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TRAVEL DEMAND GROWTH:

RESEARCH ON LONGER-TERM ISSUES

THE POTENTIAL CONTRIBUTION OF

TRIP PLANNING SYSTEMS

P G Hopkinson and A D May

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1. INTRODUCTION

1.1 The growth in demand for travel

Over the 20 years from 1965, National Travel Survey (NTS) data shows a 61% growth in total person - km of travel. More detailed analysis suggests that this is made up roughly as follows:-

due to increased population	4%
due to more journeys	22%
due to longer journeys	35%

This implies that around 60% of the growth in travel has been due to people travelling further, rather than making more journeys.

It is interesting to note, too, that the same phenomenon occurs even in the most congested areas. Between 1975 and 1985, NTS shows an 11% growth in person -km by London residents, at a time when population fell by 5%. In this case, the growth is made up roughly as follows:-

due to lost population	- 5%
due to more journeys	4%
due to longer journeys	12%

It is of course difficult to estimate the extent to which future growth in travel will be generated by longer journeys. The NRTF, which predicts a growth in car-km of between 120% and 180% between 1985 and 2025, is not based on a procedure which enables the effects of journey making and journey length to be separated. However, it is worth noting that if the same pattern were to exist at a national level in future, the predicted growth in car travel due to longer journeys could be equivalent to between 75% and 100% of today's car travel. It seems appropriate to ask whether it is a wise use of scarce resources to provide the infrastructure and energy needed to enable people to carry out their activities further from home.

1.2 The factors affecting journey length

This substantial increase in journey length may have arisen in several ways. Clearly growth in car ownership, which removes the constraints of public transport on journey patterns, and of walking and cycling on journey length, will have played a major part. So will increased incomes more generally, in that they permit people to purchase a more attractive residential environment, which often implies longer journeys to work. Changes in land use and built form will equally have had important effects, with the continued expansion of lower density residential areas, and the development of larger units for a wide range of activities, from shopping to schools and from hospitals to leisure facilities, which will in turn have induced longer and often car-borne journeys. It is also argued that transport policy has stimulated such trends by the pull-factors of reduced journey costs, and the push-factors of reductions in the availability of bus services and in the acceptability of walking and cycling.

The NTS results do not provide much guidance on these issues. They do however, indicate that the largest growth in journey length has been for work journeys (at 58%), with that for other purposes nearer to 20%.

1.3 Ways of reversing the process

If it is considered desirable to encourage a reduction in journey lengths, there are several possible approaches which can be considered. One is to increase the cost of travel; this will happen anyway for public transport, as subsidies are reduced, and could arise for private transport if new fuel taxes or road pricing were introduced. A second is to change the pattern of land use provision, by avoiding high concentrations of activity, and making facilities more available nearer to homes. A third is to make the shorter distance modes, and particularly walking and cycling, more attractive. To this can be added the possibility of encouraging alternatives to travel, in which the distance travelled to carry out a desired activity is reduced to zero.

Any of these processes can be expected to operate both in the short term as people try out new shopping or leisure activities, or services such as teleshopping and in the longer term as people make locational and life cycle decisions. It is probable that the latter have the greater potential effect on total travel.

Much will depend, therefore, on the short and long-term decisions of individual travellers, influenced in turn by the decisions of providers and operators of transport, and the developers of new facilities. The effectiveness of their decisions will be influenced by the adequacy of the information available to them. Current developments in Information Technology promise to provide significant advances in the quality and quantity of information available to the decision maker. This paper concentrates on the role of Trip Planning Systems, which are primarily designed to offer improved information to the user, but may also have an impact on operators and developers.

1.4 The Role of Trip Planning Systems

Information plays a central role in the planning of individuals' trip planning decisions. Information about travel options and conditions is available in numerous forms. Developments in Information Technology are providing the potential to provide information from a central source covering more aspects of a potential journey than is often currently the case. Automated systems which are currently being developed or already in use include enquiry systems for public transport, real time information on bus and train delays, and real time guidance on optimum routes for vehicle drivers. Whilst much of the emphasis at present is on information during the journey, there is considerable interest in the provision of a combination of static, real time and predictive information to potential travellers before they make their journeys. The concept of a Trip Planning System involves the provision of information at all of these stages. However, no such comprehensive system exists currently. In order to seek experience relevant to the assessment of Trip Planning Systems we have broadened our review to include those types of system which provide information at one or more of these stages, for one or more modes. In practice, much of the work to date has focused on route choice and route guidance, and it is noteworthy that, while the processes of choice of destination mode, time of day and route are different, they give rise to many similar research issues.

Information from such systems could assist in many trip planning decisions and potentially lead to significant changes in demand for travel. Whilst it seems plausible that these changes could be significant, the direction and scale of effect are by no means clear. It is conceivable that trip planning systems could encourage people to make more efficient use of transport or, indeed, not to travel, and such a direction of effect could be influenced if the system was operated in the interests of public policy. Conversely, as appears to have been the case with telecommunications,

trip planning systems could increase the number of journeys made, by making users aware of new opportunities. It is these uncertainties in the impact on demand which are the main focus of this paper. However they depend in turn on the success of trip planning systems themselves.

The success of a trip planning system in terms of providing the traveller with useful information depends on an ability firstly to define "useful" information and secondly to design a system that makes that information available and accessible to the user.

1.5 Structure of the paper

This paper is one of a series which have been commissioned to review the factors which might potentially affect the long term demand for travel in the UK. It examines the various factors which are likely to affect the use of trip planning systems and their likely impact on user behaviour. In the light of this, it considers the research requirements necessary to assess the potential impact on travel demand.

Section 2 of this report describes a number of current trip planning systems, systems currently under development as well as systems that have been developed but have not proved to be successful or widely used. Section 3 of the paper deals briefly with the components of a trip planning system, and how these components might fit together in a general framework for exploring the development and potential of such systems. Section 4 discusses the possible range of user responses to trip planning information, including the information that might be required by a user and the possible responses to that information. Section 5 deals with the way in which these issues might be researched.

2 CURRENT TRIP PLANNING AND INFORMATION SYSTEMS

2.1 Introduction

The potential users of a trip planning system include all types of traveller; road user and public transport user, freight transport and passenger transport, local and international traveller. Data from the system may be useful to operators and managers of transport systems. While the main applications wil be in affecting the ways in which journeys are made, other uses will include advice on whether a journey is needed and longer term information on home, work and business locations.

It follows that two types of data must be supplied by the system;

a) Static information: Such data is not usually time-dependent or at least does not fluctuate in the short-term in response to short-term changes in travel conditions on the transport network. The type of information includes timetable and fare information and route itineraries held by such organisations as the AA.

b) Dynamic information: Such data varies with changes in travel conditions. It may be real-time data (describing what is actually happening) or predictive information (describing what is likely to happen in the near future). Real-time data is held by authorities such as the Police and highway engineering departments and may be passed to the broadcast media. Predictive information is less readily available but is already provided in some public transport applications. The advent of Autoguide provides the potential for the automatic detection and forecasting of travel times and speeds.

