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Strategic Review of Travel Information Research

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CONTENTS

Executive summary

The availability of travel information to the public has changed dramatically in recent years with the arrival of the Internet and mobile telephony and communications. In the UK there has been a concerted transport policy effort in relation to travel information. In particular since its announcement by Government as a concept in 2000, Transport Direct has emerged as a major new service in the travel information marketplace – a national multi-modal web-based door-to-door journey planning service with real-time and mapping features. Research has been an important aspect of the development of Transport Direct.

With the service itself well established, the Transport Direct Programme in 2006 wished to understand what developments had taken place in the broader field of travel information research from 2001 to date. This report sets out the findings of a review of such developments.

The review has examined over 100 articles of international literature. The orientation of the review has principally been towards the (prospective) users of travel information (as distinct from considering technical 'back office' developments). Main themes considered are as follows: understanding choice making; demand for informed choice making; behavioural consequences of information use; and methodological issues. A series of key points are drawn out under these themes:

1. There is a range of decision-making approaches individuals take to journey planning – varying across individuals and for a given individual.

2. 'Bounded rationality' highlights human tendency (for reasons of cognitive limitations and other constraints) to look for short-cuts to decision making – short cuts which can prove effective for the individual in terms of decision outcomes.

3. Simply providing more information may not always improve decision making if people are naturally boundedly rational.

4. Regret theory suggests people will only seek (more) information if they anticipate regret at the decision outcome given their current level of knowledge.

5. This points to the significance of the 'cost' of becoming better informed in the context of weighing up the 'costs' of different travel options.

6. Even when provided with information, people rely on and can (sometimes) overweight personal experience.

7. Reliability and uncertainty of travel choice outcomes play a part in people's choice making and information is found to influence this in ways not necessarily expected.

8. Habitual behaviour (apparently) inhibits the seeking of information.

9. There is a social context to travel information use – people imitate, help and learn from each other instead of or alongside making use of formal information provision.

10. In many cases only a minority (or at best a slender majority) of the public are aware of given information services – this may be an impediment to realising the demand for information.

11. Demand for and use of information is significantly influenced by travel context – demand is higher where journeys are unfamiliar and/or unpredictable and/or time critical.

12. The nature and amount of information demanded by individuals is influenced by their experience of the travel situations under consideration.

13. Research continues to understand how demand for information is related to user characteristics but there are many different facets to characterisation: socio-demographic attributes; socio-psychological and cognitive factors; physical and mental processing abilities; and extents of experience (with travel and with travel decision making).

14. Research continues to identify information content needs of specific types of individuals but this does not appear to relate to understanding on decision mechanisms: if more (apparent) information needs were met, information use might not necessarily increase (significantly).

15. There remains a need for information being available through a range of (complementary) media (including more traditional printed media) in order to address a range of people (with differing characteristics and abilities) and contexts - meanwhile there is very little evidence of how media preferences are evolving over time (with the exception of some evidence of declining use of telephone services in the face of comparable web services).

16. Meeting significant minority information needs could be very important to the affected groups and individuals.

17. Willingness to pay continues to receive limited attention (and produce mixed results) although willingness to pay is generally deemed to be low (perhaps given the Internet culture of freely available information).

18. In terms of information media, the radio (notable for car drivers) is (enduringly) dominant in its popularity though it is noted that it cannot service all types of information need and use.

19. There is little or no coverage in the literature of the increasingly widespread and affordable availability of in-car satellite navigation systems.

20. It is clear that most people, most of the time, do not consult travel information – however, in actual terms many people are using information for particular types of trips.

21. There is (remains) a paucity of empirical insight into the behavioural consequences of information use.

22. Recalling the low proportion of circumstances when information (from a 'formal' information source) is consulted, where consultation takes place it seems the most common consequence is that no change to travel results (although the potentially important confirmatory and 'feeling in control' value of such consequence must not be ignored).

23. While findings are context specific, there is some evidence of the influence of information on mode choice, albeit that the scale of impact appears small overall (though the significance of the

impact to the individuals concerned and the transport system overall is not clear nor is it clear how the scale of impact could change over time).

24. Driver route choice has been a popular feature of the field of travel information literature - latterly, it has tended to be considered as a focus for experimental research exploring decision theories associated with risk and uncertainty and past experience.

25. Journey scheduling and departure time effects of travel information use appear to have received very little if any focused attention in the literature.

26. In a multi-method research field and with the complexity of the topic under study (reinforced by this review) there is need for research articles to apply clear caveats and (sometimes) health warnings to their results.

27. The uncontrolled environment of the real world (as an alternative to experimental constructs) makes achievement of greater understandings highly challenging.

In light of the review findings, a series of specific research needs are identified. These are not all necessarily specific to Transport Direct or deemed a priority for Transport Direct itself to address. However, a key message from the review is that much of the insight into how people make decisions, their demand for information and the behavioural consequences is context specific. As such most if not all of the following research needs may indeed be fruitfully examined in the specific context of the Transport Direct service:

1. to understand why, in terms of decision mechanisms, people do make specific use of specific real-world information services;
2. to explore individuals' cognitive limitations in interpretation and use of travel information and how these limitations can be addressed by travel information services;
3. to understand how and why people's specific use of specific information services leads to effects (behavioural and psychological);
4. to understand the social context in which information services 'perform' and thus how information is received and assimilated in the course of interaction with other people;
5. to explore how the phenomenon of social imitation could be incorporated within the design of information services (through feedback data from users);
6. to identify and better understand the non-users of information services who would most benefit from using information;
7. to determine to what extent overall levels of information use of a given information service are dictated by types of individuals (more inclined to seek information) versus by types of journeys (more inclined to prompt an information need);
8. to explore (new) information content and presentation (possibilities) in the context of their compatibility with decision theory;
9. to identify what role printed media formats continue to play in travel decision making;
10. to consider in depth, at the level of the individual, how information need and use evolves over time; and
11. to specifically examine the effects and potential longer term consequences for travel choices and outcomes of in-car satellite navigation systems and other in-car travel information systems.

1 Introduction

In January 2007 the Transport Direct Programme within the Department for Transport awarded a contract (TDT/149) to the Centre for Transport & Society at the University of the West of England, Bristol to conduct a 'Strategic Review of Travel Information'.

The historical context for this contract is as follows. In 2000 the UK Government announced within its 10 Year Plan for transport the development of a multi-modal travel information service called Transport Direct. In 2001 the then Department for Transport, Local Government and the Regions commissioned a review of travel information to identify the research needs pertinent to Transport Direct (key issues identified in that review are reproduced as Annex B). Guided by that review and its recommendations, a Transport Direct 'Market Research Programme' commenced in 2002 which went on to inform the development of the actual Transport Direct web service which was formally launched in December 2004. Two years later the service had recorded over 10 million user sessions. In 2006 the 'Design, Build, Operate' contract for the service drew to an end, then moving into a new phase of 'Operate, Maintain, Enhance'. This provided a natural juncture for Transport Direct (and indeed perhaps more widely the Department for Transport) to examine what its future research needs might be.

This current review is intended to examine new research literature that has emerged since the 2001 review and to help inform the examination of future research needs. The review has examined over 100 articles with international coverage.

The report is structured as follows. The next section aims to provide a context to the review coverage itself: touching upon how conventional wisdom concerning the informed traveller is changing; clarifying the scope of the travel information field; overviewing the evolution of the travel information marketplace; and highlighting the ongoing process of review in the field. The following sections address the main four themes of the review: understanding choice making; the demand for informed choice making; behavioural consequences of information use; and methodological issues. The report then summarises the review findings before going on to consider the emergent research needs and specifically set out a series of eleven such needs that are recommended for consideration.

The methodological approach to the review is described in Annex A. In total 113 articles have been examined. For each article a summary template has been completed. The set of completed templates forms a 'Travel Information Research Compendium 2001-2007'. The report itself refers directly to 65 articles from the Compendium. The referencing format in the report uses the identification numbers corresponding to the numbering of the Compendium entries.

2 Review context

Prior to entering into the substance of the review itself, this section briefly touches upon some contextual issues.

Travel information utopia

Individuals face choices every time a trip is to be undertaken – about where they are travelling to, when they are travelling, by what means and by what route. As so-called rational decision makers they wish to make the best choice by minimising the generalised cost (incorporating monetary, time and other costs) or maximising the utility of the journey choice(s). Rational decision making can be impeded if the individual has imperfect or incomplete knowledge about the available choices and the attributes of those choices. Thus by providing individuals with travel information they can make more fully informed choices which will be to their personal advantage (in terms of better choice outcomes and journey experiences) and potentially that of the transport system as a whole.

What is set out above is reflective of a rather utopian view of the field of travel information but one upon which the development of the field has been founded until more recently. It implies that individuals would like information whenever they make a trip and thus created the supposition that once information services which were useful and usable became available, the public would use them. As this review will reveal and explore, the reality is not quite as straightforward – the overall level of information use (in the context now of widely available services across a range of media) is far lower than the amount of travel that takes place, and the ways travel information is interpreted and used by travellers do not necessarily lead to the desired or the predicted improvement in the performance of transport systems.

The field of travel information

An understanding of the term 'travel information' may appear self-evident. However, upon closer examination it quickly becomes apparent that it reflects a very broad field and set of issues. Information relates to different modes of travel, and is associated with choices about departure time and route. A myriad of specific information can be relevant to these choices concerning time, cost, convenience, comfort, security, and so on. Information can assist both the planning and execution of a journey. It can apply before or during a journey. It can be historic, schedule-based or real-time. It can be text-, graphics- or audio-based. It can be obtained via a number of media – face-to-face, electronic and paper-based. It can be broadcast or personalised. Travellers may use information to assess known alternatives or for generating new travel alternatives they are not familiar with. Information can be provided in a prescriptive way, by making strong recommendations to individuals about travel choices, or in a descriptive way, leaving travellers to determine how best to interpret and use the travel information.

Such diversity underlines both the scope of the field of travel information but also compounds the problem of complexity when it comes to understanding. While there may be a wish to simplify and generalise in order to assist the ongoing development and use of information services, understanding must be derived from empirical examination of specific contexts which, as the review reveals, is itself far from straightforward methodologically.

