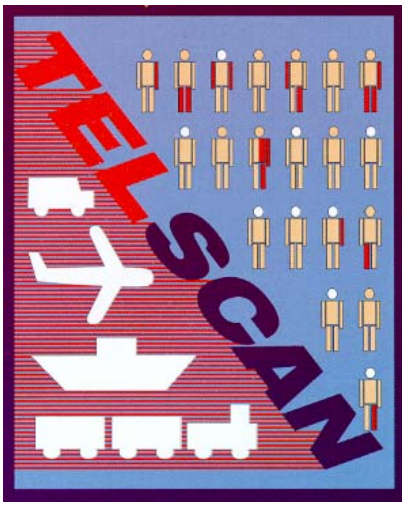
TELSCAN

TELematic Standards and Coordination of ATT systems in relatioN to elderly and disabled travellers

TRANSPORT TELEMATICS PROJECT No.: TR 1108



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Inventory of ATT System Requirements for Elderly and Disabled Drivers and Travellers

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Executive Summary

This Inventory of ATT System Requirements for Elderly and Disabled Drivers and Travellers is the product of the TELSCAN project's Workpackage 3: Identification and Updating of User Requirements of Elderly and Disabled Travellers. It describes the methods and tools used to identify the needs of elderly and disabled (E&D) travellers. The result of this investigation is a summary of the requirements of elderly and disabled travellers using different modes of transport, including private cars, buses/trams, metros/trains, ships and airplanes. It provides a generic user requirements specification which can guide the design of all transport telematics systems. However, it is important to stress that projects should also capture a more detailed definition of user requirements for their specific application area or system.

A literature review updates the state of the art (Section 2), and has contributed to a review of existing and prospective E&D travellers' aid systems with particular emphasis on telematics (Section 7). The tools used in data capture are provided, including a Travelling Task Model and a Definition of the Travelling Task for the various modes of transport (Section 3) and a Functional Classification of E&D Travellers (Section 4). The data collection methods are described for identifying user requirements of travellers (Section 5), and the user requirements for drivers were matched from the TELAID and EDDIT projects (Section 6), so that this data can now be integrated with the results of TELSCAN.

The identification and updating of the needs of elderly and disabled travellers have resulted in a specification of user requirements, in general and those specific to the use of telematics. It also indicates to what degree advanced technologies fulfill the requirements of elderly and disabled travellers.

The results (Section 8 and Appendix 6) combine the matching and updating of user requirements from TELAID and EDDIT (Section 6 and Appendix 2), data collection from experts and users, observations with users (Appendix 3), and the expertise of the TELSCAN Consortium. The resulting table, Inventory of Requirements for Elderly and Disabled Travellers, indicates if there is an ATT system available to solve each problem, and if so, reference is made to the numbered system in the inventory of existing and prospective E&D travellers aid systems (Appendix 1).

The Inventory of Requirements for Elderly and Disabled Travellers provides an overview of the main impairment groups having difficulties with components of the travelling task. By scanning the table, we can see:

- Where there are no solutions existing
- Where current solutions/systems need adaptation or enhancement
- Where new system ideas may emerge

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1. Introduction

The following report is the product of the TELSCAN project's Workpackage 3: Identification and Updating of User Requirements of Elderly and Disabled Travellers. The main objectives of this workpackage were:

- To develop an assessment method to identify the needs of elderly and disabled (E&D) travellers, and

- To identify and update the user requirements of E&D drivers and travellers, particulary in relation to Advanced Transport Telematic (ATT) systems

TELSCAN's overall objective is to ensure that the needs of E&D people are taken into consideration in the development and application of ATT systems. The TELSCAN consortium possesses the knowledge and expertise to provide this support, but much other knowledge needs to be taken into account, for example with respect to general interface design issues in meeting the needs of elderly and disabled people. Knowledge from the TELAID and EDDIT projects has now been integrated, together with an updating of the literature and state of the art, not only in the transport sector but also in telematics designed specifically for E&D people, for example within the TIDE programme.

The result of this investigation is a summary of the requirements of elderly and disabled travellers using different modes of transport, including private cars, vans/minibuses, buses/trams, metros/trains, ships and airplanes. It provides a generic user requirements specification which can guide the design of all transport telematics systems. However, it is important to stress that projects should also capture a more detailed definition of user requirements for their specific application area or system. The same methodology described in this deliverable for the identification of needs can be followed by projects to capture their system-specific data.

The methods used and described in the following sections follow the systems approach adopted in TELSCAN to define E&D issues in Transport Telematics, as shown in Figure 1.

A Travelling Task Model and a Definition of the Travelling Task were developed. Main impairment groups were identified through TELSCAN's Functional Classification of E&D Travellers. A survey of E&D travellers' requirements was conducted using different modes of transport.