The provision of this information has the capacity to achieve a wide variety of individual and public sector goals. For the user, these include:-

a) deciding where to travel to
b) selection of the most efficient mode
c) selection of the optimum route
d) selection of the optimum travel time;

for the public sector, they can include:-

a) influencing the journey destination
b) reduction of traffic congestion
c) improving safety
d) protecting the environment
e) marketing tourist and development areas
f) conveying regulatory information.

The effectiveness of travel information in meeting these goals will inevitably be dependent upon the effectiveness of the means of distribution of information, the ease with which the information can be retrieved from the system and its perceived reliability. Information can be made available at a number of destinations including the home, the workplace, during the journey or in a public area. Trip planning systems make information available in a wide number of ways through a variety of devices. The specification of the system will have a major bearing on the potential market. If the system operates through traditional technology then it might be more acceptable to users but may suffer in the type of information that can be displayed.

2.2 Media and systems

Travel information is used in many different forms in trip planning and travel decisions. The main types of information currently available and some of the systems by which they are supplied to the user are described as follows in order of increasing complexity and sophistication:

a) Fixed information boards

This represents the simplest form of static information and includes fixed city maps signs and timetables. It is most often provided by public authorities and public transport operators.

b) Printed material

Printed material comes in a wide range of forms, including timetables, leaflets, guides and maps. It provides static information, but can be updated readily.

c) Recorded messages

Telephones with pre-recorded messages or timetables provide an alternative means of providing information in a form which can be updated.

d) Public access terminals

Public service terminals can provide similar passenger information to recorded messages. They are most common in mainline rail stations. Again, the information is static, but can readily be updated.

e) Personal advice

Personal advice by means of telephone or face to face contact provides answers to detailed enquiries on travel or other types of information such as weather conditions. Some dynamic data can be provided on changing conditions, but much of the information is static.

f) Newspapers

Certain newspapers carry information about road conditions including expected delays due to construction, new traffic management measures etc. These are issued by the press office of the Department of Transport, the police and the local authorities.

g) Road signs

In addition to standard direction signs the Department of Transport provides itinerary information in the form of signposted holiday routes and diversionary routes to avoid congested routes and disruptive construction works. Most signs are fixed, but variable message signs, responsive to changing traffic conditions, are available.

h) Radio broadcasting

Radio bulletins and broadcasts can provide topical, real-time information about road-works, rail delays or traffic congestion. Radio travel programmes can inform people about new opportunities and destinations, as well as general travel advice.

i) Television

Television can provide the same service as radio broadcasting with the addition of visual information. This information is most likely to be broadcast to the home and is therefore only likely to be of relevance in the pre-planning of trips. Even then there are no dedicated programmes for travel information other than holiday programmes. The medium is less suited to travel bulletins than radio.

j) Teletext

The BBC and IBA offer Teletext services, CEEFAX and ORACLE, which are received by specially adapted television receivers. This information offers visual information which can be browsed by individuals. Road reports concerning delays and diversions are given for the national motorway network and for different regions. The sources of the information are normally the same as for local and national radio. British Rail and London Regional Transport provide information about delays on local rail and bus services. Air traffic news is supplied by the major airports and airlines. Ferry news and sea conditions are also offered. Certain tourist authorities also utilise Teletext services receiving information from a variety of databases.

k) Videotext

Videotext is a private subscription service which is transmitted over the public telephone network. The extent of the information is unlimited and is not subject to any restrictions. Information can be provided by a private person or a public body. In the UK one major motorway service area operator offers a videotext information system in some of its service areas but this is restricted to news of congestion and roadworks on the motorway system. In Germany information on holiday traffic and tourist routes is provided by the Federal Ministry of Transport via videotext although currently this service is not widely used. The most successful example of information provided by videotext is in France, where the MINITEL system now has over four million subscribers. This system offers many facilities including journey itineraries, costs, expected durations, weather conditions and so on.

l) Electronic databases

Electronic databases offer similar possibilities to videotext, but their use is in general restricted to a limited number of people. They can be accessed by telephone with a modem. In Scotland an EMU (Electronic Marketing Unit) database system is operated by the Scottish Tourist Board. Travel information is held on the database, with organisations such as the AA and BR paying for space on the database. The data is static and only revised a few times a year at most.

m) Route Guidance

Route guidance systems currently available or under development include ones which provide solely static location finding and route finding services, and ones which provide real time information on the most appropriate routes to take given the current, or predicted, traffic conditions.

2.3 Examples of Travel Information Systems

2.3.1 Provision of Real Time Information for public tranpsort users

Research into the provision of real time information for public transport passengers has indicated benefits both to the passengers and the public tranpsort operators. The benefits to passengers took a variety of forms. It was found for example that the presence of dynamic information systems on several platforms on the London Underground reduced perceived waiting times by an average of 0.68 minutes (Forsyth & Silcock 1985). In a study involving the provision of real time information at a major public transport interchange in Newcastle 23% of passengers interviewed believed the information led them to wait for a shorter time period (Cowell, James and Silcock 1988).

A second major benefit to passengers was the reduction in uncertainty and associated stress and frustration of waiting for a vehicle to arrive. In the Newcastle study 40% of the passengers interviewed found the system reassuring, whilst in the London study 95% of passengers considered the system useful, 65% commenting on reduction in uncertainty.

The third major benefit was the assistance with trip planning decisions. In the Newcastle study 35% of passengers made use of the system to plan their journeys on a more informed basis, enabling them to make what they considered to be optimum journeys. The information was found to be useful and relevant to the needs of interchanging and bus-travellers. 39% of respondents would let a crowded bus go if they knew a second bus would be arriving shortly. In the London study 12% of passengers said they used the information to aid their choice of train, either in selecting interchange points or waiting for a less crowded following train.

A final benefit to passengers and to the public transport operators, reported only in the Newcastle study, was the increased use of buses. 11% of travellers claimed to use the buses more often as a result of the enhanced public information system.

The evaluation of the potential attractiveness of providing real-time information by operators was calculated using some very crude assumptions. In the case of the Newcastle system it was calculated that a 2% generation of passengers would produce a 10% return on the capital investment per annum and enable payment of the recurrent annual costs. In the London Underground study the direct benefits in terms of generated demand were not calculated.

