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A Review of Drivers' Requirements for Guidance and Information in CLEOPATRA Cities

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1. Introduction

The contents of this working paper were submitted in modified format as the End Users' Requirements section of Deliverable 1, Work Package 3, of the European Commission DG X111 C Telematics for Transport project CLEOPATRA (City Laboratories Enabling Organisation of Particularly Advanced Telematics Research and Assessment), project no. TR 1012, June 1996.

Various studies on drivers' requirements for guidance and information have been carried out in both Europe and the USA. An executive summary of these requirements is provided in the following sub-section. The full details of research previously conducted is given in section 2, where the main findings from a selection of studies are summarised. The subsequent section 3 on Drivers' Requirements in CLEOPATRA Cities, gives city specific requirements where previous work has been undertaken to assess these as part of work for other European projects. Finally the conclusions on Drivers' Requirements are summarised in section 4 and research references listed in section 5.

1.1 Executive Summary of Drivers' Requirements for Guidance and Information

From a review of various research into driver requirements for information (see Appendix), the following requirements are summarised. There is a demand for improved traffic information with 80% of drivers surveyed in one study stating that the present information was inadequate. Information will need to be made flexible to meet the demands made by different driver types. One study has identified four main groups of drivers; route changers, non-changers, route and time changers, and pre-trip changers.

Drivers' general requirements for information are that it is accurate, credible, timely, and easy to comprehend. Credibility is increased if advice is corroborated by local conditions. Accuracy is increased if information is real-time and frequently up-dated. Drivers' requirements for information differ by information system, the level of familiarity with the network, and by the travel scenario. The most important factors required of information for business and journey to work trips are saving travel time and increasing certainty of arrival. The most important factor for leisure trips is to avoid congestion.

Drivers' requirements for In-Vehicle Route Guidance information are: that it should be based on real-time information; guide right to the destination; have knowledge of the full network; be able to recover position if an incorrect turn is made; and, provide guidance within other cities. If possible, information should be tailored to individual driver's specific needs, including preference for routing strategy. Familiar drivers need specific details about traffic conditions at the local level (i.e. street name). However, when in familiar networks, drivers would prefer to assess the implications of information themselves, rather than receive prescriptive advice without information. When in unfamiliar networks, drivers require strategic information (i.e. main routes) and would welcome prescriptive advice, even without supporting information. This suggests that detailed in-vehicle route guidance is more valuable than VMS when making unfamiliar trips.

Drivers' requirements for VMS information are for notification of road works, accidents and congestion problems, and to a lesser extent for information about weather conditions (e.g. fog). Information on general traffic conditions is required to enable journey time estimation. Messages which include an estimate of delay and information about the cause of the delay are particularly persuasive. When a diversion is possible, drivers are less concerned with knowing the extent or duration of a problem, they wish to know only that a problem exists and can therefore tailor their response to individual travel goals. Similarly to above, familiar drivers need specific details, whereas unfamiliar drivers would find strategic information to be of more use. The format of VMS

information however, does not facilitate information to be provided for the individual driver, and this is a restriction. There is also a demand for parking information to be provided by VMS.

2. Research Review of Drivers' Requirements for Guidance and Information

2.1 Drivers' Use of Existing Information Sources

A brief summary of the information sources currently available for motorists to use in order to determine their route choices is given by Robb (1987). These include; road maps, signposts, personal knowledge, advice form other people, and broadcast traffic information (radio). A survey of drivers' requirements for route guidance carried out by Bonsall & Parry (1990), indicated that in London and Paris, the most frequently used sources were: street maps, signposts and road atlases. It is assumed that these conventional sources of information will still be available to drivers in the future. Therefore it is important that information from new sources not only be precise and reliable, but that it is also consistent with these other sources.

