	0.2	1.6	14.5	65.2	100.0
15	0.0	59.7	84.9	94.7	98.3	99.6	100.0
17	0.0	0.8	3.8	13.7	39.2	75.7	100.0
18	0.0	9.5	27.1	51.5	74.8	91.0	100.0
20	0.0	1.2	5.7	19.2	47.4	80.8	100.0
21	0.0	9.4	31.1	63.8	87.9	97.1	100.0
22	0.0	7.8	26.9	57.8	83.3	95.5	100.0
23	0.0	3.9	10.0	22.0	41.9	75.9	100.0
24	0.0	0.6	2.7	10.3	33.4	70.5	100.0
25	0.0	10.6	32.5	61.2	84.6	96.3	100.0
26	0.0	10.1	42.6	75.8	87.8	95.3	100.0
27	0.0	6.5	23.8	55.9	83.0	95.4	100.0

TABLE 3.12　　　　Grossed up arrival profiles by Destination zone
for the period 0745 - 0915

Cumulative arrival (%)

Time period ending

Destination Zone	0745	0800	0815	0830	0845	0900	0915
1	0.0	12.1	20.0	36.4	59.0	83.4	100.0
2	0.0	15.6	37.5	54.4	74.9	90.6	100.0
3	0.0	2.8	7.5	16.0	36.0	70.3	100.0
4	0.0	27.4	47.0	66.1	79.3	92.0	100.0
5	0.0	10.4	27.7	48.0	67.3	86.0	100.0
6	0.0	8.2	29.4	61.2	82.8	92.5	100.0
7	0.0	4.4	11.6	24.0	50.0	84.4	100.0
8	0.0	8.5	30.0	54.8	74.1	90.0	100.0
9	0.0	13.6	40.4	70.8	89.2	96.5	100.0
10	0.0	7.8	23.4	48.1	69.9	86.0	100.0
11	0.0	2.2	15.4	45.1	72.1	93.4	100.0
16	0.0	10.1	31.2	57.6	77.5	90.2	100.0

that profiles by SIC vary markedly one from another. For example, SIC 3 (Food, Drink and Tobacco) has a noticeable peak of arrivals between 0846 and 0900, whilst SIC 15 (Clothing and Footwear) has a peak between 0746 and 0800. It is most probable that this reflects the prevalent type of work hours in operation in these SICs.

Table 3.12 again reflects the current pattern of work hours, but here the differences between zones are not as marked as those between SICs; this is probably due to the mixture of SICs present in each zone, with the overall effect of cancelling at extremes. However, it is noticeable that within zone 3 for example, only 36.0% of employees have arrived by 0845, whilst in zone 9, 89.2% have arrived. For further comment and discussion see May and Montgomery, 1981.

3.9 Analysis Technicalities

As in Stage 1 analysis, completed questionnaires were analysed using Leeds University's Amdahl V7A computer, using solely SPSS package programs.

4. Traffic Surveys

4.1 As stated in Chapter 1, validation of the model output requires details of journey times (delays) along selected links by time periods, whilst updating and temporal disaggregation of O-D matrices requires classified count data by time period. The collection of this data involved the organisation of traffic surveys.

4.2 Fig. 1., showing Wakefield divided into the study area sections, also shows the distribution of the corridors used in the delay surveys and the points at which the classified counts were made. In addition, it shows the locations of 3 automatic traffic counters put down by WYCC to collect data for the study.

4.3 The traffic surveys were all carried out over the week of 17th - 21st November 1980. The roadside counts were undertaken by 6 temporary staff supplied from a pool by West Yorkshire County Council (although they were paid from study funds), and supervised by members of the study team. The delay surveys were undertaken by postgraduate students from ITS, under study team supervision, and also by the study team themselves.

4.4 The sequence of events in organising the roadside counts was as follows:

1. Setting up the survey, which involved:

    i) Identify the cordon crossing points where traffic was to be counted.

    ii) Check that the coverage of the Inner cordon crossing points was 'car-tight' i.e. that there were no small side roads, or indeed major routes, that were not being covered at some stage during the week.

    iii) At each count point identify a place for the counter to stand, preferably sheltered in the event of bad weather.

    iv) Draw up a file for each of the counters showing each their programme for the week, including: large scale maps showing exactly where the crossing point was located; enumeration sheets divided into columns, one each for cars, CV and Buses (Appendix M); and classifications of vehicles (Appendix N).

    v) Organise and attend a briefing meeting with the counters to explain the purpose of the counts and to emphasise the need for accuracy in terms of timing, i.e. that each 5 minute period was to be exactly 5 minutes.

vi) Run a series of checks on the accuracy of the stopwatches to be
used by counters to ensure that they were accurate to ± 5 secs. over
the 2 hours (0730 - 0930) the counts were to last (4 of the 10 watches
checked failed to meet this criterion).

vii) Notify the police that the surveys were taking place.

2. Supervise the surveys on the ground, which involved:

i) Ensuring that each counter was in the correct position per day for
the start of the count period.

ii) Ensure that they had accurate stopwatches (pre-set by the study
team from G.M.T. signals).

iii) Collect completed enumeration forms at the end of the count period,
together with stopwatches and ensure that each counter knew
where they were to be the following day.

In the event, the counters all proved to be very experienced, having carried
out a large amount of similar work previously, mainly for WYCC. In the event
of any of them being unable to participate for any reason, they arranged them-
selves for somebody else from the pool to replace them.

The majority of the counters had their own transport, and the sites were so
arranged that all counts could be done from the relative comfort of a car,
permission being sought from the police for one location, and from the
management of a garage for another.

4.5 11 crossing points on the Inner Cordon were identified, together with 7 on
the Outer Cordon (See Fig. 1.) 3 automatic traffic counters were put down
by WYCC at the points indicated on Fig. 1. Of the 11 Inner Cordon crossing
points, 1 was counted every day as a control (point 4 Northgate), to check for
daily variation in traffic volume through the week, and this, together with the
data collected by the automatic counters, has shown that variation through the
week is negligible.