At the same time, a survey was conducted of existing and prospective E&D travellers' aid systems with particular emphasis on telematics.

The resulting Inventory of Requirements for Elderly and Disabled Travellers in relation to the travelling task (Appendix 6) was then matched with the Inventory of Telematics systems for travellers (Appendix 1), to provide an overview of the main impairment groups having difficulties with components of the travelling task, and what their requirements are, in general and those specific to telematic systems. The synthesis enables us to see more clearly the areas where gaps exist and where telematics can play a part, and has also identified broader issues with respect to the needs of elderly and disabled travellers and where telematics may play a role in the future.

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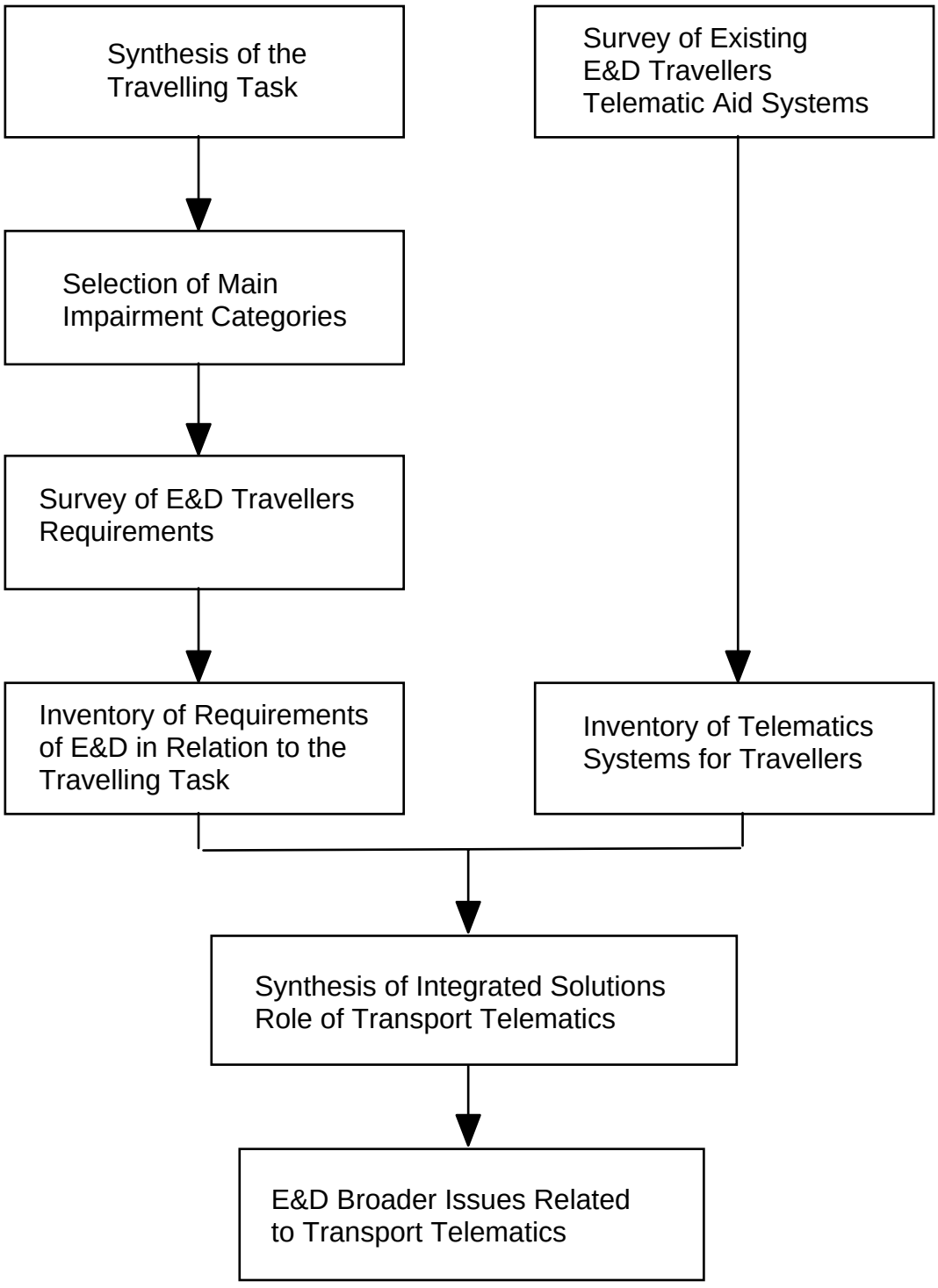
Figure 1:

A systems approach in defining E&D issues in relation to Transport Telematics



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2. Literature Survey

Due to an increase in the number of aged and disabled people in most of the north European countries, in the USA and more recently in Japan, the number of research programmes dedicated to this population becomes more and more important. This is all the more true in the field of transport, as mobility is directly linked to autonomous living and has socio-economical impact.