2.3.2 Bus Passenger Timetable and Service Information

An important facet of a trip planning system is that it can advertise transport services and facilities that people may not know about or may be using inefficiently. This can result in an increase in benefits to existing and potential travellers, to the operator and to the performance of the transport network. The results of a simple experiment carried out in West Yorkshire indicated how even small-scale advertising of services can lead to significant benefits to the public and operators (Tebb & Ellson 1981). Travel information in the form of free leaflets and bus-stop panels were distributed in Bingley, West Yorkshire over a 24 week period. Nearly 11,000 leaflets were distributed at bus stops and a variety of public locations. The leaflets indicated the price, frequency and journey time characteristics of alternative services to a wide range of destinations. The results of the advertising campaign indicated benefit to the public in terms of increased number of trips being made and a more efficient use of the system overall.

2.3.3 Computerised Public Transport Travel Information

An example of an integrated computerised public travel information system was developed and tested by the TRRL during the late 1970's (Pickett 1982). This system was designed for use by clerks at enquiry desks to be able to respond more quickly and more accurately to passenger enquiries. The trial involved the input to a computer of the timetable data for virtually the whole of the public transport network in and around Wiltshire. This information was assessed by a suite of software to select routes and generate integrated travel information. The study found that it was feasible to generate and maintain an integrated travel information data-base by computer. The initial data-base and creation required 120 man-days and thereafter needed 40 person days per year to update the information. The software development needed about 160 person-days. All these figures were of course in a regulated bus-industry. Six possible methods of dissemination were investigated. At the time of the trial it was found that the micro-fiches were the most cost-effective.

The response of the clerks and users to the system were somewhat different from what had been expected however. Firstly the travel enquiry staff did not use the system as frequently as was originally envisaged. Interestingly the system was only used by a clerk if a member of the public asked for information which necessitated the use of the system. The clerks did not consider it to be a part of their job to encourage enquirers to undertake a previously untried route. Despite widespread publicity, via newspapers and local radio, this had little effect in encouraging the public to demand information requiring use of the system. It was found that when making enquiries the public mostly had selected their mode of travel before asking for journey details and seemed unwilling to consider alternative possibilities.

It was felt that the short duration of the trial, the lack of confidence shown by clerks in disseminating information and the public's resistance to change in the short-term all militated against the ability of the system to affect travel choices. Whilst the public transport management could see the overall benefits of the system they were not convinced that the system would generate any extra revenue.

2.3.4 Dynamic Route Guidance

The first substantial trial of dynamic route guidance is currently under way in Berlin. Some 600 drivers' cars have been equipped with a system which enables them to seek guidance to any destination within the city; the guidance itself is updated based on travel time information obtained from the equipped vehicles. Early results suggest that drivers make frequent use of the guidance, but primarily for occasional rather than regular journeys.

2.3.5 Holiday Route Information

The best example of large scale use of a trip planning system is the Bison Futé system in France. This system alerts road users to potential travel difficulties based on a variety of media. This includes publication of an annual traffic calendar pointing out heavy days, publication of press copy before each period when difficulties are expected, publication of special road maps denoting congested areas and alternative routes and other subsidiary information. In the 10 years of its operation peak period traffic has increased by 50% but the level of congestion has not increased. Surveys by the Ministry of Transport suggest that the system influences around 8-16% of motorists before their journey begins and induces changes both in the timing and routeing of journeys.

2.3.6 Experience from other sectors

In the closely related field of telecommuncations services, such as video-conferencing, remote-working and tele-shopping (a system allowing the consumer to browse and order shopping items from a home-based link to a store) three competing claims for the effects of new technology on travel demand have been put forward. Firstly it is suggested that telecommunication technology would act as a substitute for travel; in other words people replace shopping at home for shopping activities which previously involved a physical trip to a shop. Secondly it is suggested that an increase in the use of electronic based communications is likely to lead to an increase in the demand for travel either as previously time-consuming activities are capable of more rapid transaction or as the technology itself identifies new opportunities and possibilities. A third claim is that there is no single direction of change and that substitution and generation can occur leading to alterations in the organisation of daily activities and trip-making and possibly longer term processes such as decisions on where to live and work. In fact there is little or mixed empirical support for any of these claims.

Recent evidence from a large-scale Telecommute Pilot Project (where telecommuting is defined as the performance of work outside the traditional central office, either at home or at a neighbourhood centre close to home), indicated that telecommuting is an effective trip reduction measure (Kitamura, Goulias and Pendyala 1990). The survey analysis examined the trip records from 146 respondents, of which 66 were telecommuters. The latter telecommuted on the average 1.25 days during three-day travel diary periods. They were all state employees or members of a household of a state employee. The following were the main findings:

(a) Telecommuting serves as a trip-reduction measure for commuting trips without resulting in an increase in non-work trips. The average number of non-work trips on telecommuting days is 1.17, while on commuting days it is 1.71. This compares to a daily average of 1.81 trips shown by the control group who commuted to work every day.

(b) Based on the study sample, the total travel distance was reduced by an average 40 miles per telecommuting day. On a telecommuting day telecommuters travelled less than 20% of the distances they normally travelled when they commuted to work.

(c) The household members of telecommuters do not increase car use even when additional family cars may become available for their use.

2.4 Conclusions

There is currently a wide range of information available to public and private transport users. There are also a number of developments which provide the possibility of a greatly enhanced level of information to aid trip planning decisions. Moreover technological developments in telecommunications and information technology are providing the possibility for a new form of relationship between travel and activity.

The evidence there is suggests that in the public transport sector, enhanced information provides benefits to passengers and operators, and enables more efficient use of the system. The extent to which computerised retrieval systems will add to those potential benefits will depend upon passengers' and operators' attitudes to, and confidence with the system.

In the private transport sector experience elsewhere indicates that enhanced information can have a significant effect on trip planning and travel demand. Similarly evidence from the USA shows that remote working concepts can have a significant effect on travel demand.

Overall however there has been little research to understand the relationship between information and travel choices and demand. In the next two sections we explore this relationship.

3. DEVELOPING THE POTENTIAL OF TRIP PLANNING SYSTEMS

The potential level and pattern of use of a trip planning system will be affected by two interacting considerations. The first involves the willingness of suppliers to provide information and institutional factors which might deter co-operation between suppliers. The second relates to the way people actually plan trips and the way in which information, including its location, cost and ease of access, affects decisions prior to travel. We examine both of these issues in turn, highlighting those factors which we consider to be most important in terms of the potential influence of trip planning systems on demand. We then consider the systems effects which are likely to arise.

3.1 Suppliers' willingness to supply information

The potential providers of information to a trip planning system and disseminators of information can be divided into three categories.

3.1.1 Administrative authorities and public institutions

This group includes government departments, local government authorities, the police, national radio stations operated by the BBC, and tourist boards. There is currently a range of cooperative relationships between several of these organisations. For example, BBC information is gathered from the police road data service. Some of the larger independent radio stations operate their own surveillance systems (eg helicopters) to provide travel information. All the authorities make the information available free to the public.