The evolving travel information marketplace

The field of travel information is, in its broadest sense, as old as travelling itself. However, developments in the field have been gaining pace. The 20th Century was first characterised by fixed signage and paper-based information (such as maps and timetables) and more latterly by access via (landline) telephone. The last two decades of the 20th Century saw electronic information begin to come to the fore. The emergence into the public domain of the Internet, Web and mobile telephony in the 1990s has substantially augmented the technological possibilities for the creation and delivery of information to the public. High levels of connectivity and computer processing power are facilitating new opportunities to gather and interrogate data and allow end users to make information enquiries. There are now examples internationally of information service websites which provide varying degrees of geographic and transport modes coverage. Mobile phones are transforming into personal digital assistants (PDAs) with Internet access - allowing increasingly widespread access to information on the move. Electronic information signs and on-street kiosks are growing in number. Real-time information across modes is increasingly available. Individual route guidance systems using global positioning have now reached the mass market. Opportunities for (some) personalisation of information services are also increasing. Some embryonic information services are even being created 'by users for users' (see for example http://wiki.openstreetmap.org/). New and innovative ways of providing travellers with information continue to emerge.

Stemming from its 1998 Transport White Paper, the Department for Transport has given and continues to give notable attention to traveller information systems (often referred to in the literature as 'Advanced Traveller Information Systems' or ATIS) as part of its integrated approach to transport policy. ATIS can, in principle, empower individuals to make more fully informed decisions about how, when, where and whether they travel. This can in turn lead to changes in travel behaviour in ways that are able to benefit individuals and the transport system through better matching supply and demand and thus helping to tackle congestion.

In many respects the last ten years has seen a rapid evolution of the field of travel information provision. It is clear that both the private and public sector have been investing heavily in taking advantage of what technological advance is making possible. While not everyone yet has access to the Internet or owns a PDA (nor may wish to), overall there is widespread availability of a range of different information services, many of them (almost) free at the point of use. It can be suggested that such dramatic changes may be bringing about a reorientation of research priority. Increasingly the question must become – *what are the consequences of the widespread availability of information*? In other words it is becoming increasingly important to understand the behavioural responses to ATIS. Perhaps to some extent investment in the field thus far has stemmed from the utopian view above and a degree of blind faith in the provision of information being a good thing that will yield benefits. Ensuring a positive ongoing evolution of the field is likely, increasingly, to require that we can address the question above. As this literature review reveals, it appears that research is responding accordingly.

Periodic reviewing

Perhaps because of the diversity of the field, the pace of development in information provision, the underlying, enduring and emerging challenges to understanding and the volume of research that results, it appears that reviews of the literature occur quite frequently – ten such reviews are shown in the Table below. It would be reasonable to ask why this review is worthwhile to conduct to bring the number to eleven. Most reviews are defined by a specific focus (e.g. real-time information, public transport information,

driver information, and decision-making heuristics). All reviews are clearly confined to coverage of preceding literature and there is a continual emergence of new literature (100+ articles since 2001). Most if not all reviews will be orientated towards a particular perspective of interest of the authors or the review sponsors (e.g. Wisconsin DoT's wish to determine missing research elements that are critical to its mission (1068)). What then distinguishes this review from others is as follows: it brings examination of the literature up to date (over a third of the articles considered are dated 2006 or later); it takes a broad look at literature under the umbrella term of 'travel information'; and it specifically seeks to extend the examination of research needs (oriented towards the UK context and a backdrop of major information services' developments – notably Transport Direct).

Table 1. Recent review papers on travel information and related issues

Ref	Year	Coverage
1035	2001	202 articles (international coverage) listed in the bibliography examining traveller response to real-time information at the individual and network levels
1069	2002	25 articles (mainly US, some international coverage) reviewed examining who uses travel information and how it is used
1002	2002	Some 150 articles (international coverage) examined looking at behavioural response to information services and associated research methods
1068	2002	Some 80 articles (mainly US, some international coverage) examined concerning drivers' perspectives on and expectations of Intelligent Transport Systems
1028	2003	A large scale international review of transit travel information looking at some examples in detail
1013	2006	56 articles covered (mainly UK, some international coverage) in a 'state of science' overview of the role of information in travel decisions and future prospects
1026	2006	157 articles reviewed (international coverage) in an examination of decision making strategies, the use of travel information and its behavioural effects
1008	2006	138 articles reviewed (international coverage) concerning the use and effects of travel information among car drivers
1079	2006	53 articles reviewed (international coverage) to identify and critically review examples in academic and industry literature of attempts to obtain and evaluate public feedback concerning travel information
1025	2007	65 articles reviewed (international coverage) concerning a number of forms of heuristics for decision making (not just concerning travel decisions)

3 Understanding choice making

If information is intended to support or influence choice making then an appropriate starting point to examining the field of travel information is to consider the process or processes of choice making itself. Against the backdrop of utility[1] maximisation, insights and (theoretical) understandings from cognitive and social psychology are now emerging through the literature to paint a more complex picture of decision making processes. In outlining these below it would appear that an important distinction needs to be made with regard to utility maximisation. It has tended to be seen in the specific context of making one or more travel decisions. However, what the various concepts and theories below seem to suggest is that utility maximisation may instead be something which prevails at a higher level: an individual's travel decisions take place in the context of their overall lifestyle and it is for the latter that an individual is trying to achieve what they judge as the best outcome as each decision is made. Thus trade-offs are an important part of decision making.

Decision making models

Work commissioned by the UK Department for Transport's Transport Direct Programme sought to examine the processes of decision making in journey planning. An early stage of this work (1036A) was a review of choice theory which yielded eight suggestions by the researchers of different potential decision making models. 406 interviews were subsequently conducted (1036B) with people in relation to a recent journey they had made to establish the prevalence of the different suggested models (% of sample aligning with each) relevant to information use:

Systematic search – "The traveller seeks the optimum journey within prevailing constraints (such as time or cost)" (35%)
Incrementalism – "The traveller is disinclined to make big changes to travel plans, preferring to make only small alterations in routine" (routine or habit prevails) (15%)
Assumptive worlds – "The traveller is firmly committed to a travel behaviour and will accept some costs to sticking to this routine" (14%)
Discrete choice – "The traveller begins with a number of strong expectations about their journey but when faced with obstacles, will attempt to respond as systematically as possible" (10%)
Steering – "The traveller is flexible in terms of travel objectives and will re-adjust behaviour both before and during the journey in light of new information" (7%)
Cognitive dissonance – "The traveller is apt to put the best gloss on any aspect of travel. The avid car user for example, will not be swayed by the possibility or experience of traffic jams." (13%)
Mixed scanning – "The traveller attempts to keep their broad travel goals in mind but accepts that unforeseen circumstances might necessitate changing plans" (4%)
Problem-solving – "The traveller accepts that often travelling involves too much complexity to ever be certain of the very best way to travel – they settle for 'good enough'" (1%)

Closer examination found that for just under half of the participants, more than one decision model was used at different points during the planning of the journey. The results highlight that a broad range of decision making strategies are at work across the population and there is variation in decision making approaches not only across different individuals but for a given individual. The research suggested that there were no significant differences between type of decision model and sociodemographic characteristics.

[1] Utility is a measure of the happiness or satisfaction gained from a good or service.

Effort/accuracy trade-off and satisficing behaviour

In their review of travellers' decision strategies, Chorus et al (1026) highlighted that individuals can choose which approach to decision making they adopt based upon what they perceive to be the accuracy of their current level of knowledge about options traded against the effort that would be involved to improve the level of accuracy (and level of knowledge).

This links to a phenomenon in the field of 'discrete choice theory': satisficing behaviour[2]. This is not a new theoretical phenomenon but it is now being acknowledged in more recent travel information literature (1026, 1013). In contrast to utility maximisation, satisficing behaviour concerns an individual being prepared to select a travel option which meets their minimum requirements (is 'good enough') even if other options exist which may be better (but which could require additional effort to identify).

Bounded rationality

A common belief is that by being more informed, travellers make better decisions. A recent review by Todd (1025) (though not specific to travel information) asks 'How much information do we need?'. This introduces and overviews how individuals can apply a number of 'short cut' approaches to decision making. Todd takes the starting point of the traditional view of rational decision making "where individuals should evaluate and combine all available evidence" and where "more information will yield better decisions". The author then looks, in contrast, at the concept of *bounded rationality* which considers how people can "make reasonable decisions given the constraints that they face such as limited time, limited information, and limited computational abilities". Based upon some empirical evidence it is suggested that short cut decision making that requires less information can prove to be of comparable effectiveness when considered alongside an 'unbounded rationality' approach. Two schools of thought are suggested – one is that people would wish to be unboundedly rational if only they could while the other is that people are quite content with short cut approaches that use little information and are quick to process. It is argued that if the latter holds true then trying to provide more and more information may not be a good thing.

Much of the earlier and more 'established' approaches to understand and measure travellers' responses to travel information identified the individual travellers as *'homo economicus'* - rational economic human beings who consider travel to be derived from the need or wish to be at a particular location and who try to do their best in minimising the 'cost' of getting there (including minimising risk/uncertainty). However, some of the recent studies inspired by the works of behavioural scientists provide mounting evidence (aligned with the work of Todd) that the behaviour of travellers is typified by bounded rationality (*'homo psychologicus'*). It has been argued within this literature that travellers' limited cognitive resources (gathering travel knowledge, interpreting travel information, and processing it in real time) have a strong effect on travel-choice behaviour (1001, 1002, 1003, 1005, 1012, 1014, 1015, 1016, 1026, 1030, 1031, 1044, 1083). Moreover, recent evidence reveals that even when travel information is simple, reliable and accurate, travellers tend to interpret and value this information in a way that systematically violates the assumptions of rational behaviour.