There are two kinds of research programmes in this field: some are dealing with the knowledge of the functional abilities of elderly and disabled people, and others are studying the possible impact of new technological devices on the mobility of elderly and disabled people. In the transport sector, the new technologies use mainly telematic applications and are called either Advanced Transport Telematics Applications (ATT) or Intelligent Transport Systems (ITS).

This review includes new documents related to drivers since the state of the art reviews conducted during the DRIVE II EDDIT and TELAID projects, completed at the end of 1992.

It is organised as follows: in the first part, some new (up to 1992) issues related to the functional abilities of elderly and disabled people are examined; in the second part, work related to the human factors of advanced technology and elderly or disabled users is highlighted. Reference is made to literature on elderly and disabled people, not just in the context of travelling (within the DRIVE and transport telematics community) but also telematic systems specifically for E&D within, for example, the TIDE programme (Telematics for the Integration of Disabled and Elderly people).

Systems identified within this literature search have been included in the inventory of telematic systems for travellers (Appendix 1), highlighting the relevant E&D issues.

2.1 Functional characteristics of elderly and disabled people

The literature tends to emphasise elderly drivers and disabled users of the public transport network. On the other hand, elderly travellers, in general, and disabled drivers, in particular, seem to generate less research work (with the exception of the publications of the TELAID project).

Emphasis on the elderly drivers population could be attached to the statistical predictions which show that it is likely that by 2021, 60-65% of men and 40-50% of women over the age of 70 years will have a driving licence (Stewart & David 1996). These figures are for the UK population but very similar predictions could be made for other north European countries.

With the aging process, most of the important abilities necessary for driving (vision, memory, attention, decision making process) decline due to certain phenomena which have not been fully explained up to now (Marin-Lamellet 1994). As a consequence, the mobility of elderly drivers tends to decrease. More specifically, elderly drivers tend to:

- avoid rush hours in order to reduce the pressure of other vehicles,
- travel less frequently to unfamiliar places because finding one's way while driving is a task that demands too much attention,

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- avoid complex areas on a trip due to the difficulties of extracting pertinent information rapidly.

Accidents involving these drivers are to some extent specific to the tasks of merging in traffic, turning across traffic and refusal of right of way priority. Although there are well-recognised declines/changes in visual functioning with age, their contribution to the problems of older persons performing tasks in the natural environnement, including their driving, is less known (Kline et al 1992).

Wood & Troutbeck (1993) tried to explain elderly drivers' performance and accident characteristics by three kinds of visual impairments: cataracts, visual field restriction and monocular vision. The authors simulated the visual impairments on two groups of subjects, i.e. young and elderly with normal corrected vision by using goggles. The driving performance was assessed on a closed road circuit free of other vehicles. The results indicated that cataracts resulted in the greatest decrease in driving performance followed by visual field restriction, even through all drivers satisfied the visual requirement for driving. The decrease recorded with visual impairments on the driving performance was greater for the older subjects.

This kind of approach is limited to visual aspects, but more and more often, research work also takes into account cognitive and psycho-sociological factors.

As an example, Baldwin & Schieber (1995) try to assess age difference in mental workload in a driving simulator environment with the use of a subsidiary mental arithmetic task. The results indicated that as steering task difficulty increased, verbal response latency to concurrent mental arithmetic task increased more for the older subjects than for the younger. But, the authors stated that the secondary mental arithmetic task did not interfere with steering performance. This seemed to indicate that the older subjects keep their priority to the driving task, when they have to deal with another concurent task.

Some other work related to spatial localisation in a lane choice simulated driving task showed that uncertainty concerning the location of relevant information slowed decision-making speed proportionately more for the older subjects than the young who were involved in this study (Ranney et & Simmons, 1992).

An interesting approach was conducted by Tararnek et al (1993), and McCoy et al (1993). These authors tried to find cross correlation between driving performance and factors related to vision, visual perception, cognition, range of motion and self driving knowledge. The assessment route was designed to evaluate the subjects in situations where older drivers are most often involved in accidents, i.e. left turn and right angle collision at controlled intersections in urban areas. The analysis performed (both simple correlation and multiple regression analysis) showed that among vision factors, depth perception and peripheral vision (right field) expressed statistically significant correlation with the driving performance of the elderly subjects. Visual perception seemed also to have a greater impact on driving performance: Some older subjects might have good vision but lack the ability to use it effectively. Concerning the cognition aspect, it appeared that language skills, orientation, memory, attention and the ability to follow verbal instructions were most highly correlated with driving performance. The range of motion factors did not appear to be correlated with the driving performance of subjects. The authors explained that point by the fact that in

their driving situation, the traffic was low, inducing few lane-changes, overtaking, or colliion avoidance maneuvres.