3.1.2 Clubs and Associations

The principal automobile associations, the AA and the RAC have nearly 10 million members between them. Information is provided free to their members mainly by means of mail and a telephone enquiry system. The AA offers information services on all aspects of motoring in the UK and overseas including personal itineraries, traffic forecasts, weather conditions and a range of tourist services and attractions. The RAC provides similar information although on a lesser scale. The Cyclists' Touring Club with some 40,000 members offers a comprehensive touring guide and personal itineraries and special cyclists' maps to its members.

3.1.3 Commercial Organisations

Public transport information is primarily supplied by commercial organisations, such as British Rail and the various bus and coach operators. British Rail provide information via printed material, telephone operators, recorded information services and videotext services. Information is provided on prices and timetabling of services, delays and engineering works. This information is provided free to enquirers. Bus and coach transport operators provide a similar range of services to British Rail.

The private sector is also becoming involved in the provision of information to private transport users. The autoguide pilot in London is to be operated by GEC under a licence from DTp, and General Logistics have recently launched a motorway information system. In both cases, the information will be provided only to those who purchase access to the system.

3.1.4 Future Developments

As the provision of information becomes more complex and expensive, it seems probable that the private sector will become increasingly involved, with government agencies playing a developmental and enabling role, and commercial organisations financing the systems and charging for the information provided. This is likely to have a number of important implications for the availability of information which will require further research:-

(i) charging for information will reduce its use, and make potential users more careful to ensure that they are getting the information which they need; this in turn could lead to individuals failing to seek information (eg on alternative destinations) which they do not perceive that they could benefit from;

(ii) those suppliers, such as public transport operators, who gain an additional benefit from provision of information, in terms of payment for other services provided, will be unlikely to provide information on competing services; this will militate against the provision of information which might encourage a reduction in travel or use of a more efficient mode;

(iii) private sector operators may well wish to provide information which is not conducive to the meeting of public sector objectives; route guidance systems already demonstrate the dangers of the private sector failing to meet environmental, safety, or even system optimisation objectives.

3.2 Trip Planning Systems

Trip planning and travel decisions are complex, inter-dependent activities. A trip-plan refers to an intended course of action or change of action. A travel decision is what a person actually does, in terms of his revealed choices. Whilst trip planning is usually considered as a process which takes place prior to a trip being made, often associated with unfamiliar journeys, any plan can be revised during a journey or indeed form the basis after a journey for future travel decisions. Moreover trip planning is not an activity reserved solely for trips to unfamiliar locations or destinations. Trip plans can be made for habitual or daily journeys, to/from work for example, to contend with changes in travel conditions or new household or organisational constraints. The major difference is that the plans involving travel of a daily or a routine nature are likely to be more embedded or implicit, and therefore more difficult to extract and examine, than those which involve new or non-routine travel. The problems that arise in attempting to reveal introspective or embedded processes are considered further in Section 5.

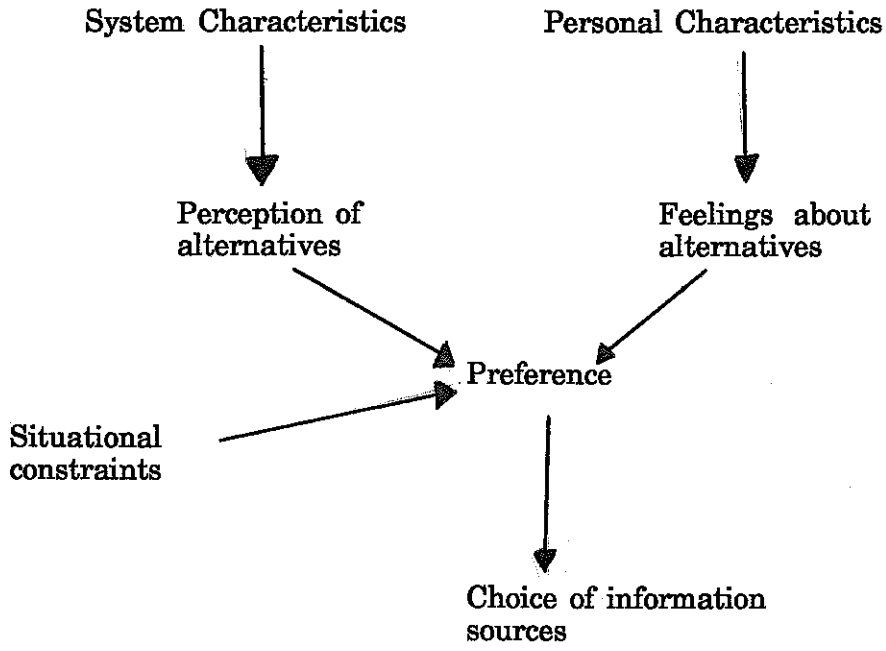
In order to understand the interactions between information and travel, a framework, based largely upon a user response to possible teleshopping systems (Solomon and Koppleman 1988) is presented (see Figure 1). Using this framework we can regard the planning of a trip, including stages prior to any travel being undertaken as well as the travel itself, as a number of overlapping steps:

(1) a decision to carry out an activity
(2) choice amongst alternative information sources
(3) information gathering and organisation
(4) evaluation of information obtained
(5) choice of consequent actions (more information, travel, do not travel, book services)

(6) travel, involving utilisation and updating of information given
(7) evaluation of information given
(8) choice of actions (continue, review information, alter plan)
(9) evaluation

The simplest trip planning behaviour would include one cycle and lead to a travel decision which is executed. A more realistic process is that the individual undertakes a number of cycles, not necessarily in the same order or the order presented or to the same conclusions, and obtains more information in each successive cycle. The series of cycles terminates when the individual has enough information to make a decision, or the information satisfies certain criteria, or the cost of acquiring information is greater than the prospective benefits of additional information.

Figure 1



3.2.1 Attitudes to and access to the system

Given the idealised framework above, it is evident that the potential of a trip planning system is likely to be critically dependent on whether the system and information is perceived as superior to other information sources. This will depend upon factors such as the location and ease of access to the system; the cost of using it, the range of services available and the quality of the information available.

Attitudes to a transport planning system will vary with the user's confidence in, or ability to use a trip planning system. With computerised systems, experience with keyboards and computers is likely to lead to a different view of the system.

In a study to identify the potential use of alternative business telecommunications media, the characteristics of the user which were considered to be important factors in determining the choice and use of a medium were: status (ie position in organisation), age, sex, education, keyboard and typing skills, occupation, attitude towards change and attitude towards computer technology (Moore and Jovanis 1988). In a study of the use of Prestel passenger information systems at a mainline London

terminus, 56.5% of the sample of 90 had experience with using a computer or the Prestel system, suggesting a higher usage of the system by computer literate people than the remainder of the population. Furthermore it was found that the most common reason given for using the information desk rather than a Prestel service was a preference for personal contact. 20% of respondents found the Prestel terminal unfamiliar or confusing whilst a further 20% required information that was not on the machine (Ghari-Saremi and Nash 1985).