Regret theory[3] is a particular aspect of bounded rationality. It concerns individuals anticipating regret if they make the 'wrong' choice. In terms of travel decisions, Chorus et

[2] Miller, D.W. & Star, M.K. (1967). *The Structure of Human D*ecisions. Englewood Cliffs, N.J.: Prentice Hall.
[3] Loomes, G., & Sugden, R. (1982). Regret theory: An alternative theory of rational choice under uncertainty. *Economic Journal, 92,* 805–824.

al (1001, 1044, 1083) argue that a regret-based approach allows for capturing a traveller's choice among uncertain alternatives as well as choice-postponement through information acquisition. If the anticipated (minimum) regret is higher than an individual's threshold then an individual is assumed to postpone the decision and acquire additional information first. Chorus et al (1044) examine how regret theory can be consistent with both satisficing and maximising choice behaviour. A maximiser will accept higher 'costs' in order to reduce the number of unknown alternatives than a satisficer, who will only do so when the known alternatives are perceived as being unsatisfactory.

Many of the above studies provide evidence that travellers do not necessarily respond to the information they are provided with in the same way ATIS designers may believe they should. Many behavioural scientists claim that even when provided with descriptive sources of information (for example statistical information or pie charts) people usually rely on (and in some cases – overweight) personal experience when making decisions (1015, 1010, 1097).

Reliability and uncertainty

Travellers can encounter problems of reliability and uncertainty associated with their travel choices for a given journey. Uncertainties may relate to travel times, travel costs (for example in the context of variable road pricing) and other journey attributes. Information on the level of uncertainty and reliability involved in the journey, may affect travel choices. A common belief is that being generally risk averse, individuals will avoid the more risky and uncertain alternatives. Much of the prior literature examining factors influencing travel choices has overlooked how variability of travel times and other measures of uncertainty - and the provision of associated information - might affect choice. However, more recently this has been receiving attention (1003, 1004, 1005, 1006, 1012, 1014, 1031, 1086).

In some cases it has been found that providing travellers with information about uncertainty can in fact slow down their (natural) learning process (for repeated journeys) and make less efficient choices (accounting overall for uncertainty across many trips) more attractive (1014, 1015). The format and framing of information on uncertainty is also found to appreciably affect travellers' responses to the information (1004, 1012, 1076). It has even been suggested that the framing or format of travel information should be addressed to deliberately influence travellers' choices (comparable to techniques used to influence consumers' choices).

Habit

There has been a growing recognition of the (apparent) prevalence of habit in travel choice making (1026, 1030, 1033, 1040, 1047, 1055, 1062, 1076, 1083). In effect habit is the preclusion of any conscious consideration of choice. Habit may not prevent information use altogether since certain confirmatory information may be consulted e.g. in relation to reliability and uncertainty (1047). However, it can be particularly significant in terms of mode choice - limiting the chance that an alternative transport choice is considered (1033, 1040, 1083). Qualitative research by Kenyon and Lyons (1033) concerning mode choice suggests that individuals have a 'primary' mode which they habitually use for a given journey type and a 'default' mode which they revert to in situations where the primary mode is unavailable. Gärling and Gärling (1055) in their overview of the role of habit in travel behaviour do suggest that there remains a question over whether habitual behaviour involves basing decisions on past experiences or whether regular patterns of behaviour are based on using similar information each time and coming to the same decision.

The role of social interactions in information use and decision making

Travel information research has, to date, largely neglected to consider the potential significance of social interactions in terms of how travel information systems are used and thus how they are and might be designed. Through social interactions individuals are able to exchange information and influence each other's behaviour. For example, Australian users of ATIS supplemented their own experiences and knowledge by asking for ideas and seeking advice from friends, relatives, or workplace colleagues (1097). Other research has revealed that people with learning disabilities find common sources of travel information difficult to use and tended to rely on word of mouth and help from other people when planning journeys (1058).

Todd (1025) examines the concept of *social learning* or *social imitation* where an individual short-circuits their own decision making by copying the decision making of others. Ongoing research by Sunitiyoso et al (1005, 1006) is attempting to use an experimental setting to examine whether there is evidence of social learning in travel decisions – people making decisions based on the behaviours or preferences of others rather than just comparing the alternatives themselves. These works examine the role of *minority influence* – where a small number of individuals with consistency of choice diffuse their choicemaking to others. Better understanding of social interactions could lead to implications for how 'soft' measures can be (better) employed in changing travel behaviour.

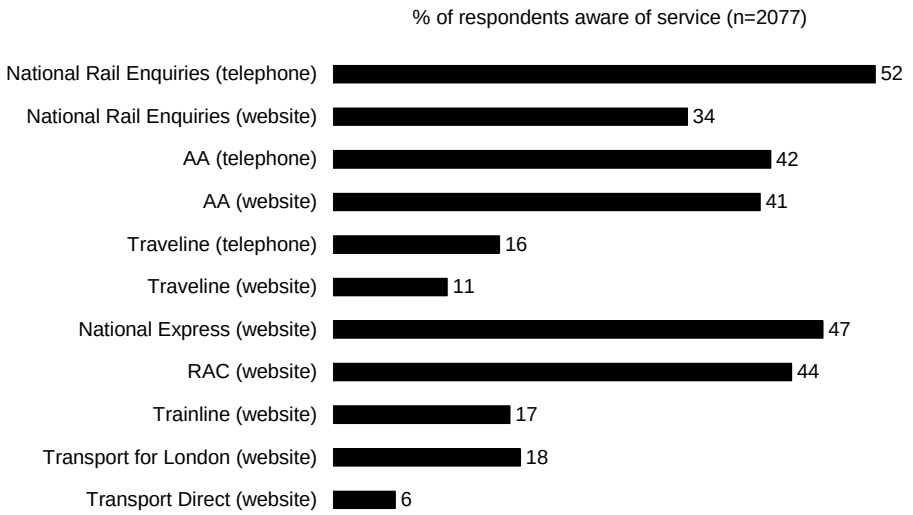
4 Demand for informed choice making

The preceding section (notwithstanding efforts in the field of literature to develop empirical insights) was largely theoretically based but sets an important context for assessing the nature and extent of demand for information.

Awareness of information services

One inevitable prerequisite of actual use of information services is that an individual is aware of their existence. Seemingly high levels of use of an information service can mask relatively poor levels of awareness (1013). For example the Transport Direct service (www.transportdirect.info) had registered over 10 million user sessions by the end of its second year of formal operation and yet a national survey revealed correspondingly (as at September 2006) that only 6% of the public were aware of the service (1085). Levels of awareness for any product or service take time to build up yet it seems few if any travel information services can boast a majority of the public being aware of them. Figure 1 shows awareness levels (as at 2006) for a number of major information services in the UK. Likewise examination of data from the Puget Sound Transportation Panel in the US concluded that "a majority of the population is still unfamiliar with many of the Seattle region's ATIS offerings" (1027).

Awareness can also be at different levels – people may recognise the branding or the name of an information service but not really understand what service it provides (1011). Of English motorway and trunk road users it appears that one in five of those who currently do not seek pre-trip information do not know where to find this information (1074). Awareness is likely to be associated with an individual's need to make use of the functions a service may have to offer – some of the insights from the previous section are likely to relate to or affect this level of need. This may explain why in an observed response survey of motorists in London passing a variable message sign displaying immediate warning information only 33% saw the sign (1032).



Source: Omnibus survey data (1085)

Figure 1. Awareness of major travel information services in the UK (as at 2006)

Awareness of public transport information (or lack of it) has been highlighted in several studies (1021, 1037, 1105) and has been identified as a barrier to modal shift. Despite marketing efforts, awareness of information services remains low, and often awareness of transport services is low as a result (1013). Increasing awareness has been identified as one of the major challenges providers of travel information systems are faced with (1011, 1085, 1093).

An important question stands out – to what extent are those individuals who have a wish or desire to be informed aware of services that could assist them (as distinct from individuals who have no such wish or desire)? There is some insight available at least (albeit not addressing this question) concerning person characteristics which associate with awareness. One study found that awareness of ATIS is higher among professionals, people on a high income, younger persons, car owners, and owners of a bus pass, as well as among control seekers and technologically astute individuals (1026). A US study has also highlighted factors associated specifically with awareness of travel information on the Internet (1037). It found that households with a higher frequency of public transport use than other households are more likely to be aware of travel information on the Internet. Income does not seem to play a significant role in awareness. Older individuals are less likely to be aware of online travel information, whereas professionals are more likely to be aware of this. Ownership and availability of computers and Internet at home and work have a strong positive effect on information awareness. Mobile communication technologies have a similar effect on awareness.

Travel context

The nature of journeys people plan and undertake varies for a number of reasons – the mode(s) used, the distance and duration, the journey purpose, timing constraints and the predictability and familiarity. Accordingly it should come as no surprise that the demand for and use of information is significantly influenced by travel context.

Profiling users of online traffic information in the Los Angeles and Seattle regions (1041) it was found that the most frequent users are those exposed to the greatest amount of congestion and volatility in traffic conditions. Information is primarily used for commute trips with greater use for the afternoon commute than the morning commute (findings from the Puget Sound Transportation Panel (1027) also note that consulting information is more likely for trips in the peak periods though determine that information is consulted nearly twice as much for the morning peak period compared to the afternoon peak). Information is also consulted but to a lesser degree for trips to the airport, holiday or weekend trips (noted also in 1068). In the US it has been noted that “surveys of usage of 511, the telephone number designated for traveller information in the United States, show that usage peaks sharply in winter months, when weather challenges are most significant, as opposed to summer months, when traffic volumes are higher" (1029). This suggests people (motorists at least) are concerned about unpredictable conditions most of all - and for regular routine/local journeys, the experience can still be rendered unpredictable by the weather conditions. It is also found that there is considerable demand for information about what to do when things go wrong during journeys (1036B). In this respect, journey distance is not necessarily an overriding determinant of travel information need. Nevertheless, other studies do highlight a (strong) correlation between duration and (a likelihood of) drivers consulting some form of travel information (1027, 1018). Driver intercept surveys in England (1018) found drivers are more likely to consult pre-trip and en-route traffic information when making longer distance, unfamiliar journeys, often with a time constraint or where there is a perception that problems may be encountered, such as a holiday weekend (research in Seattle also notes travellers are more prone to seek

information for a trip which is arrival-time sensitive or when there is a great deal of variability or uncertainty about the travel time (1042).