2.2 Review of Previous Surveys on Drivers' Requirements

The work conducted by Jeffery & Russam (1984), has suggested that drivers are most keen to receive warnings about hazards ahead, particularly accidents and fog, but see less need for information about other weather conditions or congestion ahead. Further work carried out by Russam & Jeffery (1986) into route guidance and information systems indicated that drivers' needs for information changed with circumstances and the degree of familiarity with the network. Subjects expressed a wish for reliable information on weather conditions and the state of the roads; information on the general traffic situation to enable estimates of journey time; and, notification of abnormal bottlenecks and congestion.

The study conducted by Shirazi, Anderson & Stesney (1988), had previously identified different groups of drivers in a telephone interview survey on traffic information systems. The main objective of the exercise was to identify how various forms of traffic information were currently used and to assess the drivers' attitudes to diverting from a main road with improved traffic information. The survey considered three types of information provision, including, continuous radio reporting, electronic message signs (VMS) and also a traffic information telephone service. The study concluded that commuters wanted improved traffic information and 80% stated that the present information was inadequate. It was also noted that 70% stated that they would alter route if accurate traffic information were made available to them regarding shorter travel time. When asked how traffic information could be improved, respondents indicated that information reporting could be more timely and accurate.

A `Motorist Information Survey' was carried out in Seattle USA, by Barfield, Conquest, Spyridakis & Haselkorn (1989), who researched information requirements from 4,000 drivers in order to design a motorist information system that would have impact on commuter behaviour and thus increase the efficiency of the use of the existing highway network. The study identified different groups of drivers, for which very different information needs were evident. The four groups identified were: Route Changers, drivers willing to change routes before or during their journey; Non-Changers, drivers unwilling to change either departure time, route, or mode; Route and Time Changers; drivers willing to change either their route or time of travel; and Pre-Trip Changers, those unwilling to change en route, but willing to change time, route, or even mode, prior to starting their journey. The study concluded that the difference between route changers and non route changers, whilst en route, had important implications for the design of an effective motorist information system, and that it was necessary to target the different driver groups by tailoring the information, in this manner the decision behaviour of each group in response to incidents and congestion could be influenced.

Further work by Wenger, Spyridakis, Haselkorn, Barfield & Conquest, 1990, reported that with regards to sources for obtaining traffic information, motorists prefer commercial radio and 92% stated that they would use a radio station dedicated to receiving traffic information. The study also pointed out that half of the respondents stated that they prefer to receive traffic information before driving. Variable message signs were the second most popular source (Spyridakis, Barfield, Conquest, Haselkorn & Isakson, 1991), and the study concluded that regarding response to VMS, commuters wish only to know that a traffic problem exists and that they wish to tailor their response to individual travel goals.

A questionnaire survey conducted by Bonsall & Parry (1990), regarding drivers' requirements for route guidance information in London, Munich and Paris, found that drivers' would prefer to assess the implications of information themselves when in a familiar network, rather than receive prescriptive route advice without information, whereas, when in an unfamiliar network they would welcome advice even without information. Respondents thought it important that any guidance system must be aware of minor roads; be able to recover position if the driver made an incorrect turn; and be able to direct them right to their destination.

A series of studies using route choice simulators and stated preference techniques have been conducted by ITS Leeds, (Bonsall & Parry, 1991; Bonsall, Clarke, Firmin & Palmer, 1994; Bonsall & Merrall, 1995; Wardman, Bonsall & Shires, 1996). These studies have suggested that drivers' route choice can be influenced by information and guidance from radio, other in-car devices, and from VMS, but that the extent of this influence is very dependent on message content and credibility. It also depends on network topology and, to a lesser extent, on drivers' familiarity and socio-economic factors. Messages which include an estimate of delays ahead and information about the cause of the delay seem particularly persuasive. There is some reluctance to follow prescriptive routing advice unless it is backed up with reasons for any diversion or is corroborated by information from other sources, including local conditions visible through-the-windscreen.