In the study by Moore and Jovanis a long list of perceptual and affective variables were found to be important in explaining use and choice of alternative business communications media. Those which are relevant to trip planning systems are as follows:

Perceptual variables

- accessibility and availability
- cost of use
- speed of delivery
- quality and reliability
- ease of understanding of how to use the media

Affective variables

- trendiness of media
- familiarity of media
- degree of comfort using the media.

The ways in which these and other factors will affect attitudes towards a trip planning system are likely to be complex and subtle and requiring detailed attitudinal and market research investigations. For example, if the trip planning system is to be set in a public domain then the ability to be able to observe other people using the system, the opportunity to learn how to use it and the provision of privacy in order to try out the system away from the public gaze will be conflicting requirements affecting the use of the system. If the system is home-based however, these factors will be less relevant, but a major factor affecting attitude to the system may be its purchase and use-cost and its ease of use including its compatibility with other systems.

In France, for example, the success and popularity of the MINITEL system is due largely to the fact that the four million subscribers were given a free computer by France Telecom, the national telephone company. Even so the system has proved to be expensive for the average user (Newman 1990).

The extent to which these factors might influence the take-up of the technology and its use can be demonstrated through two simple observed examples. The first example is the FAX machine. The FAX has become a popular form of communication in a relatively short space of time. The reasons for its success are self-evident. It is able to transmit written and graphical information rapidly and at relatively low cost. The transmission technology is based around familiar devices - a telephone system and a paper copier. It is simple to use.

In comparison if we consider the advent of the multi-featured telephone there is a different story. Here the system is a development of the ordinary telephone. In practice most users seldom if ever make use of any of the facilities other than normal dialing. It appears that the need to memorise each facility code is a major deterrent. Moreover, although many of the facilities would be potentially useful,

such as follow-on calls or telephone conferences, the fact that these are so seldom used in practice suggests a major system design flaw. Thus the design of a system, even at a highly simple level, can affect its usefulness.

3.3 Potential System Effects

While suppliers' and users' decisions can each be influenced by the costs and benefits of the information provided, they may well interact with one another in ways which may build on the synergy of the overall system but could potentially be disbeneficial. The specific area of dynamic route guidance illustrates the problem well. Suppliers can elect to provide different levels and qualities of information; these will in turn help to determine the level of use of the system. The fewer the users, the less information is fed back to the system, and the less reliable is the information provided. This can in turn generate mistrust of the information and a further decline in use. Conversely, the higher the number of users, the greater is the chance that rerouteing of large proportions of the driving public will cause instabilities, and lead to drivers being given inappropriate advice. Misperception of benefits is likely to aggravate the situation, particularly in highly congested conditions, or in situations where environmental or system efficiency considerations require routeing on other than user optimal routes.

Similar interactions are likely to arise in the wider field of trip planning systems, particularly given the extra dimensions of choice of mode and time of travel. It will be difficult to identify in advance the full range of these possible systems effects, but it will be necessary to bear them carefully in mind in system design, particularly where public sector benefits are being sought.

4. USER RESPONSE TO TRIP PLANNING SYSTEMS

Knowledge of how users might respond to actual information is important to understanding the likely impact on travel demand and upon the transport network. In this section we discuss in more detail the forms of information which users might need for trip planning purposes the factors which might affect the use of information in actual travel decisions.

4.1 Information requirements

There are many types of information which may be useful to support travel decisions. Information requirements however can conveniently be discussed under three headings:

1. Mode(s) and time of travel
2. Conditions of travel
3. Trip-end facilities

Mode(s) of travel

A basic requirement in many trip plans is how to travel. In many circumstances people will be constrained in their choice of mode and may therefore seek information about a specific mode only. In other situations a person may have a choice of mode or be unaware that there are alternative modes that may be available to make the same trip. In this situation people need comparative information. In both instances journey time, distance and cost will be critical items of information. The importance of this information will vary by mode. In the case of private travel, time and distance will probably be more important than cost. Where there are public transport alternatives the fare level will probably be more important. In a major study of passenger telephone enquiries to British Rail at 5 mainline stations, 87% of all enquiries were found to involve either timetables or fares (Ghahri-Saremi and Nash 1985). Of these, enquiries about timetables accounted for nearly 60% of the enquiries. In the case of multi-leg, or multi modal journeys, information about connection time between stages or the travel distance in order to switch modes may be important to the selection of mode.

Conditions of travel

Information about conditions of travel, for example traffic congestion or seating availability, may influence the initial choice of mode but is also likely to be important in trip scheduling, notably in terms of times of departure and travel and the choice of route. If a person knows that certain trains are likely to be crowded or that a particular traffic corridor is congested between certain times then this will enable him/her to plan around these conditions. It is not simply enough to know that there will be traffic congestion however, but rather how much delay it will cause for journeys at particular times. Information about conditions of travel is needed both prior to a trip and, especially in the case of road travel, where conditions can fluctuate markedly, during a trip.

Trip end facilities

Trip planning and travel decisions may take into account a string of features and facilities at the trip end. Information about these facilities may affect choice of travel mode or the precise organisation of the trip by a specific mode. Obvious information requirements include parking availability and costs, accommodation and places to eat, how to find destinations and cost and methods of travel to them.

4.2 User responses

From the point of view of estimating the likely scale of effects of a trip planning system, two sets of decisions are of interest. The first concern attitudes and decisions relating to the trip planning system itself. The second concern responses to that trip planning information. The range of possible responses to trip planning information are outlined below:

i) Whether to travel
ii) Where to travel to
iii) When to travel
iv) How to travel
v) Whether to travel by one or several modes
vi) Which service or route to use.

These decisions all apply to trip making as a short term process. In addition trip planning information can be envisaged as having a role to play in longer term decision-making specifically in decisions about where to live, work and do business.

1) Whether to travel

Three broad groups of factors could be expected to affect a person's decision whether to travel: conditions, need and alternatives.

There is relatively little evidence to show what factors or levels of those factors deter people from travelling. We can hypothesise that factors such as adverse weather conditions, congestion or overcrowding, accidents or anticipated disruptions to a journey are all likely to affect the decision to travel.

Certain trips will be more susceptible to these factors than others. The decision whether to travel will depend upon the urgency of the trip and affect different classes of travellers to different degrees. A person on an urgent trip, to catch an international flight, for example, might be less inclined to cancel a trip or not travel than someone planning a day outing. A trip that has been pre-booked will be less likely to be affected than non-booked trips.