Accounting for familiarity and reliability, Lyons (1013) has suggested that demand for and importance of information into the future will be dictated significantly by two factors: the share of overall travel between familiar and unfamiliar journeys; and the extent of stability and predictability of transport system performance. (A third factor suggested is the extent of change in the relative 'costs' of alternative travel options.)

An Australian study (1097), reporting drivers' experience with an SMS-based travel information system, showed that most drivers want information of a predictive/analytical nature rather than merely an announcement that there has been an accident at a particular location. Less experienced drivers wanted more descriptive situational information, while more experienced drivers, although also wanting situational information, required less detail. It seems that the extent to which drivers are capable of processing data is closely related to their knowledge of spatial and traffic conditions. Driver demand for, and hence valuing of, information appears to depend on the trip purpose, the driver's experience with processing information, and with her experience driving a given route.

It should be noted that the literature in relation to travel context has tended predominantly to consider driver information and is also likely to have a leaning towards checking travel conditions of otherwise familiar journeys rather than journey planning.

User characteristics

A three-year research study is underway in the UK (1011) which is examining barriers to information use. It has adopted a socio-psychological framework which aims to understand how people differ in their use of travel information in relation to their goals, their anticipated emotions on achieving the goal (e.g. completing a given journey 'successfully'), and also their subjective norms, attitudes, and past behaviour. It is noted that external factors are important concerning both the travel context but also the individual. Such an approach has links with the examination (considered earlier) of decision theory but it focuses itself specifically upon the use of information and an attempt to distinguish varying propensities to use information according to user characteristics.

There is some limited new evidence in the literature concerning user characteristics and information use. Work in the US finds that users of online traffic information are more likely to be male, between 26 and 45, highly educated, on a high income, and frequent users of information and communication technologies (1041). Meanwhile a survey of users of a national public transport information service in Scotland (1038) found that users were more likely to be women, aged 25-44, employed, on a high income, and living in urban areas. The decision of householders in the Seattle area to seek information while not seeming to be strongly influenced by sex or income is correlated with employment status, internet usage and experience with congestion. A brief review study (1069) has suggested that potential users of travel information can be divided into three groups: *control seekers* who travel frequently, are comfortable with technology, and like to plan ahead; *value-added service buyers* who are uncomfortable with maps and computers but appreciate things that make life easier; and *wired with children*, who have high incomes and long commutes but value convenience.

While the limited evidence above suggests some characteristics that align with propensity to use information – age, income and familiarity with new technologies – it also highlights some apparent contradictions (e.g. between 1041 and 1038 above). These may not in fact

be contradictions but differences in the specific focus of study – online traffic information in the US (1041) versus online and telephone-access public transport information in the UK (1038). This underlines an important point in general concerning travel information – it is very difficult to generalise and greater acknowledgement should be given to the array of different sub-areas of study and application within the umbrella term 'travel information'.

The problem of understanding how user characteristics may correlate with levels of information use is compounded by the myriad of different classifying characteristics that can apply. Individuals can be defined in socio-demographic terms (as above); they can be defined in socio-psychological and cognitive terms. More misleadingly there has been a tendency to (wrongly) characterise people according to their journey purposes – commuters, business travellers, leisure travellers etc. Individuals can also be defined by physical and mental processing limitations which can importantly define both their need for and difficulties with information provision (e.g. 1020) – for instance qualitative research in the UK has examined the information needs of dyslexic travellers (1010). Other research (1023) has highlighted (website) usability issues associated with age: visual acuity and fine motor skills. Individuals can also be characterised by their experience of using given modes of travel – Halden (1021) has pointed to a failure in information provision to distinguish between experienced and occasional public transport users.

Information content and willingness to pay

Analysis of the Puget Sound Transportation Study in the US (1027) found that for those trips where information was consulted, "36 percent of the time the traveler was unable to obtain any information at all about the trip in question." Clearly an information service will not be (repeatedly) used if it does not provide information content that is useful to the enquirer (and accessible). Certain information can be deemed as rudimentary or widely applicable: schedule information for public transport and information on fares; and route directions and estimates of distance/time for car journeys. Over and above this it has long been recognised that there are likely to be other information needs to be met across the travelling population.

Molin and Timmermans (1019) identified 54 aspects which public transport passengers might need to know about and examined these through a stated preference survey with inter-city train passengers in the Netherlands. Real time information (on planned and dynamic changes) was rated most highly of all. Other aspects rated highly were: planning options (cheapest route, minimum interchange, mode choice); tickets (how to buy); walking route (distance, directions, platform number); and interchange functional requirements (cash machine, telephone etc.). Aspects which scored lower related to private transport (parking), interchange activities (shops, restaurants), comfort and service en route and destination facilities. Research in Scotland examined pre-travel information needs for bus and rail (and ferry) use across four categories of disability (physically impaired, visually impaired, hearing impaired and people with learning disabilities) (1020). Eight categories of essential pre-travel information were identified and considered applicable across all modes (while acknowledging varying importance across disability groups): staff assistance (the most important); physical accessibility of stops; physical accessibility of vehicles; help facilities; stop facilities; timetable and service communication methods; lighting; and surfaces. The study noted that advance accessibility information is generally good for rail services but very limited for other modes. Once more concerning public transport in Scotland, another study examined barriers to modal shift (1021) and found that measures which would encourage individuals to use buses included electronic information at bus stops telling if buses are on time, published bus timetables including paper information at bus stops on the scheduled times

of buses, and electronic information on buses stating location so that passengers can get off at the right stop.

As the previous DTLR review noted, distinguishing between information that is considered 'nice to have' and 'essential' is not straightforward because across individuals this distinction can change for particular information aspects. Accordingly, creating a truly inclusive information system that can meet all travellers' needs would be a challenging task and unlikely to be achieved without substantial cost implications. However, there is a risk that if only prioritised information needs at the population aggregate are addressed then significant minorities of individuals could be disadvantaged. For instance as part of a programme of research for Transport Direct (1050) it was found that information on end-legs and interchanges associated with public transport was 'nice to have' for some people, but only a minority. Yet later research also for Transport Direct concerning dyslexic travellers (1010) highlighted that the same information could be important if not essential to them having the confidence to make the journey.

Meeting significant minority information needs can be problematic in an online information culture where people tend to expect information to be free and thus recouping investment in information provision directly from enquirers is not necessarily a viable option. A survey of callers to a travel advisory telephone system in California (1017) found that if charges were levied for use of a non-improved service then usage would decline. Callers would be willing to pay 25 cents per call for a customised service, though usage would decline at higher levels of charge (income levels did not appear to have any significant impact on willingness to pay). There is some evidence of interest in real-time information and associated willingness to pay (1050, 1019). However, Chorus et al (1043) note what they refer to as a paradox in this regard: exactly in those moments where travel time estimates are needed most among travellers, travel time information is perceived as particularly unreliable. Indeed travellers would seem likely to have demanding expectations associated with charged for (real time) information: from a survey of motorists in England (1074), 38% who received warnings of congestion while driving said they wanted further information about: alternative routes, estimates of how long delays will continue, earlier notifications of delay, and more accurate and up-to-date information.

Zhang and Levinson (1024) explored drivers' willingness to pay for information provided at the beginning of the journey. Drivers generally appeared to have a very low willingness to pay for acquiring travel information: up to $1 per trip for pre-trip travel time information. The value for information is higher for commute and event trips and when congestion on the usual route is heavier. Most travellers (70%) considered that travel information should be provided for free by the public sector.

A Swedish study (1103) on the effect of at-stop real-time information displays for public transport revealed that there is an increased willingness to pay for information, or at least to accept a ticket pricing element for it, equal to about 5%-20% of the journey ticket price.

While various studies have considered the public's willingness to pay for travel information, the outcomes reported are not in consensus and appear context dependent.

Information delivery media

As noted in section 2 the range of delivery media has increased with the advent of the Internet and mobile communications. Where there is demand for information or where there might be (greater) demand if information is suitably accessible it is important to understand which delivery media are considered most important to the public.

What is very clear from recent literature, in relation to car drivers, is the dominant popularity of the radio where and when information is received/used. This is found across a number of studies and across countries – US (1029, 1068), England (1018, 1074) and Norway (1063). Its popularity is doubtless attributable in part to its widespread availability but also to its 'low hassle' characteristic (1068) and perceived trustworthiness with its 'human' element (1018). In one of the English studies (1074) the most important reason amongst motorists for not seeking any pre-trip information was use of the radio whilst en-route. (In the same survey it was also found that those listening to the radio were more likely to take action in response to information than those reading motorway sign messages.) As well as en-route, radio also appears the dominant medium (as well as television) for consulting pre-trip information (1068). It could be suggested that popularity is equated to familiarity and availability. However, there is evidence to suggest that even in the face of emergent media and services, radio will retain its dominance – one study found that very few travellers use telephone, Internet or other technologies where these services are available and willingness to pay for on-board technologies was low (1068). When asked in a Norwegian study (1063) about preferred future sources of information, 86% of motorists identified radio as their preferred source for at home and 92% identified it for en-route. Only 7% mentioned the Internet as a preferred source of traffic information at home, compared to 39% for SMS on mobile phones, and 14% for text TV. Variable message signs were mentioned by 53% of the respondents as preferred information sources on trip, followed by SMS on mobile phones (27%) and a navigation system in the car (26%). In England the Automobile Association's website (with journey planning features and linked information on traffic hotspots) is considered the second most likely source of pre-trip information (15%) after radio (47%) (1074).

However, it should be borne in mind that the studies cited above may have been oriented overall towards regular (commuting) trips where the primary need for information related to journey disruptions and travel times. Radio could clearly not be the dominant medium for (the planning of) car journeys in terms of route directions. This is where websites (such as the AA's) are likely to be important pre-trip; and potentially in-car route guidance systems important en-route. This said, there is little or no coverage in the literature of the increasingly affordable and widespread availability of in-car satellite navigation systems either in terms of their current popularity and use or of anticipated levels of future demand. Nelson and Tarnoff (1049) make some reference to the increasing popularity of wireless Internet and, as the Internet moves into the vehicle, to the increasing range of services (including route guidance) that will be accessible to the motorist. They suggest this could hugely increase the popularity of route guidance.