A study conducted by Graham, Mitchell & Ashby (1995), into drivers' requirements for motorway traffic information, used a semi-structured interview survey to discern what information was considered to be most important. The information types considered, included: weather conditions, problem location, extent of event, diversion information, traffic speed, visibility distance, extent of queues, estimated problem duration, lane closures and estimated delay. From this list, the drivers' interest in saving journey time was rated as the most important factor. Information required by drivers was different between cases when they were able to divert and avoid a problem or not. When such avoidance was possible, drivers were less interested in knowing about the extent of any tailback or duration of the problem. Also diversion information was considered to be inappropriate for short range travel situations.

Drivers' preferences for in-vehicle information systems have been surveyed by Mannering, Kim, Ng & Barfield (1995). Drivers' ratings of the importance of information were modelled using ordered logit and regression analyses. Frequency of both departure time changes and route changes were collected from the survey respondents, who also stated their preferred distance ahead of notification of problems, and preferences for the type of visual display. Results show that socio-economics, habitual travel patterns, congestion levels, and attitudes towards in-vehicle technologies are significant determinants of travellers' information preferences. The study also concluded that it was desirable to survey drivers who possessed some experience of in-vehicle information systems and that at this present moment in time, such opportunities remained limited.

3. Drivers' Requirements for Guidance and Information in CLEOPATRA Cities

A literature search of previous studies carried out in the cities concerned has been undertaken to determine general driver requirements for information. It should be noted that not all cities covered by the CLEOPATRA project have such information available, however, a broad cross section of cities have

been covered, including: Berlin, Gothenburg, London, Paris, Southampton and Toulouse. Brief summaries for each of these cities now follow:

3.1 Berlin

Questionnaire surveys were administered to 100 drivers of cars equipped with the LISB experimental guidance system in Berlin during 1990, (Joint & Bonsall, 1990). The surveys were conducted to assess the impact of the dynamic route guidance system. Expectations prior to receiving guidance, indicated that 90% of drivers expected a reduction in journey time when traffic conditions were poor. This percentage decreased to only 23% expecting a journey time reduction when conditions were good.

Following a period of time over which the system was active, the main results indicated that guidance would be ignored if drivers did not find it credible. It was suggested that the credibility of an item of advice will be increased if it is corroborated by the local conditions. Most respondents valued the fact that guidance was based on near real-time information and made destination finding easier. Guidance was seen as being more valuable when making unfamiliar trips rather than familiar ones.

Respondents were also asked to assess some possible enhancements to the system. The most popular were: guidance within cities other than Berlin; instant recognition of guidance if departing from the recommended route; guidance to be available right to the destination; and knowledge of all roads in the network, including small ones to be included in the system (Bonsall & Joint, 1991).

3.2 Gothenburg

Surveys on drivers' requirements for information were conducted in West Sweden as part of the DRIVE II TANGO (Traffic Information and Navigation for GOthenburg) project V2054, (Chihani, 1995). This study utilised the SOCRATES system (System Of Cellular RAdio for Traffic Efficiency and Safety). A customer analysis was performed whereby the potential customer preferences and attitudes towards the RTI (Road Transport Informatics) technology applications and products were examined. The study indicated that 76% of drivers do actively seek information on travel conditions, either before or whilst driving. In the case of those drivers who do not bother to inform themselves, this was found to be due to four main reasons: they were very familiar with the city in which they were driving, relied upon their own experience, drove the same route frequently, or stated that the road infrastructure did not permit a viable alternative in any case. Of the existing sources of travel information the most highly used proved to be the radio. Indeed, 28% of survey respondents indicated that this information was sufficient for their travel purposes, and that they only drove in familiar areas. Additionally the report emphasised that drivers' may: have a fear of new technologies, consider in-car information systems to be too expensive, and also have a lack of knowledge about what benefits new systems can potentially provide.