The third factor likely to affect the decision to travel is the availability of alternative ways of achieving the same tasks or activities. The telephone is an obvious example. The ability to order goods by telephone can mean one less personal shopping trip but may lead to an additional freight trip if the goods are delivered to the door. The advent of telecommuting, previously discussed in Section 2, is a second more recent phenomenon. As noted previously however the effect of telecommunications on travel is not uni-directional.

ii) Where to travel to

People often choose to travel to the same destination out of habit or because of an unfamiliarity with alternative locations. Where there is more than one location to achieve a given purpose, such as shopping or recreation, then this information could affect the total amount of travel, and the location of that travel.

The factors which are likely to affect the choice of alternative locations are numerous and vary by trip purpose. For a large proportion of trips such as journeys to workplaces, the choice of alternative destinations is strictly limited. The trip types which are most likely to be affected by this information are shopping trips,

personal business and recreational trips. In the case of shopping, for example, evidence points to the importance of information about parking facilities and location and to the forms and costs of public transport serving alternative locations (Goodwin et al 1983). Information on the nature or quality of facilities (e.g. shopping, leisure facilities) at the destination may also be of value, but may be difficult to provide objectively. Knowledge of the alternatives and direct experience or the views of other people are all likely to be important determinants of the likelihood that a person will switch to a new destination. Where people become aware of other destinations, a trip planning system needs to be able to provide the necessary information to evaluate those alternatives.

iii) When to travel

A trip planning system has implications for travel choices other than the choice of route. Important amongst these are times of departure. In reality many drivers do delay their departure times in order to avoid traffic congestion and they may occasionally arrive earlier than if they had set off at a later time. An ability to predict travel times to a destination for a fixed arrival time would permit a driver to optimise his departure time and therefore help to reduce the level of congestion. This feature of a system implies a predictive capacity as well as a real time monitoring component. Such a capability would be feasible by using historical data from recent days combined with a predictive model of choice of departure time (Boyce 1988).

iv) How to travel

Whilst some people are heavily constrained in their choice of mode for certain journey purposes, many people have some freedom of choice of how to travel for some trips. Numerous factors can affect the choice of travel mode. For ease of discussion these can be thought of in terms of availability, cost and time differences, comfort and in-vehicle technology.

It is frequently assumed in travel demand forecasting that travellers have knowledge of the available options open to them and the characteristics of those options. These options may be between private and public transport or between different forms of public transport. A recent small in-depth survey found that, whilst most of the sample were aware of an alternative mode of travel to the car for trips to and from work, people were uncertain about the major characteristics of the alternative mode if it was not involved in the existing choice set (Hopkinson 1990). This uncertainty was due to a number of factors. The most obvious factor was that the mode had never been used or needed, or there was a preference for using the private car and the alternative had therefore never been researched. A second major factor was the effect of frequent changes in service which meant that even though a bus alternative was in objective terms an attractive alternative, the respondent had lost touch with, or no longer trusted, information about a service. In the case of two motorists interviewed who drove past a park and ride scheme everyday the absence of wayside information about the scheme was a major deterrent to its use.

The role of a trip planning system can be thought of in relation to two sets of information: the availability of an alternative mode and the characteristics of that alternative. The use of a mode is only partly related to its availability. Cost and time have long been recognised as two key determinants of travel mode choice and preference. The time and cost elements of alternative modes have different components. For example in the case of public transport, fares, wait time, frequency, reliability and walk time have been identified as important factors affecting the

perceived quality of the service and hence the information requirements about a service. In the case of private travel the cost element includes the cost of petrol, parking charges and any other costs, such as tolls, associated with the travel. Since it is well known that motorists do not perceive the real costs of motoring, a critical decision is what cost elements the system will provide. This may have a major bearing on the response to the information at the trip planning stage. By providing accurate travel time and cost information, the trip planning information system would allow travellers to improve their choices.

Elsewhere secondary attributes affecting mode choice, particularly between public transport services, have included comfort and cleanliness of the mode and station facilities. These factors have been studied in relation to satisfaction with the choice of travel mode rather than any attempt to determine how far they influence the choice of mode in the first place.

A new factor which appears likely to influence the choice of mode in the future is the role of in-vehicle technology, notably car and train phones and lap-top computers which are becoming common-place on trains. In Sweden this has been taken several stages further where computer facilities are provided on the train for business commuters. The car-phone now enables the motorist who is caught in traffic congestion to maintain contact with the office or home and thereby reduce the stress and uncertainty of travel as well as extend the office into the vehicle itself. The train phone fulfils much the same role. Both sets of technology are likely to influence the choice of mode or the attractiveness of a mode in the future.

As well as the actual trip itself, an important part of planning a certain class of trips, particularly long-distance and international trips, is knowledge of a range of services at the trip end. Such services include distances and means of travel to a range of secondary destinations, hotel accommodation, prices and availability, car hire, places to eat or visit. The ability to book such services as part of the trip plan or during the journey would be a potentially valuable feature, and could influence the use of trip planning systems, the choice of mode(s), where to travel to and potentially increase travel.

v) Multi-mode trips

In certain circumstances, the traveller may want information about alternative modes for different stages of the journey as a result of unforeseen problems on the journey or through a change of plan. The most obvious situation is the motorist who perhaps due to mechanical failure, traffic congestion, or tiredness wishes to continue the remainder of the journey by an alternative mode, for example rail, and pick the car up on the return journey. Information which enables the traveller to park and ride or gain access to other modes of transport could be highly valuable in a limited number of cases.

vi) Which service or route to use

Frequently motorists and to a lesser extent public transport users have a choice between routes. These routes may be familiar or unfamiliar to the traveller. The routes will vary in terms of time and/or cost characteristics. In the case of road based routes the time characteristics of a route can vary from day to day and by time of day. In the case of rail travel the time characteristics of the alternative routes may vary less, but perceived unreliability may still be an issue.

Motorists and public transport users are therefore often faced with uncertainty about which routes to choose in the first place or which routes to take on a day to

day basis. The availability of accurate real time information about the likely journey time and travel conditions by alternative routes, and guidance on which route to take could help people to reduce journey times and stress associated with travel.

Results from initial trials of route guidance systems indicate that the majority of motorists want to receive information based on time-savings, although a significant minority want a trade-off between least journey time and least mileage. The information requirements vary by type of journey. On unfamiliar journeys people want guidance, whilst on familiar routes people want information. The information which people perceived as being most useful was, in priority order, knowledge of prevailing travel conditions, parking availability, detailed street knowledge, recovery of missed turnings, pre-trip estimates of time of arrival and guidance right to the destination.

The provision of in-vehicle route guidance information presents the motorist with information and guidance on current and future conditions. Whether the motorist uses the information provided or follows the guidance will depend upon a number of factors. Firstly does he/she trust the information or guidance? The notion of trust will have many elements. If the information or guidance matches the direct experience of conditions, for example if a motorist can see congestion ahead and is instructed to turn off, then he/she is likely to follow that information. In the absence of visible trouble the motorist may be less inclined to follow the advice. Where the information or guidance relates to trouble further ahead then the willingness to follow the instructed route will depend on factors such as the motorist's prior experience of the suggested route, the expected level of trouble ahead or whether the information has been judged in the past to be accurate or reliable.