There is little reference to information media associated with public transport with the exception of brief mention of the issue in the Scottish study of barriers to modal shift (1021) and a study in Dublin (1053) to examine the provision of both existing and potential methods of accessing public transport information, with particular focus on Intelligent Transport Systems applications. From a 'snowball' sample of 248 usable responses from passengers it was found that 35% of people drew upon 'existing knowledge', 30% used the Internet and 20% used a mobile phone to obtain information. The main preferences for information at different stages of a trip were also considered. For rail journey planning in the UK (see 1011) the level of use of the telephone-based National Rail Enquiries service has been in decline since the availability of the equivalent web service.

In recent research (1058) looking at disabled travellers' needs for public transport information, it was found that most participants liked to obtain transport information through timetables and in person at travel information centres and train stations. Blind and partially sighted and physically disabled people preferred to use the telephone to obtain information, whereas deaf and hard of hearing people made more use of the

Internet. In general, the type of public transport information required varied considerably according to people's mobility characteristics.

Levels of information use

While a range of literature examines factors influencing the demand for travel information, there is also a modest amount of empirical evidence concerning the actual level of use of information.

Such evidence provides a clear message – most people most of the time do not consult travel information. In the Seattle area, wave 9 of the Puget Sound Transportation Panel which involves completion of a 48 hour travel diary found that participants used "some form of traveler information on 3.2 percent of their total trips" (where a 'trip' referred to a trip segment as distinct from a full origin to destination journey) (1042). "This includes all sources – broadcast traffic reports, websites, telephone alerts, cable TV stations, and so on." Across the diary period some 12% of participants consulted travel information at least once. The high level finding from wave 10 of the Panel (1027) was that information is sought for only 1 in 10 trips. Intercept surveys of English car drivers (1018) found that less than 20% of respondents had accessed information pre-trip and less than 30% en-route; and specifically considering real-time information less than 10% pre-trip and less than 20% en-route. In another survey of English drivers (1074) it was found that the proportion of respondents ever checking road conditions before travelling is 38%. Of those respondents ever seeking pre-trip information, 45% do so every time they travel, while 34% do so if they are making a long journey and 22% do so if they are making an unfamiliar journey. The most important reasons for not seeking any pre-trip information are: use radio while en route (30%) and can't be bothered (29%).

While the levels of information use may appear low in percentage terms, in actual terms (given the overall levels of daily travel) a substantial amount of demand for information does exist. It is also important to recognise that 'information use' can either have a very broad scope or an ambiguity of meaning. Taken in its broadest sense it means the conscious consideration of information from any source (including word of mouth, paper-based, fixed signage, telephone, Internet and electronic signs) in the process of choosing a course of action. In some studies 'information use' is more specifically defined – e.g. the use of a telephone or Internet-based service (1052).

5 Behavioural consequences of information use

Of particular interest from a policy perspective given investment in the development of travel information services is the nature and scale of behavioural response resulting from information use. Yet within the literature itself calls continue for better understanding of behavioural response (1002) with acknowledgement of a paucity of empirical insights (1026, 1013). This said, there are some insights available in the literature.

From two-day travel diaries of Seattle-area households, for those trips where travel information was consulted the behavioural responses were as follows (1042): 'made no change' – 63%; 'changed the time I left' – 13%; 'took planned route but with small changes to avoid congestion' – 11%; 'took a whole different route from my planned one' – 9%; 'added, delayed or cancelled trip' – 2%; and 'changed means of transport' – 1%. Intercept surveys of drivers in England (1018) found that most individuals who had consulted pre-trip information (62%) were selecting the best route (30% were checking road conditions and 12% were seeing how much time the journey would take). In terms of en-route information use, "most (55%) had done so to confirm their location and route, while 26% had used the information to warn them of any potential congestion / queues ahead." However, only 7% of those consulting the information changed their travel (route change or journey interruption). Those who did not change indicated there was no disruption to their chosen route (67%) or that there was no suitable alternative route (14%).

Confirmatory information

It seems then that a common behavioural consequence of consulting information is that no change to behaviour occurs. It is important to note that this does not necessarily imply that the individual has gained no benefit. Benefit seems to arise from the individual either confirming the specific details of their journey planning (e.g. public transport departure times for a chosen route (1038)) or gaining some reassurance or 'peace of mind' about their current/chosen course of action (1042). It can also concern, potentially, the ability to lower the 'costs' of arriving late by the traveller's ability to contact those affected at the destination (1075). This said, and as noted above, doing nothing can sometimes be a consequence of not having (or perceiving to have) alternative options – in Seattle (1027) more than half of consulted individuals who had "found delays which they considered serious enough to warrant a change" did not make a change because there was considered to be no alternative.

Mode choice

In a UK study involving 1600 telephone interviews (1052) the mode of travel is decided before referring to a travel information source by 62% of respondents on a short journey, seven in ten on a long journey; usually assuming use of the car. But almost seven in ten would consult a multi-modal information source for an unfamiliar destination - largely to make comparisons across modes e.g. to find the cheapest or quickest mode. This appears to suggest the potential for rather substantial influence upon mode choice (though noting the emphasis here on unfamiliar journeys). A piece of Dutch research concerning leisure trips (specifically, trips to theme parks) found that 16% considered a mode alternative and thus had a higher need for travel information than those who did not (1040). Based on a set of assumptions on travellers' mode choice, Chorus et al (1083) showed that even in the case where public transport information is acquired, and the message is favourable to the traveller, its impact on mode choice is limited. They argue that conservative estimates regarding the impact of public transport information provision on modal shift would be realistic. A pop-up survey used on the Transport Direct multi-modal journey planning

website in the UK (1039, 1081) found that of those individuals who were seeking information on a journey they had made before (nearly two thirds of respondents were considering information for a journey they had never made before), 7.7% intended as a consequence of using the service to use public transport instead of the car while 2.3% intended to use the car instead of public transport. While it should be noted that this study cautions about bias in the results, importantly it highlights not only that travel information can influence mode choice but also that net behaviour change (5.4% in this case) can be less than actual behaviour change.

Route choice

Given that it can be expected that a car driver will have more control over their route than a public transport user, it is perhaps no surprise to see reference at the start of this section to information being used to consider route options (even if sometimes it is found that a suitable alternative route is not available). Recent work in England (1074) has found that of those motorists who sought pre-trip travel information and received warning of congestion on their intended route, most attempted to avoid the associated delay by changing route (83%) (while 14% travelled at a different time of day and 2% travelled on a different day). Though now less evident in the literature, there has in the past been a lot of research into the effects of variable message signs on route choice. One more recent study (1032) involved both a stated response survey and an observed response survey in London. The former found that 18% of drivers "said they would divert immediately in response to unexpected congestion". Meanwhile of the 33% of drivers in the latter (63 people) who saw the sign displaying the immediate warning information only two then diverted. It must be noted that in the first of these two cited studies the results refer to those who consulted information in the first place – i.e. who were minded to inform themselves about their travel options. Taken together the two studies suggest greater propensity (or opportunity) to change the choice of route before a journey (in response to adverse traffic) than during a journey – something which has already been suggested in earlier literature.

Other literature relating to information and route choice concerns experimental research. In particular laboratory experiments with participants involving simple route choice scenarios are being used to examine models of learning behaviour (1014). The experiments take individuals through a succession of repeated choices between two (or more) routes exhibiting variability in their characteristics (typically travel time). Such experiments (1003, 1012, 1015, 1016) have explored, in relation to the influence of information provision, violations of expected utility theory (where an individual is assumed to aim to choose the optimal route accounting for uncertainty) which may be accounted for through prospect theory[4] (which considers how people differently weight losses and gains when considering choices with uncertain outcomes). Other experimental work using a travel simulator has sought to give insight into the validity of the hypothesis that average time and variance on a specific route influence drivers' behaviour but so do extreme travel times; and to analyse what impact the provision of en-route travel information has on the perception and valuation of such extreme travel times. The experiment demonstrated a preference for the route with a very wide variation in times but a high chance of a low time.

Another study (1030), this time involving real world data (but not participants) considered an information service in the US (Washington) which provides predicted travel time for two different routes with information also available (retrospectively) on actual route times. Data were collected for departures every five minutes between 6am and 9pm for

[4] A. Tversky and D. Kahneman (1992), Advances in Prospect Theory: Cumulative Representation of Uncertainty. Journal of Risk and Uncertainty 9, 195-230.

every weekday in 2003. One hypothetical commuter acted upon the journey time predictions in choosing between the two routes while another hypothetical commuter (the control) used the same route on each occasion. The two routes were each approximately 10 miles long and it was stated that "The I-90 route is historically 1 minute faster than the SR-520 route." It was found that the average time saving for a given daily departure time never exceeded one minute casting doubt for this particular pair of actual routes over whether there would be sufficient motivation for an individual to consult such information.

It is notable that route and mode choice are frequently the focus of research. Departure time (i.e. journey scheduling) does receive some attention in a comparative sense – with findings that route change is more likely than departure time change in response to information (1036B, 1042, 1074) (though with one study providing possible evidence of the reverse - and thus highlighting the context specificity of studies (1039)). However, there is very little evidence of the issue of departure time and associated information being considered as a primary research focus.

6 Methodological issues

This final section of the review itself takes the opportunity to highlight some issues regarding research methodologies. Across the reviewed literature a range of study approaches are employed: qualitative and quantitative research; stated preferences/intentions and revealed preferences; fieldwork involving intercept surveys; travel diaries; laboratory experiments and simulators. This diversity of methods reflects a range of different purposes to the research. However, attention must be drawn, across these methods, to the need for health warnings and caveats associated with research results – sometimes, but not always, these are made explicit by the research authors themselves.