Table 4.1 shows results from the control point of the classified counts,
and shows numbers of vehicles together with factors derived from the average.
For example, in the 0730 - 0930 inbound figures for cars, the average over the
5 days is 1000.8 vehicles, the figure for Monday is 1040 vehicles, thus the
factor = $\frac{1040}{1000.8}$ = 1.04. The table shows that the highest and lowest factors

TABLE 4.1   Daily Variation Factors for Flow Counts

Source: Northgate (Point 4) Classified Count 17-21/11/80

Number of vehicles (factor, as proportion of average)

		Monday	Tuesday	Wednesday	Thursday	Friday	Average
7.30 - 9.30 Inbound	Cars	1040(1.04)	951(0.95)	1007(1.01)	1007(1.01)	999(1.0)	1000.8
	C.V.	148(0.94)	174(1.10)	131(0.83)	168(1.06)	168(1.06)	157.8
	Buses	35(0.99)	34(0.96)	32(0.90)	35(0.99)	41(1.16)	35.4
	Total	1223(1.02)	1159(0.97)	1170(0.98)	1210(1.01)	1208(1.01)	1194.0
7.30 - 9.30 Outbound	Cars	625(0.98)	640(1.01)	625(0.98)	653(1.03)	639(1.00)	636.4
	C.V.	142(0.89)	146(0.92)	158(0.99)	158(0.99)	190(1.20)	158.8
	Buses	30(1.00)	29(0.97)	27(0.99)	30(1.00)	34(1.13)	30.0
	Total	797(0.97)	815(0.99)	810(0.98)	841(1.02)	863(1.05)	825.2
7.45 - 9.15 Inbound	Cars	844(0.99)	821(0.97)	873(1.03)	859(1.01)	847(1.00)	848.8
	C.V.	114(0.92)	142(1.15)	96(0.78)	128(1.04)	137(1.11)	123.4
	Buses	27(1.02)	27(1.02)	23(0.86)	26(0.98)	30(1.13)	26.6
	Total	985(0.99)	990(0.99)	992(0.99)	1013(1.01)	1014(1.02)	998.8
7.45 - 9.15 Outbound	Cars	511(0.99)	523(1.01)	511(0.99)	524(1.01)	520(1.00)	517.8
	C.V.	95(0.80)	117(0.98)	126(1.06)	116(0.97)	141(1.18)	119.0
	Buses	21(0.96)	21(0.96)	21(0.96)	22(1.01)	24(1.10)	21.8
	Total	627(0.95)	661(0.97)	658(1.00)	622(1.01)	685(1.04)	658.6

for cars are 1.04 and 0.95 respectively; for C.V.s 1.20 and 1.80 respectively;
for buses 1.16 and 0.86 respectively; and for total vehicles 1.05 and 0.95
respectively. Thus, the table shows that the daily variation in flows over
the week is extremely small.

Table 4.2 shows actual numbers of vehicles counted by the automatic counters
for the time periods indicated, and again shows little variation over the week.

Table 4.3 shows variation factors over the week for inbound and outbound flows
and again shows little variation.

4.6   Tables 4.4 (i) to 4.4 (iv) present the data collected by the classified
counts as used as input to the model. Although data for different stations was
collected on different days, variation over the week is so slight as to enable
one average day to be constructed.   The counts for individual stations have
been grouped into: Inner Cordon (stations 1-11) Inbound (table 4.4 (i)) and Out-
bound   (table 4.4 (ii)); and Outer Cordon (Station 12-18) Inbound (Table 4.4
(iii)) and Outbound (Table 4.4 (iv)), and show vehicle numbers by 5 minute time
periods between 0730 and 0930.

Briefly, the tables show that, as would be expected, more traffic overall
crosses the Outer Cordon than the Inner Cordon over the two hour period. Inbound
car traffic crossing the Inner Cordon shows two main peaks - 0825 to 0835 and
0845 to 0900, whilst inbound car traffic crossing the Outer Cordon shows peaks
of 0820 to 0830 and 0845 to 0855.

4.7   Travel time runs, together with their results and implications are
discussed in the modelling report of this series (see May and Montgomery, 1981).

4.8   Analysis Technicalities

Analysis was carried out using Leeds University's Amdahl V7A   computer,
using purpose written Fortran programs.

TABLE 4.2   Daily Variation Factors in Flow Counts

Source: Automatic Counters (17 to 21/11/80)

Location	Time	Flow	Mon.	Tues.	Wed.	Thurs.	Fri.	Ave
2.1 Denby Dale Road	24 hr. flow	In	8695	8639	8486	9266	9563	8929
		Out	9078	9028	8732	9662	9851	9270
	0700 to 1000	In	2224	2131	2075	2178	2187	2159
		Out	1565	1579	1575	1596	1563	1576
	0730 to 0930	In	1705	1659	1649	1692	1727	1686
		Out	1142	1141	1123	1138	1138	1136
	0745 to 0915	In	1365	1339	1331	1311	1378	1349
		Out	903	911	891	920	920	909
Location	Time	Flow	Mon.	Tues.	Wed.	Thurs.	Fri.	Ave
2.2 Westgate end (24hr ave. for 4 days only)	24 hr. flow	In	17163	17253	16729	18270	missing	17353
		Out	17368	17475	17093	18560	missing	17624
	0700 to 1000	In	4281	4368	4101	4334	4342	4285
		Out	2697	2695	2679	2718	2652	2688
	0730 to 0930	In	3292	3393	3198	3357	3346	3317
		Out	1975	1987	1966	1952	1923	1961
	0745 to 0915	In	2729	2818	2719	2770	2789	2765
		Out	1529	1555	1529	1518	1505	1527
Location	Time	Flow	Mon.	Tues.	Wed.	Thurs.	Fri.	Ave
2.3 Wentworth Street	24 hr. flow	In	6104	5735	6359	7165	7155	6503
		Out	6116	5904	5956	6099	6176	6050
	0700 to 1000	In	1441	1294	1336	1778	1737	1517
		Out	1163	1170	1183	1140	1140	1159
	0730 to 0930	In	1094	960	924	1394	1346	1143
		Out	947	903	909	884	892	907
	0745 to 0915	In	826	757	713	1162	1132	918
		Out	776	743	742	732	722	743

TABLE 4.3   Daily Variation Factors from Automatic Counters
and Point 4 (Northgate) Classified Count 17-21/11/80

Inbound/Outbound

Factors are derived from calculating average inbound and outbound
flows over the week, and then calculating the daily count as a
proportion of the average, the result being the factor.