These results were used to design counter measures to address the problems of older drivers. These were: physical therapy (home based exercises designed to improve posture, trunk rotation, neck and shoulder flexibility), perceptual therapy (home based exercises 20 minutes four times per week for 8 weeks), driver education (AAA safe driving for mature operator programme) and traffic engineering improvements (limited to signs, pavement markings and traffic signal displays). The subjects had to drive on the same route as the one used in the previous experiment; the effects of counter measures on the driving performance were obtained by the difference between the two scores obtained - without (first experiment) and with the counter measures. The results obtained indicated that the combination of perceptual therapy and driver education provided the greatest improvement followed by the combinations of traffic engineeering improvements with driving education and either physical or perceptual therapy. However, the differences observed were not statistically significant. The authors concluded that this new approach is promising and need to be more extended using a different sample of older drivers (more representative of the older population) and deeper traffic engineering improvements.

2.2 E&D Drivers/Travellers and ATT systems

2.2.1 E&D Drivers and ATT systems

The new trends in telematics technologies could be a good opportunity for offering driving aids to elderly and disabled citizens, so that they can drive without restrictions. However, there are very few data available regarding the needs of elderly or disabled people relative to on-board telematics services, the behaviour of these drivers when using an on-board telematic service, and also the benefits that elderly drivers could draw from these telematic services (Warnes et al 1993).

Any Advanced Transport Telematics system intended to improve the safety and efficiency of the already congested road network must be designed and evaluated with the older population in mind. Towards this end, the experiment conducted by Ashby et al (1994) investigated the ability of a group of older drivers (55+) to assimilate and retain messages presented on an in-vehicle visual display whilst driving on a busy UK motorway. The experiment utilised an in-vehicle information system developed by Jaguar Cars Ltd., to demonstrate the potential for using Short Range communications (SRC) to support ATT applications. The demonstration system shows information concerning approaching junctions and services, poor weather (e.g. fog ahead), or road traffic events (e.g. roadworks ahead). The results of this experiment can be directly compared with a previous study involving drivers between the ages of 19 and 35 thus allowing differences to be explored (Graham and Mitchell, 1994). The comparison showed that older subjects have more difficulty with complex messages but did not express significant problems in the recall of the messages task.
In Pohlman‘s tests (1994), drivers of different ages (35-50 years old, 61 years and older) took part in the study, which tested a marketable navigation system (Travelpilot). Driving and navigation performance, as well as mental workload and the acceptance of innovative technology, were investigated. The results showed that older and middle-aged drivers differ in only a few aspects. Both age groups reveal comparable results in driving. However, regarding the operation of the navigation system and concerning its

effectiveness, older drivers performed worse. Age-related differences being rather small, analyses revealed significant global differences between the navigation system and a common road map: usage of Travelpilot influenced driving behaviour negatively with respect to traffic safety. Also, the drivers' orientation was not any better using the navigation system. Concerning the acceptance of innovative technology, the authors stressed the openness with which the older subjects adapted to such a new technology; these results are also confirmed by the EDDIT trials.

Most of the works reviewed stress the need to take account of individual differences in drivers' abilities and special needs, and that these will influence both the input devices and the way the information is presented. It is suggested that the concept of 'modular' systems founded around a basic software/hardware combination could be a relevant approach (Ross & Burnett, 1996).

With increasing development in ATT systems designed to aid elderly and disabled drivers, it is suggested that it will be possible to have automated road vehicles which will meet the needs of a specific group of disabled drivers. For example, manual gear changing on road vehicles can be a mechanically and physically demanding operation for a disabled driver, especially in short intermittent driving conditions, and an evaluation of the driver's gear changing effort requirements could be incorporated into ATT strategy (Nwagboso 1994).

2.2.2 E&D Travellers and ATT systems

Since 1992, important work has been conducted in the framework of the TIDE programme. Among all the TIDE projects, the most relevant to improve the mobility of elderly and disabled people are the following:

The TIDE MOBIC project is developing a new travel aid to increase the independent mobility of blind and elderly travellers. This aid is built on the technologies of geographical information systems (GIS) and the Global Positioning System (GPS). The MoBIC Travel Aid (MoTA) consists of two interrelated components: the MoBIC Pre-journey System (MoPS) to assist users in planning journeys and the MoBIC Outdoor System (MoODS) to execute these plans by providing users with orientation and navigation assistance during journeys. The MoBIC travel aid is complementary to primary mobility aids such as the long cane or guide dog. The results of a study of user requirements showed that the essential information for the MoPS component included basic maps and routes, and the ability to dictate the level of detail required. It was desirable to have an option to add more detail including more on public transport, and to be able to request area maps or specific routes. Ideally, however, up-to-date information was required concerning transient obstacles, and also the user should be able to edit the journey plan with own comments and memos (Petrie & Johnson, 1995). The user needs for MoBIC following interviews with blind and partially sighted people identifed (aged 26 to 75 yrs) suggested the type of useful general information people wished to have in the MoBIC aid: directions to required destination (number of streets), name of streets, traveller's current location (direction currently facing), shops (especially with stands outside), information about current roadworks, pedestrian crossings (and whether it has an auditory signal), useful buildings and landmarks (eg banks and their ATMs), layout of environment (steps), street furniture (lamp posts), and useful items in the street (public telephones). The most popular output option was synthetic speech, with other sounds and vibratory information significantly less

popular. The MoPS component contains such data as: Map information obtained from public sources, timetables of buses, trains, etc., and information on special surfaces or suitability of routes (Strothotteet al, 1995).

The methodology used to evaluate MoBIC included measures of both performance and preference. Performance is assessed by considering the amount of time participants spend studying the map before setting off on their journey, the number of mistakes they make while actually walking the route and their walking speed. Heartrate is recorded using a heartrate monitoring device. Measures of anxiety are also recorded using the Spielberger State Trait Anxiety Inventory. Preferences of the user are measured using a 7 point Lickert scale and open ended questions (Petrie & Johnson, 1996). The evaluation report has not been yet edited.

The objectives of the TIDE OPEN project are to help blind or partially sighted people find their way on the metropolitan underground systems of London and Paris. The system consists of a series of beacons mounted at key points in each station and a receiver worn or carried by the blind or partially sighted person. Messages will be sent from the beacons to the receivers using modulated infra-red beacons. The system will help users find specific features of the underground system such as ticket areas, barriers, stairs, escalators, platforms and other obstacles (Stephens & Longley, 1995). As part of the user requirements capture of the OPEN project, data were collected from 20 Belgian, 40 UK and 30 French visually impaired users of the underground in Paris, London and Brussels. The most common problem concerned the difficulty of finding correct platforms, and most respondents had difficulty finding station entrances. In summary, the majority of all respondents said they would find the OPEN system useful for providing guidance (eg to find ticket offices, ticket machines, electronic and manual gates in station foyers, lifts, escalators, stairs) and information, and improving access to the underground railway systems (Gallon et al, 1995).

The TIDE SATURN project identifies and demonstrates how smart card systems can meet the needs of elderly and disabled people, e.g. by giving more time for operating the terminal, reducing the number of available operations, enlarging the characters on the screen, providing speech output of non-confidential information (Gill 1994, Balfour 1995). In the survey conducted by the SATURN project on users requirements, it noted that 92% of the elderly people interviewed had used public transport, but only 46% of them had used a ticket machine. All those were infrequent users and had not used one in the last month. People with visual impairments asked that the design of the interface, location, layout of terminal and functions be standardised; all card readers should accept cards with same orientation; and keypads should provide tactile feedback. They suggested that contactless smart cards (or smart cards which operate at a distance rather than needing to be inserted into a slot) could help them in finding locks, using keys, and in turning on audible signals and increasing crossing time at pedestrian crossings.

People with hearing impairments wanted all information presented visually, and wanted all public telephones to have text telephony capability with smart card access to akeyboard. People with intellectual impairments would like communication to be based on pictures in combination with spoken text, and expressed a preference for identification by fingerprint rather than the use of PIN numbers.

Problems with automated ticket and information services on public transport were concerned with the need for advance information, buying ticket self-service, finding

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correct platform, ascertaining destination, boarding train/bus/ finding a seat and knowing when destination is reached (Gill, ed., 1996).

In the framework of the TIDE programme, it is also important to present an experimental product, called Isaac, which aims to support people with cognitive impairments, and enable them to do more on their own. It combines in one unit a pen-based computer, a digital camera, a GPS satellite navigation receiver, and cellular phone channels for both voice and data. The mobile units are in wireless contact with a support centre providing assistance over the phone based on pictures, position data and other kinds of information managed by the system. Facilities include: a map, managed by a Geographical Information System, with the position of the user, and the ability to select pictures for guiding sequences and personal telephone directories (Jönsson & Svensk, 1995).

Other type of telematics applications can be used to improve the mobility of elderly and disabled people. For instance, Automatic Vehicle Location (AVL) and real-time passenger information systems are being installed in buses and bus passenger shelters in the UK as part of recent contracts between local authorities and passenger transport operators. The Bus Tracker System comprises in-vehicle computer units, roadside beacons, comunication links, a central operations computer and bus stop displays. Vehicle tags are activated as they pass transponders/interrogators sited along a route. The bus travelling public will benefit from the installation of illuminated displays at the bus stops, which will give real time data on route, destination and arrival times for approaching buses. For the visually impaired, the system will also incorporate a 'talking' display which will give arrival and route information when activated (Rivett, 1996).