The characteristics of the individual, and the availability of other information including signs, visual or environmental clues, radio, maps or other people will affect whether route guidance information is followed. Individuals vary in their route-finding ability. It is widely reported for example that males in general have better route finding and spatial representation abilities than females. As the range of information increases then the possibility of alternative sources of information being used will tend to increase. In familiar networks this tendency will be reinforced whereby a knowledge of the local area enables people to make rapid switching between routes in order to find a suitable route through to a destination. To counteract this, trip planning information must be sufficiently detailed and be provided in advance of key route choice decisions. Ideally it should also provide information about the time components of the various route stages in order that the traveller can judge his own current position in relation to future events.

vii) Longer-term decisions

As well as decisions on a day to day level and for specific trips, travel conditions play an important feature in people's choice of home and job location. A range of factors are likely to affect these decisions. These include travel time and access to facilities.

While the true extent of the effect of commuting time on these locational decisions is complex it is widely believed to be important in determining the general area in which to conduct a detailed housing or job search. Although public transport operators provide timetables to indicate commuting times, travel times by car may be unknown and are likely to be underestimated (Boyce 1988). The availability of information on commuting times or local amenities might result in some households choosing different locations than would otherwise be the case.

In addition to individual location decisions, organisations may relocate in order to avoid problems in areas with inadequate infrastructure. In a review of problems perceived by inner city firms the most serious problems reported were traffic congestion, public transport problems, parking shortages and on-site delays for commercial vehicles (May and Patterson 1984).

4.3 Conclusions

This brief discussion has identified the many factors which might affect users' trip planning and travel decisions. For many important decisions we do not know how people will respond to better information or how people will react to information at different costs. This makes estimating the effects of trip planning systems on users' response and hence on travel demand extremely difficult. In the final section therefore we turn to consider what research activities and areas of investigation might be needed in order to provide the necessary evidence in order to assess the potential of trip planning systems as a took for affecting traffic congestion problems.

5 RESEARCH ISSUES AND METHODS

5.1 Research needs

The primary goals of research into the effects of Trip Planning Systems must be:-

(i) to assess the potential for improvement in travel through better information;

(ii) to determine the extent to which Trip Planning Systems could contribute to that improvement.

The first of these requires a study of patterns of journey making to assess whether benefits could be gained, for the individual and, ideally, for the transport system, by changes in destination, time of travel, mode of travel or route. There is already substantial information on the last of these; rather fewer projects have studied the optimality of mode choice (as opposed to the benefits of inducing significant modal shifts); only a very few projects have investigated the optimality of time of day choice, and there is little or no work in the literature on the appropriateness of destination choice. Clearly greater research effort is required to tackle the issues of destination and time of day choice than the others.

The second goal requires in turn an assessment of the following issues, which will be essential to the appraisal of the potential of Trip Planning Sytems:-

(1) the likely interest and willingness of suppliers to provide information

(2) the design of a trip planning system that makes it accessible to and usable by a wide range of users

(3) the type of information, for different trip purposes, the user might require from a trip planning system

(4) the range of responses to trip planning information and how this might be used to estimate the likely change in demand for travel

(5) the relationship between users' responses and the response of the system.

We consider in Section 5.2 the methods available for the research necessary to achieve both of these goals and in Section 5.3, the research agenda itself.

5.2 Methodology

5.2.1 Questioning techniques

Questioning provides a direct method for eliciting information requirements, decision processes during the course of following information and the evaluation of information after a journey has been completed. Techniques for posing questions range from structured questionnaires to semi- or unstructured interviews to group discussions.

The major advantage of questioning techniques is that they provide a detailed account from the point of view of the respondent about his needs, plans, intentions, actions, or attitudes about a given subject. At the same time however a person's verbal accounts of his plans and actions are notoriously unreliable and malleable. Moreover there is clear evidence that many tasks which people engage in, such as

route choice decisions, involve implicit knowledge, that is knowledge which is not clear to the person or capable of articulation, and which is therefore difficult to capture through questioning techniques. This implies that other supplementary techniques may be needed to capture the real nature of trip plans and actions.

5.2.2 Stated Preference

The stated preference technique is widely used in travel studies as a means of measuring people's preferences, and valuations of attributes for the purpose of demand forecasting (Nash, Preston and Hopkinson 1990). In the context of trip planning systems it would be relevant to measure the value placed by suppliers on providing information and by users on the information provided. The general form of the technique is to present a respondent with a set of choice options, which vary in terms of their attributes or attribute levels. From the choices the individual makes, it is possible to identify the trade-off or valuation placed on one attribute or level of attribute relative to another, for example time relative to cost. The main advantages of the technique lie in the large amount of choice data it can provide from a single respondent and its ability to present scenarios, or situations which might not actually exist, and which it would be impossible to obtain data on by other means. The main difficulty with the technique lies in detecting possible biases in the responses and whether the respondent has understood the scenario and the object of valuation in any meaningful way.

5.2.3 Observational Techniques

Observation, manually or by video, provides a means of studying the actual behaviour of people, in terms of their actions and interactions with other people, machines or the physical environment. These actions may provide clues to how well a person is performing a task, for example, which may differ from their personal account of their actions. There is a large psychological and sociological literature on the meaning of clues which non-verbal behaviour provide about a person's feelings or state.

5.2.4 Listening techniques

Listening techniques involve the recording and analysis of natural verbal interactions or commentaries between people or between a person and a machine. Listening techniques have the advantage of recording people's natural conversations uninhibited and without the contaminations of a researcher's questions. Such techniques are used in the area of machine-human interaction to assist in the design of expert systems and intelligent machines. The disadvantage of the technique is that the analysis of conversation or discourse is extremely detailed and skilled, and represents a specialist area of pyschology and sociology. Accordingly the technique is expensive to apply in a widespread application. Such techniques would be relevant to understanding the types of problems that occur in travel enquiries and how those problems are resolved.

5.2.5 Travel/Activity diaries

Asking people to keep a record of their travel and activities over a given period of time is a way of examining the choices and activities that people actually make and the constraints they work under in their daily lives. This can be used for determining changes in travel behaviour and choices over time. Indeed the National Travel Survey data referred to in section 1 is based upon travel diary data. Typically the travel or activity diary records the trip purpose or activity, the time and duration of travel, mode of travel, origin and destination and, for public

transport trips, the fares paid. In more detailed diaries, people might be asked to record the alternative modes available or supplementary information about the journey or activity they made. The success of the technique lies in the ability of respondents accurately to recall or keep a diary for the time period of interest.