	Source	Mon.	Tues.	Wed.	Thurs.	Fri.
24 hour Flow	Denby Dale Rd.	0.97/0.98	0.97/0.97	0.95/0.94	1.04/1.04	1.07/1.06
	Westgate End	0.99/0.99	0.99/0.99	0.96/0.97	1.05/1.05	- / - (1)
	*Wentworth St.	0.94/1.01	0.88/0.98	0.98/0.98	1.10/1.01	1.10/1.02
	Northgate (2)	- / -	- / -	- / -	- / -	- / -
0730 - 0930	Denby Dale Rd.	1.01/1.01	0.98/1.00	0.98/0.99	1.00/1.00	1.02/1.00
	Westgate End	0.99/1.01	1.02/1.01	0.96/1.00	1.01/1.00	1.01/0.98
	*Wentworth St.	0.96/1.04	0.84/1.00	0.81/1.00	1.22/0.97	1.18/0.98
	Northgate	1.02/0.97	0.97/0.99	0.98/0.98	1.01/1.02	1.01/1.05
0745 - 0915	Denby Dale Rd.	1.01/0.99	0.99/1.00	0.99/0.98	0.97/1.01	1.02/1.01
	Westgate End	0.99/1.00	1.02/1.02	0.98/1.00	1.00/0.99	1.01/0.99
	*Wentworth St.	0.90/1.04	0.82/1.00	0.78/1.00	1.27/0.99	1.23/0.97
	Northgate	0.99/0.95	0.99/0.97	0.99/1.00	1.01/1.01	1.02/1.04

*Data for Wentworth St. Inbound is slightly suspect, since this counter
was a Pneumatic Tube, whereas those on Denby Dale Rd. and Westgate End
were Inductive Loops.

(1) No data was obtained for this point for Friday.

(2) Counts were not made over a 24 hour period.

TABLE 4.4 (i)   Inbound Traffic Crossing the Inner Cordon

Direction of Traffic is Inbound

Data is for Stations 1 to 11

Time End	Cars	CV	Buses
735	180	47	16
740	146	46	7
745	208	46	7
750	209	42	4
755	291	49	13
800	339	63	11
805	278	44	4
810	281	45	8
815	397	50	5
820	401	48	10
825	427	48	10
830	445	49	9
835	448	44	13
840	387	68	14
845	436	58	7
850	483	56	5
855	403	62	11
900	429	58	11
905	369	64	17
910	279	59	11
915	295	70	10
920	247	65	6
925	244	56	10
930	229	63	7

TABLE 4.4 (ii)   Outbound Traffic Crossing the Inner Cordon

Direction of Traffic is Outbound
Data is for Stations 1 to 11

Time End	Cars	CV	Buses
735	160	31	10
740	121	25	9
745	136	44	17
750	145	38	8
755	187	33	1
800	187	43	13
805	179	49	12
810	163	42	5
815	228	48	10
820	250	55	7
825	297	52	9
830	239	53	12
835	275	56	6
840	251	65	13
845	260	44	17
850	237	45	7
855	230	49	6
900	192	61	5
905	194	55	8
910	193	96	13
915	165	71	11
920	142	64	5
925	137	62	5
930	137	53	9

TABLE 4.4 (iii)   Inbound Traffic Crossing the Outer Cordon

Direction of Traffic is Inbound
Data is for Stations 12 to 18

Time End	Cars	CV	Buses
735	298	62	12
740	333	85	5
745	395	74	4
750	467	80	9
755	544	102	9
800	487	118	6
805	478	101	8
810	585	73	7
815	582	88	7
820	641	64	8
825	600	86	9
830	680	90	7
835	626	90	12
840	588	97	10
845	609	90	6
850	546	106	6
855	594	101	9
900	535	112	20
905	453	107	15
910	402	97	16
915	318	83	7
920	337	106	10
925	266	97	6
930	274	96	12

TABLE 4.4 (iv)   Outbound Traffic Crossing the Outer Cordon

Direction of Traffic is Outbound

Data is for Stations.12 to 18

Time End	Cars	CV	Buses
735	256	75	17
740	217	89	9
745	226	72	10
750	243	90	17
755	295	87	9
800	245	89	10
805	274	81	8
810	269	80	7
815	296	61	5
820	328	95	7
825	286	95	8
830	319	99	7
835	348	104	14
840	328	120	7
845	286	76	10
850	289	90	16
855	321	104	12
900	240	91	4
905	256	99	9
910	235	126	16
915	217	121	16
920	196	135	10
925	200	103	8
930	217	106	9

5.   Conclusions

5.1   There are a number of points raised from the implementation of the surveys:

     (i)   Data bases

    (ii)   Circulation of questionnaire forms

  (iii)   Response rates

   (iv)   Data analysis.

5.2   A major part of the preliminary survey work was concerned with identifying potential survey sites. As discussed earlier, it proved impossible to obtain an 'off the peg' up-to-date list of employers and corresponding employee numbers. It was felt by the study team that an inordinate amount of time was spent in compiling such a list from the various data sources available, and also surprising that no such list was available, particularly from such bodies as Chambers of Commerce, or even West Yorkshire County Council Planning Department.