3.3 London

A study to assess user requirements was undertaken in 1989. A questionnaire was developed which sought to establish the sorts of guidance and advice that users might require in different circumstances. Surveys were conducted in London, Munich and Paris (Bonsall & Parry, 1990), the results applicable to London are summarised in the following two paragraphs.

With regards to route choice, the single most important factor for all journey purposes was stated as being saving time, whereas, for leisure journeys, avoiding congestion was more important. For journeys to work, drivers also highlighted the importance of certainty of arrival. Most respondents thought that route guidance would be very useful for journeys to areas never previously visited.

Respondents were asked to select the features that they would find most useful in a guidance system. The most popular feature was that guidance systems should have up-to-the-minute information about traffic conditions. Knowledge of scheduled disruptions was also highly regarded. Guidance that would take the user right to their destination was particularly valued. Detailed street networks were regarded as desirable. Confidence in the ability of the system to recover position, if the user missed a turning was seen as a useful extra feature for city drivers. Knowledge of current traffic conditions were seen as useful for journeys in parts of London not well known, but not for areas in London frequently visited (Joint, 1990).

End user requirements for CLEOPATRA related activities in London relate to UTC and VMS. For UTC, there is little knowledge available on end-user requirements, as systems evaluation has traditionally focused on aspects of improved efficiency, through impacts such as reduced delay, congestion and vehicle operating costs. For VMS, however, a number of studies have sought to identify end user requirements. Two studies of note for CLEOPATRA include (I) a `Driver Information Study' undertaken by the consultants SDG Research for the Department of Transport (DOT), reporting in 1994 and (ii) a study undertaken for the DOT by the consultants W.S. Atkins, in collaboration with TRG Southampton, into the effectiveness of VMS in London, using a variety of modelling, questionnaire and interview techniques.

The first study, covering all road types and prevailing information systems included 1200 face to face interviews. Issues addressed concerning VMS included (a) user requirements, where a positive view of VMS was confirmed, particularly if reliability is improved through more frequent updating and removal of messages, (b) message requirements, where roadworks and congestion information was considered important, particularly if the reason for congestion is displayed and (c) diversion rates, where it was found that 10% of drivers changed route when seeing a VMS message of any kind. The study was followed by a further study focusing on driver information needs in London. The results of this study are in the process of being obtained. The second study of VMS effectiveness in London concentrated on the 17 inner London VMS proposed for CLEOPATRA collaboration. This study included a pilot questionnaire survey enabling driver response to the signs to be evaluated, including proposed improvements. However, this evaluation was undertaken while technical and operational aspects of the VMS were still being improved and results therefore have limitations.

3.4 Paris

From the previous comparative study conducted by Bonsall & Parry, (1990), and Joint, (1990), some results obtained were of particular relevance to drivers in Paris. Notably, it was found that parking space availability was seen as a useful extra feature for city driving. Capability for guidance within other cities was also highly valued. The choice of route selection method for journeys to other parts of the country, but not within Paris, was also seen as being useful.

A CARMINAT experiment has been conducted inside the CITIES, PLEIADES and MELYSSA projects between July 1994 and June 1995. Users' requirements have been analysed through questionnaires and users' groups. Global satisfaction is judged to be very satisfying for the majority of users. The products can be improved from the information point of view. The conclusions of the users' requirements analysis have been taken into account and led to the increase of devices for the collection of data. Dynamic route guidance is a function asked for by the end users.

3.5 Southampton

CLEOPATRA related activities in Southampton are concerned with journey time prediction (JTP), in-vehicle information systems (IVIS) and UTC/VMS. Applications in these or related areas were

developed during the ROMANSE project (1992-1995). A socio-economic evaluation was carried out of the ROMANSE project by the University of Westminster. As part of this evaluation ROMANSE products were assessed with regard to a number of important measures. Four of the products have some relevance to CLEOPATRA: Parking Guidance System (PGS); VMS (three signs for outbound traffic from city centre and five mobile signs); Radio Solent Traffic News; and TRIPlanner (interactive terminals providing trip information).