5.2.6 Simulation/Design Manipulation

The simulation of a trip planning system or route guidance system to monitor their responses to different types of information and tasks is a powerful technique. The basis of the technique is that the information presented does not correspond to a reality but is an artificial creation or representation of a realistic situation or possibility. The technique allows respondents' behaviour to be studied for situations which might be difficult to observe in reality or which might not actually exist.

5.2.7 Vehicle monitoring

In-vehicle monitoring of the routes a person actually takes, their distance travelled, the speed of travel at different points or the number of trips made provides a means of tracking actual travel behaviour through time. The monitoring device may be relatively crude, such as a tachograph system, highly specific such as accelerometers or more sophisticated such as electronic tagging of vehicles and wayside detection. The merit of vehicle monitoring is that it can ascertain the driver's actual behaviour. This can be compared to information which has been provided either prior to a trip or during a trip. The disadvantage of the approach lies in the cost of equipping individual vehicles. Moreover the monitoring information provides only a behavioural history for a respondent: it does not tell us anything about the actual decision processes that lay behind the behaviour.

5.2.8 Physiological techniques

Changes in physiology, such as sweating or brain activity, can provide evidence of emotional or cognitive arousal. Such techniques are frequently used in studies of individual decision-making to detect levels of stress or information processing abilities.

5.3 Research Agenda

In this section we consider the research appropriate to assessing the potential for improving travel, and that required for the five issues identified in Section 5.1 as prerequisites for the appraisal of Trip Planning Systems.

5.3.1 Optimality of existing travel

Research in this area requires three elements: a record of journeys actually made, an assessment of their optimality for the individual, and an assessment of whether modifications in user decisions could contribute to system optimality. The first of these is relatively straightforward, although it will be necessary to draw a sufficiently broad sample and to record all attributes of journeys made. Questioning techniques and activity diaries provide the most appropriate tools for this.

The second area presents more difficulties, as indicated by earlier research on the optimality of route choice (Jeffery et al, 1987). It requires informations not just on the range of alternatives available, but also on the criteria which the user is adopting in making his choice. Even with route choice, treatment of optimality for those using less objective criteria such as scenic quality or ease or safety of use is

difficult. Quality factors are also known to be an important attribute in mode choice, and will equally present difficulties in assessing optimality for such choices. Time of day choices raise in turn the issues of trade off between travel conditions and activities, whose characteristics may be difficult to quantify. Destination choices raise the even more difficult problem of assessing the relative quality of facilities at alternative destinations. It appears sensible for the initial research to concentrate on awareness of alternatives, criteria for making choices and perception of attributes of the alternatives against the respondent's own criteria. Comparison with measured attributes, including those of alternatives of which the respondent was apparently not aware, can then help to identify the potential of improved information. More detailed interviews, together with direct observations, should provide the majority of the information required. This can then be supplemented by simulation of the choice process to determine likely responses to improved information.

Such simulation could also contribute to issues of system optimality. This, however, is a more complex area, and is considered more fully in paragraph 5.3.6 below.

5.3.2 Supply side issues

Whilst travellers already have access to a wide range of travel information from a large range of suppliers, there is little evidence to indicate either

(i) suppliers' perception of the value of the information they supply, or of enhancing it

(ii) their willingness to supply and update information to a trip planning system which includes information from potential competitors.

Two important research undertakings therefore would be to investigate the ways in which a range of suppliers plan and organise the provision of travel information; the importance they attach to providing and updating this information and their views on the likely costs and benefits of contributing data to a larger information base. This work would best be undertaken through interviews and questionnaires. This initial phase would then be used to undertake more structured investigations, using stated preference experiments, to identify the level of benefit to the supplier which they would require before entering and staying in the system.

5.3.3 Design Considerations

Identifying the factors which would encourage people to use a trip planning system, rather than current available information, would be extremely important in specifying the design of the system as well as its likely level of use. This needs to be approached at a number of levels. The first would be to examine in detail the full range of ways in which people currently plan and organise different trips; where they acquire information from and the problems and frustrations involved in this process. On the basis of information from this study it would be possible to hypothesise where, and in what form, a trip planning system might be most useful. These investigations would involve face-to-face interviews with potential and existing travellers with travel enquiry clerks, and with travel agents, as well as listening to the types of enquiries people make to travel enquiry desks for example.

At a second level we would need to identify the value which people place on information, and how much they might be willing to pay to obtain enhanced information or more readily accessible information. Again we would recommend the use of stated preference experiments for this work. A third level would involve a

simulation and design experiments, which would perform the tasks and provide the information service of a proposed trip planning system. This might involve a demonstration system in a public transport terminal for example.

5.3.4 Information Requirements

There would be some overlaps between this research area and the previous research undertaking, for example in identifying what sources of information people currently refer to in the course of trip planning. This research area however would be concerned to identify the information people would like to have or need and for which trips and purposes. This work would identify the full range of potential facilities that a trip planning system might be required to provide. Such evidence would be best provided by questioning and observation.

Clearly the more facilities demanded or required, the more complex the system will be. This will involve higher costs to the supplier, and hence user. This issue would again be best suited to a stated preference investigation.

5.3.5 User Response

The previous three topic areas have all been concerned with providing information relevant to the specification of a trip planning system. The fourth research area would investigate the likely responses to different forms and types of trip planning information. There are many different types of response to trip planning information which we are interested in. These include responses to real-time dynamic information as well as pre-trip information. Different methods are suited to different types of response enquiry.

Our view is that there are three important types of enquiry to be undertaken:

(i) Response to information provided by a trip planning system

This investigation would examine how people assess information provided by a trip planning system prior to a trip being undertaken. This is needed to assess how far the quality and detail of the information matches the user's intended requirement.

(ii) Responses to information provided during a trip

This is particularly relevant to route-guidance systems, but would be concerned with detecting how people respond to information provided during the course of a journey.

(iii) Post-Trip evaluation of information

This area of investigation would determine how people evaluate information they have been provided with, and the extent to which the information proved useful, affected their responses during a journey, and might influence their readiness to use such information in future.

Identifying and measuring the responses to trip planning information raises a host of methodological and experimental problems. The major difficulty is that many of the responses are likely to be fleeting in nature, and occur in situations where they are difficult to observe or record. Relying upon verbal recall, as we have discussed, is not always a reliable measure of what people actually did. It would be unwise to specify any single technique to conduct investigations in these three areas, or how they should be investigated. Rather we feel that a range of techniques need to be

applied, combining observational and questioning techniques with other innovative and exploratory approaches.

5.3.6 System Response

As section 3.3 indicates, this is an extremely complex area, and one in which simulation offers the only adequate starting point. Proposals for simulation have already been made to tackle such issues in the route guidance field (May and Bonsall 1988), and related research is now underway. It will be necessary to consider carefully the complexity of the simulation task, once it involves decisions in advance of the journey as well as ones taken en route.

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