Golledge (1002) has questioned the ability of travel simulators to represent real world situations. Meanwhile researchers in the Netherlands have developed a multi-modal simulator which is intended to be able to examine the probable use and effects of 'next generation' travel information services (1031). In an article which reports on an attempt at validating the simulator (1031) it is said the ideal is where "observed choices made within the simulator resemble those made in real life under comparable conditions". However, it is noted that "no actual choices for any comparable situation are available, or can be easily made available." Therefore the authors determine that they "are forced to adopt a less strict definition of validation: TSL* [Travel Simulator Laboratory] may be considered a valid research tool when it is established that observed choices made within TSL* resemble our intuitions concerning what kind of choices would be made in real life under comparable conditions." The paper proceeds to set out a number of formulated 'intuitions' which are then tested for validity by analysis of data collected from participants. The paper concludes that the simulation "appears to have a very acceptable level of face validity." It is a familiar dilemma for the research community – simulation can allow for a controlled environment and for the repeated examination of scenarios across different participants which would not be possible in the real world. At the same time it can be difficult for the use of such approaches to dispel associated scepticism about how much credence the results deserve.

Similarly, work by Chatterjee et al (1032) is candid in its representation of results from both a stated intention and stated response survey. The authors conclude that along with evidence from other studies, their own results reveal that "out-turn behaviour is more conservative than the stated intentions" and that "models based on stated-intention questionnaires were not as successful as we would have wished".

Given the increasing availability of information services there should be a strong case for more effort to be devoted to gathering empirical real-world data on use and non-use. However, while there are some examples of this (e.g. 1018 and 1027) it can prove difficult to reach beyond relatively high level observations of what people did and why to probe more deeply into people's decision-making processes and the situational contexts and personal characteristics that have influenced whether and how they use information and with what effect. For certain types of decision making, understanding the role of information is a problem compounded by the low frequency of information use (on average). When one talks of information users it can be tempting to presume use is as it might be for word processing or email – something an individual does frequently and which thus renders them well-versed in being able to recall their experiences of and attitudes towards use. In practice an individual may only plan a journey once a month or even less – to then attempt to ask them how they would 'usually' plan this type of journey may yield ambiguous and unsound response data.

Sample and response bias are concerns for all research and become especially important where there is the temptation or intention to generalise from the research. It seems that generalisation in many respects will prove increasingly difficult in the field of travel information research as recognition grows of the complexity of choice making and the sensitivity to travel context. It is important that researchers in the field make every effort to be explicit in considering implications of sample and response bias in reporting their results so that as the literature base grows (unintended) misdirection of interpretation is not introduced.

Most study approaches explore the needs and responses of the individual user of travel information systems. Methodologically there is a need for more effort to suitably examine Issues such as social interaction, knowledge sharing or social influence.

7 Summary of review findings

This section of the report seeks to synthesise the main findings and messages emerging from the review. Firstly, Figure 2 offers a diagrammatic overview of travel decision making for an individual which strongly characterises the coverage of the literature examined.

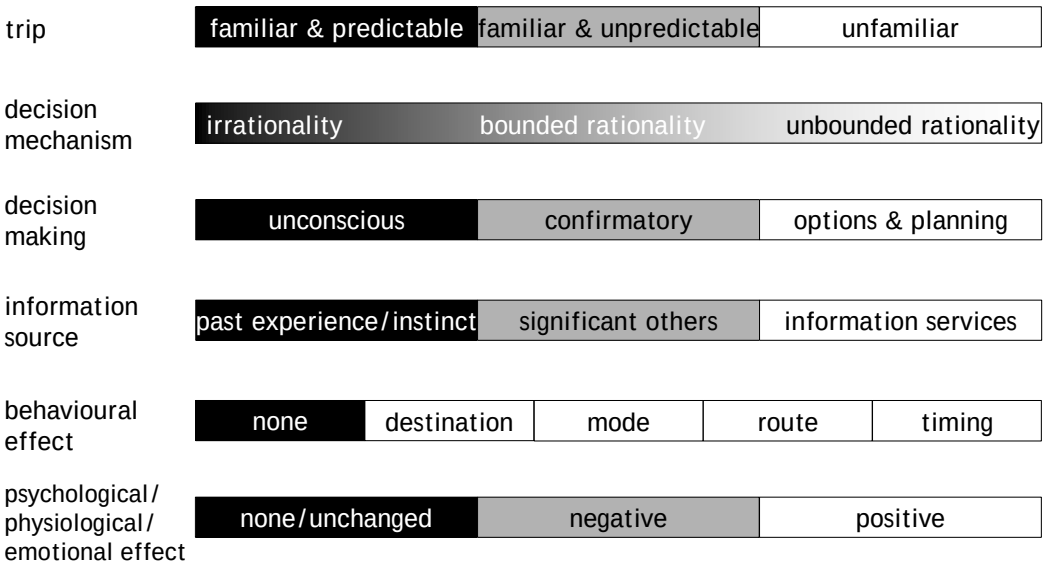


Figure 2. Travel decision making in overview

The elements of Figure 2 are explained as follows:

Trip - A trip can be familiar (it has been done before, the ritual of the travel experience is well known) or unfamiliar – not all journey attributes are known: knowledge is not complete. Concurrent with familiarity is predictability. A trip can be predictable – one knows what to expect; or it can be unpredictable – features of the journey such as travel duration may be prone to vary thus the individual may have imperfect knowledge.
Decision mechanism – A range of decision mechanisms or models exist: from (conceivably) complete irrationality; through those where the individual wishes to be or is forced to be expedient – a short cut decision (or boundedly rational decision) is called for; to those where the individual strives to be rational, in as full a possession of the facts as possible and making a utility maximising decision – unboundedly rational.
Decision making – Stemming from the decision mechanism(s) it may be that no conscious decision appears to be made by the individual – behaviour is habitual. The decision instead could be confirmatory – e.g. "I'm going on the train to London and just need to double check the scheduled departure time". Alternatively, decision making could comprise assessing the available options and courses of action and wishing to plan the details of the trip to allow its successful execution.
Information source - Decision making requires that one or more information sources be consulted. This source could be the traveller herself – i.e. a reliance on past experience or instinct. The source could be significant others – other people such as friends, family or other travellers who are believed to be able to offer up their own past experience or to be able to source information for the traveller from elsewhere. Alternatively the information source could be a formal information service (paper-based or electronic). In practice the traveller is exposed to a combination of such sources and must synthesise from a set of (possibly contradictory) signals.

Effects - Based upon a level of knowledge and decisions made, the effects of those decisions then arise. There are possible behavioural effects and possible psychological, physiological or emotional effects. There may, in practice, be no behavioural effect. Alternatively various influences on the trip may result in terms of (changes to) the intended destination, mode of travel, route and trip timing. In terms of psychological or physiological effects there may not be any or in other words the person's state is unchanged. Alternatively the effects could be negative – anxiety, uncertainty and lack of control may be experienced. Meanwhile the effects could be positive – peace of mind and a sense of control.

With this in mind, the specific aspects of the review are now summarised.

Understanding choice making

Decision theory emerges as an area rich in insights which appear to have a strong relevance to understanding how individuals make travel choices – an important precursor to understanding the use of information. Research within the travel information domain seems now to be taking a greater interest in decision theory. Empirical insights are beginning to emerge, however this is a complex area of study which has yet to yield robust understandings specific to travel decisions and the role of information. Collectively this broadening examination of choice making does yield a clear message – if decision strategies other than utility maximisation and unbounded rationality are (also) prevalent, then the extent of information need may, overall, be much less than would otherwise be assumed. This might suggest that the need to provide information is therefore also less than previously envisaged. Another school of thought could, however, be introduced. Much of the theory points to trade-off: an individual is prepared to settle for a seemingly less than optimal travel option if unacceptable additional time, cost or cognitive effort is required in identifying a better option. On this basis, if the provision of information could be advanced to the point where time and monetary cost of acquisition and processing and cognitive effort could be reduced to a minimum and anticipated regret and tendencies towards social learning could be accommodated in the nature and means of presentation of information to individuals, then the prospects of informing and influencing travel decision making could be increased.

Specific key points about understanding choice making are as follows:

- There is a range of decision-making approaches individuals take to journey planning – varying across individuals and for a given individual
- Bounded rationality highlights human tendency (for reasons of cognitive limitations and other constraints) to look for short-cuts to decision making – short cuts which can prove effective for the individual in terms of decision outcomes
- Simply providing more information may not always improve decision making if people are naturally boundedly rational
- Regret theory suggests people will only seek (more) information if they anticipate regret at the decision outcome given their current level of knowledge
- This points to the significance of the 'cost' of becoming better informed in the context of weighing up the 'costs' of different travel options
- Even when provided with information, people rely on and can (sometimes) overweight personal experience

- Reliability and uncertainty of travel choice outcomes play a part in people's choice making and information is found to influence this in ways not necessarily expected

- Habitual behaviour (apparently) inhibits the seeking of information

- There is a social context to travel information use – people imitate, help and learn from each other instead of or alongside making use of formal information provision

Demand for informed choice making

Evidence for the demand for information would appear to demonstrate a consistency with the understandings set out above concerning mechanisms of choice making although notably articles in the literature seldom if ever explicitly make the connection between the two. Information is clearly only sought for a minority of journeys overall – reflected by the familiarity and (sufficient) predictability of many journeys such that (presumably) satisficing behaviour and bounded rationality would preclude a need for being further informed. Where information is sought it tends to be in situations of uncertainty or time criticality – situations which would play upon people's tendency to be risk averse and, according to regret theory, a need for information prompted by anticipated regret (of the wrong choice outcome) being higher than acceptable. Perhaps allied to decision theories, demand for information is also dependent upon different types of individuals but there is a complexity here in terms of the multiple ways in which individuals can be characterised. Specific information needs of given individuals can be hard to address, even if such needs are recognised because willingness to pay for information (such as it is understood to date) is generally low. Accounting for decision theories, it is also not clear as yet how stated information needs might translate into actual levels of information use. The demand for and/or use of information across different (new/emerging) media is presumably evolving over time (though there is little longitudinal evidence highlighting or probing this) but notably, in the face of new media, radio endures as a popular source for certain contexts.