5.3   The circulation of Stage 1 questionnaire forms was straightforward once the sample base had been identified. Stage 2, however, proved to be slightly more difficult insofar as the study team was not in control of how or when forms were circulated amongst employees of individual firms. The methods of distribution and collection of Stage 2 forms varied from firm to firm in the study, depending on how the management representative responsible for the task viewed the study. Ideally, it would have been desirable for the study team to devote a longer period of time to each firm, taking a personal hand both in negotiations with trade unions and the actual logistics of distribution and collection. In a previous study (May, Montgomery and Wheatley 1980b) it was found that a close involvement on the part of the study team led to an extremely high response rate (94%), and that the less directly the study team was involved, the lower the response rate became.

In this study the resources available did not allow such close involvement in questionnaire distribution and collection, and the response rates are correspondingly low.

5.4   It is felt that in the case of Stage 1 response rates, a closer involvement on the part of the study team, perhaps to the extent of interviewing each surveyed firm instead of circulating questionnaires, would have led to a higher response rate. However, it is conjectured that the reason for the shortfall

in the projected response rate of 66% is due in the most part to two main reasons:

    (i)   the state of the economy at the time of the surveys, making employers feel that there were other issues of more immediate importance to the day-to-day business of running the firm;

    (ii)   many employers do not perceive the benefits to themselves of peak spreading unless they are directly pointed out. This is borne out by examples of American organised alternative work hour schemes where large amounts of money were spent in media advertising to encourage firms to participate. (May, Montgomery and Wheatley, 1980a).

It is felt that higher response rates in both stages of the survey might have been obtained from a combination of closer study team involvement, and an explanation of the potential benefits to be derived from peak spreading.

5.5   Table 5.1 presents a summary of survey responses (Stages 1 and 2) together with estimates of total numbers of employers and employees in both Central and Intermediate areas of Wakefield and forms a summary of background data to the study, together with a summary of collected data used as input to the modelling process.

TABLE 5.1 SURVEY BACKGROUND AND SUMMARY RESULTS

Firms

i)	Total with $\geqslant$15 employees in central area	112
	Estimated no. with<15 employees in central area	283
	Estimated total number of firms in central area	395
ii)	Total with$\geqslant$15 employees in intermediate area	80
iii)	Number of forms originally sent out	147
iv)	Number of forms returned by G.P.O. as 'gone away'	26
v)	Total number firms surveyed in Stage 1	121
vi)	Total number of responses from Stage 1	51

Employees

i)	Total in firms with $\geqslant$15 employees in central area	5432
	Estimated number in firms with <15 employees in central area	1077
	Estimated total number of employees in central area	7818
ii)	Total in firms with $\geqslant$15 employees in intermediate area	7389
iii)	Total number of employees in firms surveyed in Stage 1	6558
iv)	Total number of employees in firms responding to Stage 1	4394
v)	Total number of employees in firms agreeing to Stage 2	2553
vi)	Total number of employees in firms surveyed in Stage 2	2456
vii)	Total number of responses from Stage 2	886
viii)	Total number of employees agreeing to Stage 3	130

Central area only

	Firms			Employees		
	No.	%	%	No.	%	%
Total	398	100	–	7818	100	–
$\geqslant$15 employees	112	28.4	100	5432	69.5	100
Forms sent out in Stage 1	112	28.4	100	5432	69.5	100
Forms received from Stage 1	52	13.1	48.4	3935	50.3	72.4
Forms with up-to-date information from Stage 1	47	11.8	42	3495	44.7	64.3
Agreeing to Stage 2	27	6.8	24	2032	26.0	37.4
Surveyed in Stage 2	22	5.6	20	1935	24.8	35.6
Responses from Stage 2	21	5.3	19	790	10.1	14.6
Agreeing to Stage 3	N/A	N/A	N/A	119	1.5	2.2

List of Appendices

APPENDIX A

Summary of SIC Orders

1. Agriculture, Forestry, Fishing

2. Mining and Quarrying

3. Food, Drink and Tobacco

4. Coal and Petroleum products

5. Chemical and Allied Industries

6. Metal manufacture

7. Mechanical Engineering

8. Instrument Engineering

9. Electrical Engineering

10. Shipbuilding and Marine Engineering

11. Vehicles

12. Metal goods not elsewhere specified

13. Textiles

14. Leather, Leather goods and Fur

15. Clothing and Footwear

16. Bricks, Pottery, Glass, Cement etc.

17. Timber, Furniture etc.

18. Paper, Printing and Publishing

19. Other manufacturing industries

20. Construction

21. Gas, Electricity and Water

22. Transport and Communication

23. Distributive Trades

24. Insurance, Banking, Finance, and Business Services

25. Professional and Scientific Services

26. Miscellaneous Services

27. Public Administration and Defence

FOR EMPLOYEES WORKING FLEXIBLE HOURS:

Please state the earliest and latest permitted times of starting and finishing work:

Start		Finish	
Earliest	Latest	Earliest	Latest

For how long have employees been allowed to work flexible hours

	yrs		mths

FOR EMPLOYEES WORKING ROTATING SHIFTS:

Please indicate the hours of the shifts and the numbers working each (as for today):

Start	Finish	Professional/ Managerial	Technical/ Clerical	Manual/ Shop floor

FOR ALL EMPLOYEES:

How many car parking spaces are reserved on the premises for employees working at this site?

Are all the available spaces usually full by 9.30 a.m.?

yes	no

Please state how the allocation of car parking spaces is made: (e.g. on the basis of seniority; need; first come, first served).

Please tick if you provide a works bus service:

To work	From work

Please indicate with a tick whether you are willing to discuss the possibility of a survey of some of your employees:
(If yes, please give a name and telephone number so that we will be able to contact you)

yes	no

If you have any suggestions about how travelling conditions in Wakefield might be improved, please write them in the space below.

APPENDIX C

Reasons for inclusion of specific questions on the Stage 1 questionnaire.