Other examples are the Advanced Traveller Information Systems, which provide intermodal travel information prior to trips. The market for this type of system is considered broad, but will depend on the variety and value of the information provided and the ease with which it can be accessed. Guthrie and Phillips (1995) stressed that this and other systems could be modular, allowing users to purchase systems to match individual requirements.

Arnold et al (1994) conducted a study with the objective of facilitating travel for people with sensory and cognitive disabilities, on-board public transportation vehicles, through the adoption of new and existing technologies. Several methodologies were employed and task analysis techniques were used to determine the information requirements of travellers. The effectiveness of information systems on-board existing vehicles was assessed by applying human factors knowledge, conducting travel observations with experienced travellers with disabilities and travel simulations with inexperienced travellers with disabilities. Promising technologies for improving information provisions were gathered, reviewed, and studied for suitability for implementation on-board the different vehicles. The results indicated that information systems on-board vehicles need to be improved in order to assist travellers with sensory and cognitive disabilities. Recommendations formulated by the authors took three forms: improvements to existing systems, the application of appropriate technology, and improved sensitivity training for staff.

Other telematics applications are the VTX, or teletext, systems which exist in Europe already and offer a large number of services from home, eg home shopping, home

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banking, ordering of special transport services, classified advertisements, etc. However, there is some evidence that knowledge about these services is not widespread, especially among the groups of elderly or disabled people. Moreover, the use of the system is very often a difficult task that needs good explanation and guidance. Risser & Stahl (1993) analysed these problems as a main concern for experts that develop and implement different telecommunication services. Especially as far as information to potential users of services on all levels is concerned, much work has to be done. Among other things, the conclusion of the authors stressed that these experts should be better trained and instructed in order to be able to meet the information needs of customers.

Concerning the Automatic Teller Machine (ATM), Jönsson (1993) outlined the problems disabled users face today with these systems: positioning of the equipment not suitable for people in wheelchairs or easy enough for visually impaired to find it, design does not take into consideration people with poor eyesight (eg display, instructions and text are small, illumination and contrast poor), complex procedures or extensive instructions, muscle strength or a twisting movement sometimes required, inconsisency from one machine to the next. He emphasised the importance of taking these problems into account in future development work and also suggested that information be stored in smart cards so that it will adapt itself to the individual needs of the users.

Remote control devices could be interesting for people with mobility impairments to interact with fixed terminals, but, the design of such remote controls should take into account elderly and disabled users' specific needs. In the study of Mann et al (1994), two prototype remote controls and two commercially available remotes were tested for user speed, accuracy and satisfaction. The prototype remotes had large buttons, large numbers and characters on the buttons, and high colour contrast between the buttons and background. One remote had 15 buttons and one had 6 buttons. One of the commercially available remotes had small buttons, small print, and more features. The other had somewhat larger buttons, but still smaller than the prototypes. Thirty people over 60 years of age with fine motor and/or some visual impairment took part in the study. Results indicated a significant difference among the remotes in number of errors made. They made the fewest number of errors on the 15-button prototype. There were also significant differences in user satisfaction: users preferred the 15-button prototype. There were no significant differences in speed. Almost 3/4 of the sample desired fewer features and larger buttons.

People with hearing impairments are not very often included in evaluation or experimental work. This is why the study conducted by Geehan et al (1992) is interesting. These authors studied assistive listening devices (including infrared, AM and FM broadcast systems, and induction loop systems), which are sound reinforcement devices designed to facilitate better understanding of speech by persons who are hard of hearing. They compared four types of assistive listening devices with respect to existing applications, sound reception, power requirements, receiver requirements, coverage area, flexibility for expansion, and cost of installation. The results showed that the induction loop system was the most viable one for applications in air transportation terminals. It also suggested that there were 3 locations within an airport terminal where different information was required and where a loop system would be useful to people who are hard of hearing: around a ticket purhase/check-in counter, in the waiting area/cafeteria area, and at the boarding gates.

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In this field, several reports from Sweden (National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992; National Swedish Board for Consumer Policies and the Swedish Handicap Institute, 1995) discussed the problems elderly and disabled people have with self-service machines with respect to various application areas: banking and payments, sales and distribution, travel and transport and telecommunications). These reports constitute a great amount of data, guidelines and recommendations, and are difficult to summarize in a brief literature review. Most of the recommendations and guidelines formulated in these documents, and others in this literature review, are under consideration by TELSCAN for testing or inclusion in the TELSCAN guidelines handbook.