Specific key points about demand for informed choice making are as follows:

- In many cases only a minority (or at best a slender majority) of the public are aware of given information services – this may be an impediment to realising the demand for information

- Demand for and use of information is significantly influenced by travel context – demand is higher where journeys are unfamiliar and/or unpredictable and/or time critical

- The nature and amount of information demanded by individuals is influenced by their experience of the travel situations under consideration

- Research continues to understand how demand for information is related to user characteristics but there are many different facets to characterisation: socio-demographic attributes; socio-psychological and cognitive factors; physical and mental processing abilities; and extents of experience (with travel and with travel decision making)

- Research continues to identify information content needs of specific types of individuals but this does not appear to relate to understanding on decision mechanisms: if more (apparent) information needs were met, information use might not necessarily increase (significantly)

- There remains a need for information being available through a range of (complementary) media (including more traditional printed media) in order to address a range of people (with differing characteristics and abilities) and contexts - meanwhile there is very little evidence of how media preferences are evolving over time (with the exception of some evidence of declining use of telephone services in the face of comparable web services)

- Meeting significant minority information needs could be very important to the affected groups and individuals

- Willingness to pay continues to receive limited attention (and produce mixed results) although willingness to pay is generally deemed to be low (perhaps given the Internet culture of freely available information)

- In terms of information media, the radio (notable for car drivers) is (enduringly) dominant in its popularity though it is noted that it cannot service all types of information need and use

- There is little or no coverage in the literature of the increasingly widespread and affordable availability of in-car satellite navigation systems

- It is clear that most people, most of the time, do not consult travel information – however, in actual terms many people are using information for particular types of trips

Behavioural consequences of information use

Perhaps in part because information use itself is not a dominant feature of (many) people's day to day travel, evidence concerning behavioural consequences of information use remains limited either in terms of depth of understanding or because a very specific context is considered, or both. General indications are that the consequences of information use may relate as much if not more to improving the traveller's state of mind as to changes to their travel choices.

Specific key points about demand for informed choice making are as follows:

- There is (remains) a paucity of empirical insight into the behavioural consequences of information use

- Recalling the low proportion of circumstances when information (from a 'formal' information source) is consulted, where consultation takes place it seems the most common consequence is that no change to travel results (although the potentially important confirmatory and 'feeling in control' value of such consequence must not be ignored)

- While findings are context specific, there is some evidence of the influence of information on mode choice, albeit that the scale of impact appears small overall (though the significance of the impact to the individuals concerned and the transport system overall is not clear nor is it clear how the scale of impact could change over time)

- Driver route choice has been a popular feature of the field of travel information literature - latterly, it has tended to be considered as a focus for experimental research exploring decision theories associated with risk and uncertainty and past experience

- Journey scheduling and departure time effects of travel information use appear to have received very little if any focused attention in the literature

Methodological issues

Many studies do not deal (directly) with real-world travel environments and behaviours. Nevertheless, many of these studies show that understanding the impact of providing information on travel alternatives is not a straightforward task, and that we have quite some way to go in understanding how travellers make choices. There appears still an underlying reliance on the 'homo economicus' assumption. Some studies are based on theoretical models of computer agents representing travellers. Other studies, based on attitudinal research methods, fail to address cognitive limitations and bounded rationality aspects since individuals are not aware of them (and sometimes may deny their existence). Other research methods, based on static stated-preferences questionnaires, hardly reflect the complex and dynamic aspects of travel information use. Although travel behaviour is dynamic by nature and involves dynamic cognitive mechanisms such as learning and adaptation, travellers' needs and responses to information are seldom explored in repeated-choice, feedback-based situations.

Other specific key points on methodology include:

- In a multi-method research field and with the complexity of the topic under study (reinforced by this review) there is need for research articles to apply clear caveats and (sometimes) health warnings to their results

- The uncontrolled environment of the real world (as an alternative to experimental constructs) makes achievement of greater understandings highly challenging

8 Assessing research needs

The final section of the report aims to arrive at the identification of some specific recommendations on future research needs. In order to do so, some context is appropriate, drawing upon the report as a whole.

The previous review of travel information commissioned in 2001 by the Transport Direct Programme pre-dated the existence of the Transport Direct service itself and indeed of other services (or of specific services then in existence but not as we know them today). In short, electronic information services have evolved rapidly, partly through public sector investment and partly through market forces. It seems clear that the travel information marketplace itself will continue to evolve and future development of services will arise through interactions between public and private sector providers and (end) users. Technology platforms themselves will continue to evolve – e.g. we now have truly mobile Internet access from hand-held devices. It can be suggested that future travel conditions could become less stable and predictable as people's activity schedules become more flexible and as a result of network and service disruptions. This may strengthen the need for information in relation to what is suggested from behavioural science. We are also being faced with new informational determinants of our choice making – road pricing and carbon footprinting.

While the travel information marketplace may be changing and expanding it is likely that how people make their travel choices and what factors influence demand for information are more fundamental to human nature and thus enduring over time. This said, the review highlights the complexity of issues associated with understanding choice making and information use. However, further developing this understanding, in conjunction with how it relates to existing information services and behaviours, should provide important clues regarding where the main benefits (economic, social, environmental) may lie in terms of options for how to (further) develop the products and services of the information marketplace.

Many research studies appear, understandably, fuelled by the researchers' own interests and a conviction of the significance of their topic. This makes much of the research very context specific in terms of the behaviours and information types under study, the methodological approaches used and the research assumptions made. In spite of if not because of this, it is clear that an ability to generalise in the field of travel information is often difficult (notwithstanding that this review has highlighted some broadly applicable issues or 'truths'). (Moreover, there is little literature addressing some of the links between the four themes examined in this review; for example, what are the two-way effects between the demand for travel information and the behavioural consequences of travel use?) Context specificity is important and necessary if understanding is to be advanced in the field of travel information. Accordingly, to develop clear understandings may often dictate that the research in question be specifically oriented towards and addressing the policy, product or service of interest. A specific case in point is that the Transport Direct service in some cases will not easily be able to draw upon findings from research elsewhere to inform its own development (with a sufficient degree of confidence). This last point brings into sharp relief the matter of what questions Transport Direct feels should be addressed or which govern its ongoing development. These could relate to aims to increase overall levels of use, to increase the scale of behavioural effect from use, to better target greatest information need where subsequent use may be particularly important to the individual if not also the transport system. Such matters in turn relate to whether there is a view to increasing the amount of information content and/or the accessibility of such content. An enduring challenge which may ultimately

justify further development will be the ability to evaluate the impacts of the service in such respects.

To offer research recommendations specific to Transport Direct would require a separate assessment of what its future objectives and requirements might be. Nevertheless, there are some research needs which it is believed emerge from this review, some or all of which, could indeed have a relevance to Transport Direct if research were pursued specific to the context concerned.

Thus to conclude the report, we set out what we believe are some key research needs facing the travel information field:

1. to understand why, in terms of decision mechanisms, people do make specific use of specific real-world information services;

2. to explore individuals' cognitive limitations in interpretation and use of travel information and how these limitations can be addressed by travel information services;

3. to understand how and why people's specific use of specific information services leads to effects (behavioural and psychological);

4. to understand the social context in which information services 'perform' and thus how information is received and assimilated in the course of interaction with other people;

5. to explore how the phenomenon of social imitation could be incorporated within the design of information services (through feedback data from users);

6. to identify and better understand the non-users of information services who would most benefit from using information;

7. to determine to what extent overall levels of information use of a given information service are dictated by types of individuals (more inclined to seek information) versus by types of journeys (more inclined to prompt an information need);

8. to explore (new) information content and presentation (possibilities) in the context of their compatibility with decision theory;

9. to identify what role printed media formats continue to play in travel decision making;

10. to consider in depth, at the level of the individual, how information need and use evolves over time; and

11. to specifically examine the effects and potential longer term consequences for travel choices and outcomes of in-car satellite navigation systems and other in-car travel information systems.

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Annex A – Review methodology

The previous DTLR review reported in 2001. Accordingly, this new DfT review was tasked with examining literature that had emerged subsequent to the previous review, i.e. from 2001 to 2007. The study methodology in overview was that of a rapid evidence assessment, as distinct from a systematic review. In other words the search of the literature was substantial but not exhaustive. Described below is the process of identifying (potentially) relevant literature, reviewing and synthesising the literature and convening a 'progress' workshop with other experts in the field.

A.1 Identifying literature

The Centre for Transport & Society has access to the bibliographic database 'Transport' that catalogues at an international level research concerning transport. This database was thoroughly searched, and potentially relevant documents identified and located within the database and copies obtained. The terms 'travel* information', 'travel choice' 'choice making' were used to identifying potentially relevant articles. The abstracts of such articles were examined and used as the basis for selecting articles which should be included in the review.

The Transport database yielded the majority of articles for the review. However, it is not able to identify certain 'grey' literature – i.e. articles which are not in the public domain or which have only very recently been published or are about to be published. To supplement use of the Transport database, other approaches were also used. Project team members used their own expert knowledge of and involvement in the field of travel information to identify articles. The Google (Scholar) search engine was also used (though revealed little beyond that already found. Recent conference proceedings were examined by the research team. Finally, news of the review exercise was circulated via email lists to research and practice communities with requests for individuals to alert the research team to literature. This yielded a small number of additional articles.

A.2 Reviewing the literature

To structure the process of reviewing the assembled literature and to provide a documentary summary of it, a review template was developed. In order to develop template, the research team brainstormed what they believe were potentially significant questions to be raised in the field of travel information. The intention was not to constrain the review to such questions but to help guide and focus the examination of the literature. The following questions were established (with the highlighted terms going on to be used in the template itself):

1. **Awareness**: Why is it that if information is seen to be needed by travellers that so many people are not even aware of the information services that exist?
2. **Demand, access and use**: What is the (potential) nature and level of demand for travel information that does (could) exist and how can more people be helped or encouraged to make use of travel information - what are the key factors and to what extent can they be influenced?
3. **Context**: In what social and situational contexts is travel information used?
4. **Content**: What information do travellers need (in the mind of the travellers themselves, in the mind of the developers of travel information systems, in the mind of academics) and is it being provided?
5. **Behaviour**: What are the different forms and extents of behavioural effects from information use (especially in relation to modal shift)?