1. Definitions:

   Given to ensure that each respondent completed sections requesting
   information about different types of work hours based their responses
   on the same definitions, i.e. to ensure compatability of response.

2. Employee numbers split by sex and job category:

   Included to ensure that details of all employees were given, i.e. that
   no ambiguities about who should be included were present.

3. Job category by work hour type:

   Included to obtain details of the range of work hours present in each
   firm, used later in the grossing up and modelling processes.

4. For employees working fixed hours:

   Included to identify fixed hour and staggered hour employees. If start
   and finish times were the same for all employees, then it was considered
   that fixed hours were in operation, and the permitted start and finish
   times were obtained. If start and finish times were not the same for all
   employees, it was considered that staggered hours were in operation, and
   details of each schedule were obtained.

5. For employees working flexible hours:

   Included to obtain the range of permitted start and finish times, together
   with the length of time flexible hours had been in operation, as it was
   thought that this may have affected the uses to which the facilities
   offered by flexible hours were put.

6. For employees working rotating shifts:

   Included to obtain work hour and job category details of employees working
   this type of work hour system.

   4, 5 and 6 above collected data which was also subsequently used in
   synthesising arrival profiles for firms not responding to the survey
   (see May and Montgomery, 1981).

7. For all employees:

   i) Car parking details:

      Included as background information, and as information of use to a

more behaviourally orientated study which time and resource
constraints did not permit.

ii)   Works bus service:

      As i)

iii) Willing to discuss Stage 2 participation.

iv)   Space for comment on current travelling conditions in Wakefield.

APPENDIX D

List of comments from Stage 1 responses in response to asking for suggestions for improvements in travelling conditions in Wakefield.

Comment	Number of times mentioned
Reduce bus fares	4
Provide a new bridge over the River Calder	2
Construct a by-pass	2
Provide a city-wide traffic management scheme	2
Restructure the Chantry Bridge area	2
Widen Chantry Bridge	1
Provide more parking spaces	1
Re-open the pedestrianised city centre to traffic	1
Stagger school hours	1
Provide more peak period buses	1
Introduce flexible work hours	1
Introduce cheap peak period bus and train fares	1
Introduce a park and ride scheme	1
Promote car sharing	1
Restructure the one-way system	1
Introduce transferable bus and train tickets	1
Dispose of the existing traffic management scheme	1

Total number of different comments	=	17
Total number of comments made	=	24

APPENDIX E

List of comments from Stage 2 responses in response to asking for suggestions
for improvements in travelling conditions in Wakefield.

Comment	Number of times mentioned
Reduce bus fares	39
Introduce flexible working hours	32
Restructure the Chantry Bridge road system	23
Provide more and cheaper car parking facilities	21
Public transport should keep to its timetables	20
Improve standard and frequency of public transport	18
Provide a relief road for through traffic	15
Restructure the overall traffic system	12
Provide another bridge over the River Calder	11
Change school hours	11
Introduce staggered work hours	7
Improve rail commuter services	7
Introduce express bus services	6
Introduce organised car-sharing schemes	6
Introduce more one-way traffic schemes	5
Introduce more urban clearways	5
Put conductors back on buses	5
Provide more peak period buses	4
Introduce traffic lights at unsignalled junctions	4
Others (3 or less)	44

Total number of different comments	=	47
Total number of comments made	=	298

APPENDIX F

Leeds
LS2 9JT
Telephone (0532) 31751
Ext. 7216

From the Institute for
Transport Studies

Director and Professor
of Transport Engineering: A. D. May

Professor of
Transport Economics: K. M. Gwilliam

Dear Sir or Madam,

The Institute for Transport Studies, acting on behalf of the
Department of Transport, wish to carry out surveys in Wakefield in
order to determine the effect of employees' starting times on the
performance of the transport system, and to assess possible methods
of reducing peak period congestion. In order to do this we need
information on current travel patterns of employees, and to obtain
this we need your assistance.

We would be very grateful if you would complete the short form
enclosed and return it in the pre-paid envelope provided. The questions
relate to numbers of employees and their present work hour arrangements,
and the replies will, of course, remain strictly confidential.

As part of the study we also need some information from a sample
of people employed by firms in central Wakefield, such as yours,
concerning their journey to work, and would like to obtain this by
circulating short questionnaires in the near future. We would be
most grateful if you would indicate on the enclosed form whether or
not you would be willing to discuss this possibility with us.

We would also be grateful for any suggestions you may have for
improving travelling conditions in Wakefield, and there is space for
such comments at the end of the questionnaire form.

Please do not hesitate to contact Mr. Wheatley at the above
extension if there is any further information you require.

Thank you for your co-operation.

Yours faithfully,

A. D. MAY

THE UNIVERSITY OF LEEDS

Leeds
LS2 9JT
Telephone (0532) 31751

From the Institute for
Transport Studies

Ext. 7216

Director and Professor
of Transport Engineering: A. D. May

ADM/DE

Professor of
Transport Economics: K. M. Gwilliam

26th February 1981.

Dear Sir,

We recently sent you a questionnaire from the Institute for Transport
Studies asking for details of numbers of employees and their work hours.
The questionnaire results were to be used in a research study determining
the effect of employees' starting times on peak period traffic congestion,
and also in assessing methods of reducing this congestion in central Wakefield.

We have had no response from you so far, and would be very grateful if
you could complete the replacement questionnaire enclosed.   The results from
your place of work would be very useful in adding to our knowledge of travel
patterns, and hence also to our ability to assess how traffic congestion can
be reduced.

We enclose a reply-paid envelope, and would appreciate it if you could
complete the form and return it to us as soon as you are able.

Thank you in anticipation of your help.

Yours faithfully,
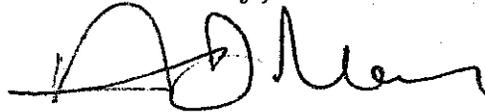
A. D. May

Please tick the following as appropriate:

Your sex

Male
Female

Your age group

Under 21	21-34	35-64	over 64

Your job description

Professional/managerial	
Technical/clerical	
Manual/shop floor	
Other (Please specify)	

Please indicate the numbers of people in your household in the following age groups, excluding yourself.