PGS, VMS, Radio Solent Traffic News and TRIPlanner are traffic information products which have the potential to inform travellers of real-time and (forecasted) future journey times so findings are relevant to CLEOPATRA. The products were evaluated for their actual performance by panel surveys which monitored the products' impacts given their current configurations and levels of implementation. It was found that 62% of Southampton residents were aware of PGS but less than 50% were aware of the other three products. All four products were considered as important by over 50% of residents. PGS had the highest usage of 35% with usage of 23%, 7% and 2% for Radio Solent Travel News, VMS and TRIPlanner respectively. In each case, at least 50% of those that had used the products felt they were `completely accurate'.

The products were evaluated for potential performance through hall based testing (which introduced respondents to the products in a controlled artificial environment) and also the INSIGHT computer simulation (which presented products by a simulated trip through the Southampton road network). VMS was the most well received product with 73% of subjects saying it was very useful and 57% thinking it should be of high spending priority. PGS was also highly regarded but TRIPlanner had lower ratings.

During the second stage of ROMANSE (ROMANSE II, 1996-1998) there will be further socio-economic evaluation of products that are developed. The ENTRANCE project, which is part of the THERMIE programme in DGXVII, is looking at ways to produce energy savings through innovation. As part of this, towards the end of 1996, the effectiveness of VMS (route information signs and car park information signs) will be examined using questionnaire surveys of (I) people who regularly use the route on which route information signs will be implemented and (ii) city centre car park users.

3.6 Toulouse

Questionnaire surveys of motorists were carried out in Toulouse following the installation of VMS on inbound roads to the city. Questions were classed in four groups: driver characteristics, understanding of messages, information requirements, and influence of information on driving.

The results of response to the messages are specific to French vocabulary and are applicable to a mixed range of drivers' journeys. Despite the limited space available on a VMS (3 lines by 12 characters), drivers indicated that they would require guidance information to be provided. The information most required is that notifying of circulation problems (location and consequence). The second most required information was regarding road works (with location and duration or nature). The third most required information was for car parking information (name of car park and parking space availability).

Using this survey, several recommendations have been established and considered, regarding policy of VMS use in Toulouse. Scope exists to conduct additional surveys following a further period of VMS operation.

4. Conclusions on Drivers' Requirements for Guidance and Information

The evidence suggests that driver route choice behaviour can be influenced by advanced traffic information. However, it is evident that in order for information to be successful in ensuring effective and efficient use of the existing road network, it needs to be credible, timely and persuasive, and users

also need to be able to comprehend it. It also needs to meet different criteria for different categories of driver, and for different travel situations.

Comprehendability is achieved by making instructions clear but concise, however it is recognised that this is not always very easy to achieve, particularly where the same message needs to be understood by people with a wide range of levels of background knowledge. Credibility is enhanced by having corroborating information and by building up a good track record. Unfortunately there are several examples of systems where this credibility has been lost. Timeliness is linked to credibility and, again, there is unfortunately some evidence that some existing systems (e.g. radio and VMS) already have a reputation for not being timely. Persuasiveness is enhanced by providing background information to support advice being proffered - thus information on the extent of any delay ahead, and on the reasons for it, are particularly valuable.

It is quite clear that driver requirements vary according to circumstances and most particularly they will differ depending on the drivers' level of knowledge of the network and the location of their destination. Drivers with good network knowledge require information about current, or projected traffic conditions and can comprehend information which might mean nothing to less familiar drivers. Thus they can recognise local place names and street names and realise the significance of incidents at specified locations. Drivers without this local knowledge will only be able to act on advice mentioning strategic locations relevant to their journey or very specific turn instructions. The ideal, of course, would be to tailor the information and advice to the needs of each individual driver and journey. This is clearly not possible with `public information' systems such as VMS or broadcast radio but might be achieved by `private' in-car systems.

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