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3. Travelling Task

3.1 Travelling Task Model

3.1.1 Purpose

The Travelling Task Model (Figure 2 overleaf) began the *descriptive analysis* of the constraints of the travelling task within the TELSCAN project. It served two main purposes:

- To describe the main travelling tasks for the various modes of travel, and to reduce these tasks into sub-tasks, and
- To match current Transport Telematic projects into tasks and sub-tasks to enable TELSCAN to select at least one project/type of system per task to be further analysed and tested (for example, the SAVE and IN RESPONSE projects for Emergency Warning and Support Services, and SAVE / AC-ASSIST for Vehicle Control systems).

The first objective, to describe the main travelling tasks, led to discussions within the Consortium as to how to turn the Model into a data collection tool which could be used to analyse the functional needs (*functional analysis*) of elderly and disabled travellers. Such a data collection tool could also be used to conduct a *dynamic analysis* of the travelling task, through observation of more detailed components, or prompts, of the task with user groups (See Section 5.4). All of these requirements led to the adoption of the Definition of the Travelling Task, as described in Section 3.2 below.

3.2 Definition of the Travelling Task

3.2.1 Purpose

During data collection with experts and with users, the Definition of the Travelling Task was used as a tool to ensure that all relevant components of the travelling task were considered. As with the E&D Classification, the Travelling Task can also provide a structure for TELSCAN reporting, and later in the project for keyword searching within the database of guidelines.

3.2.2 Development

The Definition of the Travelling Task started as a checklist to describe travel problems for disabled commuters (Hekstra, 1995). From literature and expert opinion, an overview of the accessibility of the transport modes, (taxi, multibus (bus with a kneeling system), bus, train and tram) was generated concerning the limitations in travel by disabled commuters. This checklist related the travelling task to 11 user groups, divided over sensory, motor/anthropometric, physical, and cognitive categories. It was then developed more explicitly with respect to accessibility and safety of public transport for mobility impaired travellers (mainly wheelchair users), as a tool to visualise any obstacles in the transport chain and to formulate conceivable solutions in the short, medium or long term (Veenbaas, 1996). The extension of the checklist and the definition of conceivable solutions was part of a project in which user group transport companies (taxi, bus, rail, metro and transport on demand) were involved. The extension of the checklist was based on literature and was discussed extensively within

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the project. For TELSCAN the Definition of the Travelling Task has been extended with respect to telematic aspects based upon expert opinion and literature. Additional modes of travel were also included (i.e. transportation by ship and by airplane), as well as additional sub-tasks and relevant 'country specific' travel aspects where appropriate. The driving task which has been described extensively within the earlier European TELAID project was added to the Travelling Task. Finally, the Travelling Task was divided into separate “checklists” for each mode of travel to facilitate data collection.

Insert Travelling Task Model

3.2.3 Description

The Definition of the Travelling Task is shown in its entirety in Appendix 5. It is structured into the following sections, preceded by an overview which indicates those parts of the travelling task relevant to each mode of transport.

Table 1: Overview of the Travelling Task

DRIVER	**PASSENGER**						
I	**II**		**III**				
Private transport	Private transport	Special transport	Public transport				
car/van	car/van	car/van/ minibus	taxi	bus/tram	metro\ train	ship	airplane

As noted above, the Travelling Task was divided into separate "checklists" for each mode of travel to facilitate data collection. A supplementary version of this Definition of the Travelling Task was also provided to each of the partners, thus allowing more space for writing notes during the interview process. Sections I and III of the Travelling Task (but not including taxi) have been covered in the results below in Section 8, for the reasons given in Section 5.1 below.

4. E&D Functional Classification

4.1 Purpose

The Functional Classification for Elderly and Disabled Travellers serves a number of purposes, but the first one was to identify the range of impairments to be considered in the identification of user requirements.

During data collection with experts, the E&D Classification was used as a tool to ensure that every impairment group was considered. During data collection with elderly and disabled users, the classification was used to help choose a range of impairments to invite to the focus group interviews and to define the boundaries for each interview group. As well as forming part of the data collection methodology, the Classification can provide a structure for TELSCAN reporting and later for keyword searching within the database of guidelines. For example, the E&D Classification can be used to provide examples of good practice so as not to exclude people with particular types of disabilities.

The Classification also provides a structure for other Transport Telematics projects to identify and capture requirements, evaluate their product/service with the relevant E&D groups, and ensure that E&D are not excluded from using it. TELSCAN and each individual project can then use the Classification to report the impact of their results, and the costs/benefits of particular ATT systems on different categories of elderly and disabled people.