Under 5	5-11	12-16	17-20	21-34	35-64	over 64

Of these
- how many are in full time education?
- how many are in full time employment?

If other members of your household are in full time employment
- are you the principal wage earner?

Yes	No

- if not, in which of the above age groups is the principal wage earner?

We would like to interview some families about how they make decisions concerning weekday journeys.

Would you please PRINT your name and address if you would be willing to take part in a follow-up interview at home with your family.

NAME   ADDRESS

If you have any suggestions about how travelling conditions in Wakefield might be improved, please write them in the space below.

THE UNIVERSITY OF LEEDS

From the Institute for
Transport Studies

Leeds
LS2 9JT
Telephone (0532) 31751
X 7216

Director and Professor
of Transport Engineering: A. D. May

Professor of
Transport Economics: K. M. Gwilliam

Dear Sir or Madam,

The Institute for Transport Studies, acting on behalf of the
Department of Transport, wish to carry out surveys in Wakefield in
order to determine the effect of people's starting work times on the
performance of the transport system, and to assess possible methods
of reducing peak period congestion. In order to do this we need
information on current travel patterns, and to obtain this we need
your assistance.

The management of your firm has agreed that this form may be
completed during work time, and we would be grateful if you would
do so. The questions relate to details of travel and work hour
arrangements, and the replies will remain strictly confidential. If
you have any difficulty in completing the questionnaire, please
contact Mr. Wheatley at the above extension.

We would also be interested later in our study in talking to
some families about the decisions they make on weekday journeys.
We would be most grateful if you would indicate on the form whether
or not you would be willing to be interviewed at home with the rest
of your family.

Thank you for your co-operation.

Yours faithfully,

A.D. May

APPENDIX K   Variation in the distribution of arrivals at work over the week.

Number Arriving (y-axis)

Time Period Ending (x-axis)

Legend:
——— MONDAY
– – – – – TUESDAY
— — — WEDNESDAY
············ THURSDAY
─┴─┴─┴─ FRIDAY
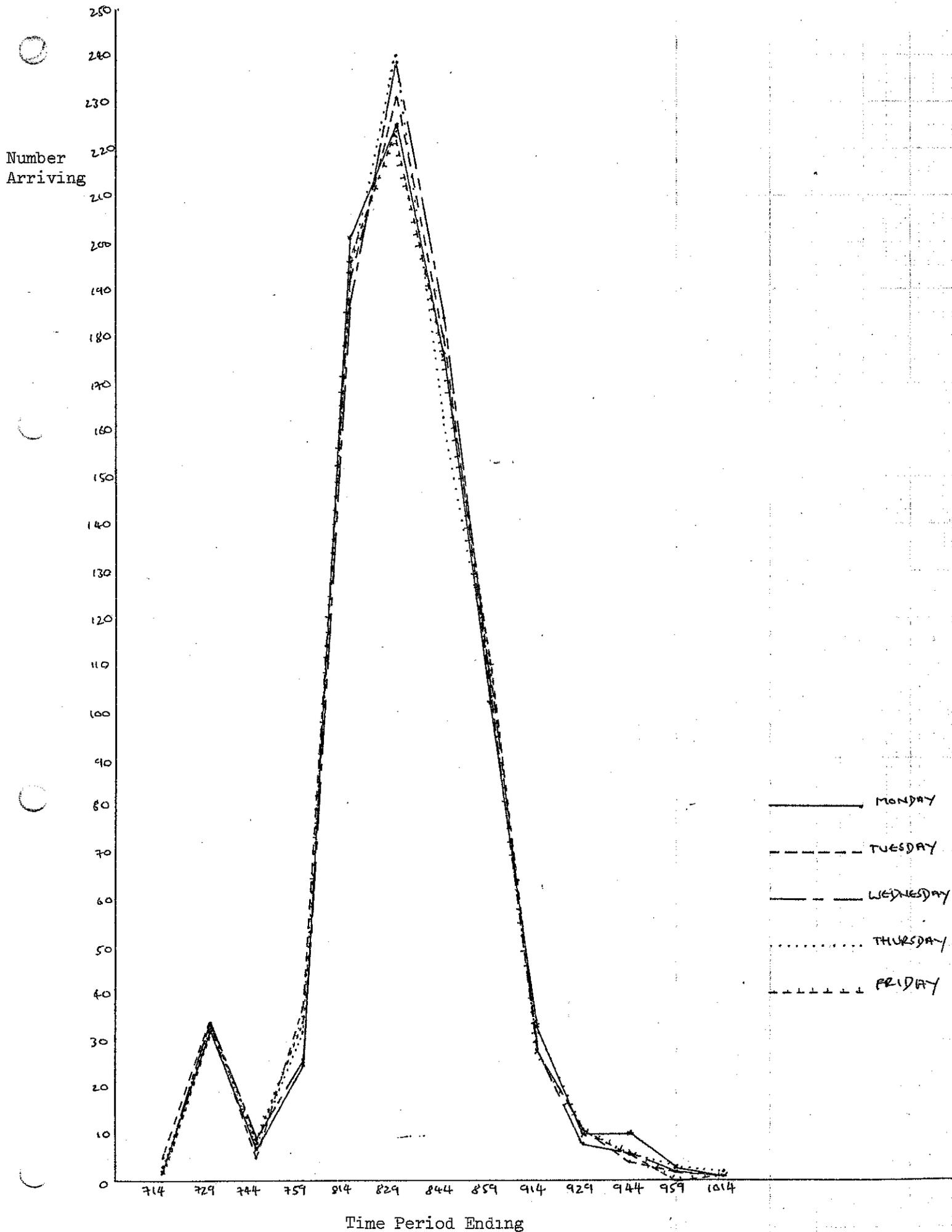
APPENDIX L   Job Classification and Household Details of Stage 2 Respondents

Table L.1. shows job category split by sex for the 866 respondents supplying the necessary information. The table shows that there is an almost 50:50 split between male and female respondents (49.4% male, 50.6% female), and that the most common job category of male respondents is Professional-Managerial (71.7% of male respondents), whilst that of female is Technical-Clerical (72.6% of female respondents). The most common job category of male and female respondents combined is Technical-Clerical (49.6%).