6. **Delivery**: What are the technological and usability challenges and opportunities in providing information?
7. **Providers**: Are the roles played by the various providers of information the most effective ones? How might these change over time?
8. **Media**: How important do 'traditional' information media such as paper and face-to-face remain in the face of ICTs and how do or should they relate to one another?
9. **Evolution**: What changes to user needs, norms and abilities and to technological possibilities for information provision are occurring and will occur over time? (see 'changing worlds' list of issues).
10. **Research methods**: Are the research methods used to try and understand what travellers need and how they behave in relation to information appropriate or appropriately used?

The finalised review template (shown in Figure A.1) was then completed for each article under review. After a small number of articles the template was assessment to ensure it was proving fit for purpose. In the event no changes were deemed necessary. Assembling together the completed templates has formed what is termed the 'Travel Information Research Compendium 2001-2007'. This is held as a Microsoft Access database which can be searched and used as a subsequent source of reference beyond the review report itself.

A.3 Workshop

Upon completion of approximately half of the review, draft review report material was prepared. This was then used to form the basis for a presentation to a roundtable workshop at the DfT on 23 April 2007 in London. The intention of the workshop was to share and discuss progress of the review exercise to date with other individuals with an interest in the research. Preparation for the event itself proved very helpful in focusing and developing the thinking of the research team and feedback from the event itself further assisted in conducting the remainder of the exercise and in the writing of this report.

The following individuals attended the workshop (a number of other invitees were unable to attend):

John Austin	Austin Analytics
Dr Erel Avineri	UWE, Bristol
Phil Blythe -	Newcastle University
Lowri Davis -	DfT
Dr Sendy Farag	UWE, Bristol
Tim Felstead	University of Southampton
Reg Harman	UWE, Bristol
Susannah Johnson	Transport Direct, DfT (minutes)
Glenn Lyons	UWE, Bristol
Peter Miller	ITO World
Michael Simmons	University of Cambridge
Shane Snow	Transport Direct, DfT (contract manager)
Chris Watts	DfT

Strategic Review of Travel Information	RESEARCH COMPENDIUM

Entry No.	**Date of Entry**		**Restricted? (1=yes)**		**Reviewer**		
Article title	***e.g. Information for bus passengers: a study of needs and priorities***						
Article reference details	*e.g. Balcombe, R. J. and Vance, C. E. (1996). Information for bus passengers: a study of needs and priorities. TRL Report 330, Transport Research Laboratory, Crowthorne.*						
Web address	*Complete if applicable*						
Project from which article is sourced	*Complete if applicable*						
Contact name	*e.g. R J Balcombe*						
Affiliation							
Email	*Of corresponding or first author*						
Research sponsors	*If known*						
Country/region/city of research conducted	*This should refer to the country or countries to which the reported research relates or be marked as international if many countries or sources of data are covered. An article with no data or clear reference to a give country or countries should be marked as unknown or not applicable.*						
Main research areas covered by article	**Awareness** **Demand, access and use** **Context** **Content** **Behaviour** **Delivery**	*Mark relevant areas*	**Providers** **Media** **Evolution** **Research methods** **Other:**	*Mark relevant areas*			
Travel mode(s)	**Car** *Y/N*	**Public transport** *Y/N*			**Walk/cycle** *Y/N*		
Information use	**Mode choice** *Y/N* **Route choice** *Y/N*	**Itinerary planning** *Y/N* **Real-time** *Y/N*					
Objectives							
Description/ method							
Findings/ conclusions	*Identifying issues which appear most relevant to the review including unanticipated issues.*						
Strengths/ weaknesses	*Identifying issues which appear most relevant to the review including unanticipated issues.*						

Figure A.1. Review template

Annex B – Key issues from previous 2001 review

In 2001 the then DTLR commissioned a review of travel information. The review principally covered literature from 1995 onwards including over 200 articles. The study report[5] highlighted 32 key issues. As background to this current review, the list of issues is reproduced below:

1. When considering consumer demand for information there is a need to identify *for what* demand is being assessed – demand will vary where the information relates to different modes of (public transport) and in turn is likely to be different again where an information service represents more than one mode.

2. Demand for an information service concerning journey planning for a predetermined mode should not be confused with demand for a service that offers mode choice information/guidance.

3. The level of demand for an information service is a fundamental consideration both in terms of the business case for the provision of the service and in terms of the scale of effect on travel choices and behaviour at an aggregate level that the service might achieve. However, the issue of what level of demand would be deemed acceptable in these contexts remains outstanding.

4. A strong modal allegiance exists across journey purposes rendering demand for information to assist in mode choice decisions limited. The time and effort to seek such information reinforces this position.

5. It appears difficult to entice car users onto local bus services and in turn for car users to be persuaded that information on bus services is worthwhile. This may be true in the context of local trips. However, it may not be the case for longer distance trips for which the bus forms part of a multi-modal multi-stage journey. Nevertheless a substantial proportion of journeys made in the U.K. are local.

6. It is important for Transport Direct to distinguish between two measures of demand. The first is the demand for a service such as Transport Direct *in the absence of* any other similar or alternative services. The second is *in the explicitly recognised presence of* other similar or alternative services.

7. The public may struggle to accurately envisage what Transport Direct might offer. In this context it will be difficult to accurately assess potential future demand.

8. What Transport Direct is and how that is conveyed must embody a unique selling point to attract public use.

9. In assessing information requirements from a service the needs of both *potential* and *actual* customers need to be taken into account. Potential customers can become actual customers whilst actual customers can become *former* customers.

10. User reactions to an actual information system cannot be equated to user requirements from a preferred system design.

[5] Lyons, G., Harman, R., Austin, J. and Duff, A. (2001). Traveller Information Systems Research: A Review and Recommendations for Transport Direct. 17 August, DTLR.

11. Reliability is a facet of travel that individuals consider important. Yet its meaning, particularly in terms of the *degree* to which a transport service is reliable, is poorly understood. Information conveying (comparative) reliability levels of travel options has not yet been addressed.

12. Walking, cycling and driving as modes between or at the ends of stages of longer distance journeys can facilitate alternative travel options to a door-todoor journey by car.

13. There is clear evidence that within elements of the population there exists a distinct lack of awareness of information sources. This is a barrier to information service use and in turn to transport service use.

14. Market research is required both to identify those individuals who constitute the target market for a particular type of information service and in turn to devise an advertising strategy to secure them as information service customers.

15. Awareness or lack of it should be gauged according to whether or not an individual is familiar enough with an advertised information service to know how and when it might serve a useful purpose to that individual.

16. Major bus groups and rail operators will have marketing initiatives directly concerning their services. In many cases these will include information on service availability. The relationship between services, information, marketing and awareness is poorly understood.

17. Pre-implementation market research might underestimate the consequences and scale of effects of an information system on behaviour – users need prolonged exposure to evolve their reactions.

18. Information systems will only be effective as part of an overall policy aimed at improving the quality and performance of public transport services. In this context evaluating an information system in isolation of external contributory factors might not indicate the degree of effect on behaviour that could occur in practice as external factors change.

19. Willingness to pay for information has seldom, if at all, been given detailed and thorough consideration within research to date. Findings to date convey mixed messages over willingness to pay.

20. The information chain from collection of raw data through its conversion into meaningful information to its delivery to end users will usually involve a number of organisations spanning the public and private sector. A common division of responsibilities seen in partnerships is as follows. The public authority has the role of data provision and maintenance of data quality. Meanwhile the private organisations have the role of using that data to deliver (commercial) information services to the public.

21. Partnerships can have endemic problems. They can be slow to take decisions. Centralisation divorces the information provider from the end user. Publicly funded projects can be ineffective at anticipating consumer needs. Such problems raise the question of whether informal partnership with only commercial motivation can succeed or whether legislation has a role in making things happen.

22. Recent and evolving partnerships in the U.K. provide encouragement. However, the detail of their formulation, operation and degree of success is poorly understood, or at least the public domain is not privy to such insight.

23. Public transport operators, particularly in the bus industry, are operating to short financial horizons. Investment in information services as envisaged in Transport Direct is a long term commitment involving not insignificant risks. This is particularly the case where there is a limited availability of robust and relevant empirical evidence that such information services as are envisaged will generate sufficient demand and in turn a revenue stream to offset the costs.

24. A number of studies point towards the need for public authorities to provide the substantial capital investment (or a part of it) required to establish (pump prime) the systems and the associated infrastructure. This comes with an expectation that private sector players will be in a position to operate the service on a commercial (and commercially successful) footing.

25. Multi-modal information services rely on a partnership across organizations in terms of the information chain. In contrast organisations such as TrafficMaster have full control over the information chain within themselves and partnership then becomes an issue for the *selling* of their service.

26. Rather than investing further in co-operative development of integrated information services, private sector information providers may be able to achieve greater financial gain by business diversification from a starting point in travel information provision.

27. The Internet (and notably the web as a main communications protocol) is set to increase in its prominence as a medium for the provision of, and access to, traveller information services. Its versatility is contrasted by the current limitations being faced by mobile Internet service developments in terms of information display area and information download overheads.

28. Technological opportunities both in terms of the types of information service that can be provided and the devices and media by which they can be accessed render information interface design an ever changing area but one which remains a vital element of successful information delivery.

29. Examples of on-line booking and payment facilities to accompany traveller information services are limited, particularly where journeys are across modes or operators. The case for booking and payment as part of Transport Direct has not been proven, partly because of the lack of maturity in this area of development.

30. Within the area of technical standards and solutions there appears to be a successful sequential process of development with successive projects building on the findings and progress of their predecessors.

31. Developments with real-time information provision remain largely embryonic particularly where such information is used in a personalised way as a direct supplement/complement to journey planning services.

32. Integration, which should signify an interaction at a system level between two or more databases or services (across modes), should not be confused with coordination, where any interaction between databases or modes is only achieved through the efforts of the user.