Table L.2. shows job category split by age group of the 862 respondents supplying the necessary information. The table shows that the most common age-group of respondents is 21-34 (47.3%), with the largest proportion of these engaged in a Technical-Clerical capacity (52.5%). 42.1% of the respondents are aged 35-64, with the most common job category being Professional-Managerial (49.9%); whilst only 10.4% of respondents are aged under 21, 72.2% of these being Technical-Clerical. Manual-shop floor does not figure highly in either table, and this is a reflection of the sample structure rather than of the population as a whole. (Information obtained from Stage 1 responses shows a percentage split between job categories as follows:

Professional/Managerial	=	25.7%
Technical/Clerical	=	33.3%
Manual/Shop floor	=	41.0%

although it must be noted that these figures are themselves taken from a sample, and are not necessarily reflecting the population as a whole).

Table L.3. shows the different household structures identified from the 849 employees responding to this question. The most common household consists of the respondent plus another adult (55.8%), followed by the respondent plus another adult plus school age child(ren) (25.1%). None of the other structures identified figure significantly, with perhaps the possible exception of single person households which account for 4.2% of the sample.

TABLE L.1.

Job Category by Sex

	Male	Female	Total
Professional-Managerial	307	41	348
Technical-Clerical	112	318	430
Manual-Shop floor	8	76	84
Other	1	3	4
Total	428	438	866[1]

[1]Note: 20 respondents did not give the necessary information

TABLE L.2.

Job Category by Age Group

	Under 21	21-34	35-64	Over 64	Total
Professional-Managerial	5	161	181		347
Technical-Clerical	65	214	148		427
Manual-Shop floor	17	32	34	1	84
Other	3	1			4
Total	90	408	363	1	862[1]

[1]Note: 24 respondents did not give the necessary information.

TABLE L.3.

Household Structure of Respondents

Household Type	Number of Households	%
Single Person	36	4.2
Respondent and Adult	474	55.8
Respondent, Adult and Child under 5	53	6.2
Respondent, Adult, Child under 5 and school age child(ren)	29	3.4
Respondent, Adult and School age child(ren)	213	25.1
Respondent, Adult, Child under 5, school age child and O.A.P.	2	0.2
Respondent, Adult, Child under 5 and O.A.P.	1	0.1
Respondent, Adult, School age child and O.A.P.	7	0.8
Respondent, Adult and O.A.P.	15	1.8
Respondent and O.A.P.	12	1.4
Respondent and Child under 5	3	0.4
Respondent and School age child	4	0.5
TOTAL	849[1]	100

(1)

    Note: 37 Respondents did not give the necessary information.

APPENDIX M

LOCATION _____ DATE _____

START TIME _____ FINISH TIME _____

DIRECTION _____ DIRECTION _____

Cars	CV	Buses	Cars	CV	Buses

APPENDIX N

WJR Wakefield Surveys

VEHICLE CLASSIFICATION

CARS :   Private cars, including invalid cars and other 3-wheelers;
          Taxis; Minibuses (up to 11 seats);
          Motorcycles with sidecars.

CVs :   All commercial vehicles (lorries, articulated vehicles,
          pantechnicons, vans, etc.);
          Pick-up trucks, dumptrucks, JCBs, etc;
          Polic cars ambulances, fire engines, Armed Forces vehicles;
          Estate cars, Range Rovers, Landrovers if firm's name
          written on;
          Private coaches.

BUSES: Stage service buses.

Not counted: Pedal cycles, mopeds, motorcycles.

Survey Control Unit

Central Statistical Office
Great George Street. London SW1P 3AQ
Telephone 01-233 8583

VIA STA

Business and Local Authority Surveys

Please complete as far as is possible (though answers to all questions will eventually be required) and send with draft questionnaire, explanatory notes, covering and reminder letters, handouts, etc, to the address opposite.
When reporting a revision to a survey previously reported, please answer Sections A and B and those questions for which the reporting details have changed.

A From (name and address)

Telephone number   Date   /   /19

Department/government agency responsible for the survey

Division/Branch/Section

Name and address of person within department/government agency to whom queries should be directed, if different from above

Telephone number

B Title of survey

Reference number (if any)

Is this (tick appropriate box)

1 a new survey? ☐   2 a revision to an existing survey? ☐   3 an existing survey being reported for the first time? ☐

If 3, in what year was the survey first carried out?

C Indicate, by ticking the appropriate box, which of the following best describes the purpose of the survey and the use to which the results will be put

1 Determining specific policy or action ☐

2 Monitoring or assessing recent/current policy or action ☐

3 Research having a general or long term effect on policy or action ☐

4 Assessing economic or social trends/providing economic or social indicators ☐

Give full reasons why the information being collected is required, referring, where appropriate, to the specific policies or action being determined or assessed

Level at which the survey has been cleared in principle (tick appropriate box)

Ministerial ☐   Assistant Secretary (or equivalent) and above ☐   Other ☐

D Is there a statutory requirement on the department/agency to collect the information? (tick appropriate box)

yes ☐   no ☐   If 'yes', under which Act?

Is there a statutory requirement on respondents to provide the information? (tick appropriate box)

yes ☐   no ☐   If 'yes', under which Act?

Frequency, if survey is regular

Date of start of fieldwork (give approximate month if exact date not known)   /   /19

Length of fieldwork period. if survey is one-off

E Industrial activity of businesses to be approached, eg SIC description: type of local authority to be approached. eg education authority, district council

Details of any other characteristics of the target population, eg exporters, single establishment companies, planning departments

Geographical area covered by the survey, eg UK (including Northern Ireland), GB, South West, Oxford

...ber of businesses/local uthorit:es to be approached	number	expected response rate
by postal questionnaire		%
by personal interview		%
by telephone		%

Maximum number of reminders/recalls

Register or list from which the sample is to be drawn, eg VAT register, Yellow Pages

Sample selection method and, for local authority surveys, sampling fraction

Business surveys only

Reporting unit (tick appropriate box)

enterprise ☐   establishment ☐   pay-point ☐

other ☐   (please specify)

Is there a cut-off to exclude small businesses from the sample? (tick appropriate box)

yes ☐   no ☐   If 'yes', at what level?

Is there a simplified form for small businesses? (tick appropriate box)

yes ☐   no ☐

Regular business surveys/One-off surveys to 500 or more businesses

Details of population and sample by employment size group
(required to assess and record the form-filling burden on small businesses)

Where stratification of a sample is based on a variable other than employment, eg turnover, or on different employment size groups, attach details of the actual stratification used and provide estimates below, following consultation with Survey Control Unit

	POPULATION			SAMPLE	
number of employees	number of reporting units	total employment	proportion of the total of a major variable measured by the survey: %	sampling fraction	number of reporting units
1-24					
25-49					
50-99					
100-199					
over 199					
total			100		
		variable			

J Is any part of the survey to be carried out by a body outside the department/agency? (tick appropriate box)

yes ☐   no ☐

If 'yes': name of body

part(s) of survey contracted out
(if all, state 'all')

fee to be paid, including VAT   £

K Estimated man/hours to complete postal questionnaire (give range where appropriate)

main questionnaire

simplified questionnaire (where appropriate)

For interview and telephone surveys, how much, on average, of the respondent's time is taken up?   _____ minutes

L Indicate, by ticking the appropriate box(es), which of the following apply

1 this survey repeats or is similar to earlier survey work ☐

2 this survey has been piloted ☐

3 this survey is to be piloted ☐

4 this survey is a pilot for a forthcoming survey ☐

5 this survey has not been, nor will be, piloted ☐

Details of any earlier surveys used in the design of this survey

Details of consultations with respondents or their representatives

Details and explanation of any known duplication or overlap with other surveys

M When will the results of the survey be available within the department/agency?

When will the results be published?

In what form will the results be published?

APPENDIX Q

Car Travel Characteristics of Stage 2 Respondents

591 respondents travelled to work by car; the types of car travel are split overall as follows:

Drive Alone	49.2%
Drive with Passenger	22.1%
Passenger	28.7%

Tables Q.1. and Q.2. show the split of type of car travel by SIC of employer, and job category of respondent respectively.

Table Q.1. again shows the low representation of certain SICs in the sample, SICs 15, 20, 25 and 26 having so few car travellers as to make the percentage splits between the types almost meaningless. However, an overall predominance of driving alone is shown, with almost equal splits of Driving with Passenger, and Passenger. Within individual SICs (excluding those mentioned above) a basic 50:25:25 proportion is noticeable (Drive alone: Drive with passenger: Passenger).

Table Q.2. shows that Drive alone is the most common method of car travel amongst Professional-Managerial employees (59.5%), Passenger is the most common amongst Technical-Clerical employees (41.6%); and also amongst Manual-shop floor employees (52.4%).

TABLE Q.1.

Type of Car Travel – by Firms' SIC

Count Row (%) Col. (%) Total (%)	Clothing SIC 15	Constr. SIC 20	Gas etc. SIC 21	Tpt. SIC 22	Retail SIC 23	Banks SIC 24	Prof. SIC 25	Other SIC 26	Admin. SIC 27	Total (%)
Drive Alone	2 0.7 33.3 0.3	4 1.4 66.7 0.7	43 14.7 49.4 7.2	33 11.3 49.3 5.5	10 3.4 43.5 1.7	33 11.3 60.0 5.5	3 1.0 42.9 0.5	3 1.0 60.0 0.5	162 55.3 47.6 27.2	293 (49.2)
Drive + Pass.	1 0.8 15.7 0.2	2 1.5 33.3 0.3	17 12.9 19.5 2.9	17 12.9 25.4 2.9	5 3.8 21.7 0.8	8 6.1 14.5 1.3	1 0.8 14.3 0.2	0 0.0 0.0 0.0	81 61.4 23.8 13.6	132 (22.1)
Passenger	3 1.8 50.0 0.5	0 0.0 0.0 0.0	27 15.8 31.0 4.5	17 9.9 25.4 2.9	8 4.7 34.8 1.3	14 8.2 25.5 2.3	3 1.8 42.9 0.5	2 1.2 40.0 0.3	97 56.7 28.5 16.3	171 (28.7)
Total (%)	6 (1.0)	6 (1.0)	87 (14.6)	67 (11.2)	23 (3.9)	55 (9.2)	7 (1.2)	5 (0.8)	340 (57.0)	596 (100.0)

Number of missing observations = 290

TABLE Q.2.

Type of Car Travel by Job Category

Count Row (%) Col. (%) Total (%)	Prof.-Man.	Tec-Cler.	Man-Shop.	Other	Total (%)
Drive Alone	173 60.7 59.5 29.7	105 36.8 39.3 18.0	6 2.1 28.6 1.0	1 0.4 33.3 0.2	285 (49.0)
Drive + Pass.	74 57.4 25.4 12.7	51 39.5 19.1 8.8	4 3.1 19.0 0.7	0 0.0 0.0 0.0	129 (22.2)
Passenger	44 26.2 15.1 7.6	111 66.1 41.6 19.1	11 6.5 52.4 1.9	2 1.2 66.7 0.3	168 (28.9)
Total (%)	291 (50.0)	267 (45.9)	21 (3.6)	3 (0.5)	582 (100.0)

Number of missing observations = 304

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