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4.2 Development

The development of the E&D Functional Classification began with the DSN (drivers with special needs) classification within the TELAID project (Nicolle et al, 1992). TELSCAN's classification was re-designed to bring it more in line with the International Classification of Impairments, Disabilities and Handicaps (World Health Organisation, 1993). It follows the accepted relationships:

Disease ⟶ Impairment ⟶ Disability ⟶ Handicap

where

an impairment is any loss or abnormality of psychological, physiological, or anatomical structure or function,

a disability is any restriction or lack (resulting from an impairment) of ability to perform an activity in the mannner or within the range considered normal for a human being,

a handicap is a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfilment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual.

We are not concerned with the disease, or cause of the impairment. As in the TELAID classification, TELSCAN's classification is a functional classification, as the same types of problems would be identified, for example, for a person with an impairment in the lower limbs, whether caused by an accident as a child or arthritis in old age. For this category of impairment, potential areas of difficulty whilst travelling could include, for example, reaching departure points for transport, the length of time required for transfer between modes of travel, waiting for, or embarking/disembarking from public transport.

4.3 Description

The E&D Functional Classification is shown in its entirety in Appendix 4, and is in itself a description and definition of the impairment groups considered in data collection. The Classification is structured under three columnar headings:

Impairment
Disability, and
Potential Areas of Difficulty/Need whilst Travelling

An overview of the E&D classification is given below, indicating in upper case the impairment categories defined by the World Health Organisation. Those groups in the shaded boxes were the target of this data collection, in order to cover a range of skeletal, sensory, communication and cognitive functions.

By including elderly people as a separate category in the data collection, in effect we covered a wider range of impairments (for example, a loss in co-ordination, dexterity or force) and a gradual deterioration in other impairments, (for example, vision and hearing) - See Section 5.1 below.

Table 2: Overview of the TELSCAN E&D Functional Classification

Impairment	Disability	Potential Problems
SKELETAL - Motion of lower limbs	eg, Cannot walk	eg, Reaching departure points
SKELETAL - Motion of upper limbs	eg, Cannot use arms	eg, Use of ticket machines
SKELETAL - Motion of upper body	eg, Cannot turn head/neck	eg, Restricted scanning of environment
SKELETAL - Anthropometrics	eg, Short stature	eg, Reaching ticket machines
SKELETAL - Co-ordination/dexterity	eg, Difficulty using hand controls	eg, Using small buttons/ knobs
SKELETAL - Force	eg, Reduced force in arms/hands	eg, Opening doors
VISCERAL	eg, Sudden loss of consciousness	eg, Obtaining help
VISION	eg, Blind or reduced vision	eg, Obtaining written information
HEARING	eg, Total or partial deafness	eg, Hearing announcements
LANGUAGE AND SPEECH (Communication)	eg, Cannot read or speak	eg, Obtaining travel information
INTELLECTUAL/ PSYCHOLOGICAL Cognitive Functions	eg, Difficulty with new tasks or in decision making	eg, Operating new technology

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5. Data Collection Methods - for travellers

5.1 Aim and Method

Our aim was to identify the requirements of elderly and disabled (E&D) travellers using different modes of transport, with special emphasis on ATT systems. The Definition of the Travelling Task (See Section 3.2 and Appendix 5) includes the following modes of transport:

Table 3: Overview of the Travelling Task - Emphasis of present study

DRIVER	**PASSENGER**						
I	**II**		**III**				
Private transport	Private transport	Special transport	Public transport				
car/van	car/van	car/van/ minibus	taxi	bus/tram	metro\ train	ship	airplane

The requirements of E&D *drivers* had already been identified through the work of the TELAID and EDDIT projects. The result of matching those user requirements can be found in Appendix 2. Our aim was now to update and broaden our previous studies (Section I in Table 3 above) and concentrate on the requirements of elderly and disabled travellers using different modes of transport (Section III in Table 1 above), with special emphasis on ATT systems. Although driver-related issues were not the emphasis of this data collection, certain issues were raised which served to update the TELAID/EDDIT user requirements.

Section III in Table 1 above, rather than Section II, was emphasised for the following reason: If an E&D person were travelling as a passenger in private, special transport or by taxi, it is usually the case that another person is available to provide assistance with most required tasks, which will have an effect on related problems and constraints. This current data collection therefore concentrated on E&D travellers using buses/trams, metros/trains, ships and airplanes, because it would be more likely that the E&D traveller could be travelling alone and requiring other forms of human and/or technical support.

Following the Cascade Model of Data Collection, as used in TELAID (Nicolle et al., 1992, and shown in Figure 3), we identified and interviewed relevant experts who could help us understand the requirements of E&D (e.g. transport authorities; customer services for airports, ships, rail stations and bus stations; and various associations and advocates for the elderly and people with disabilities). Focus groups and individual telephone interviews were later held with E&D travellers from different impairment groups. Some of these travellers were then invited to participate in field observations with a particular system to provide a finer level of detail on their special needs and constraints. This completed the third level of the cascade model.

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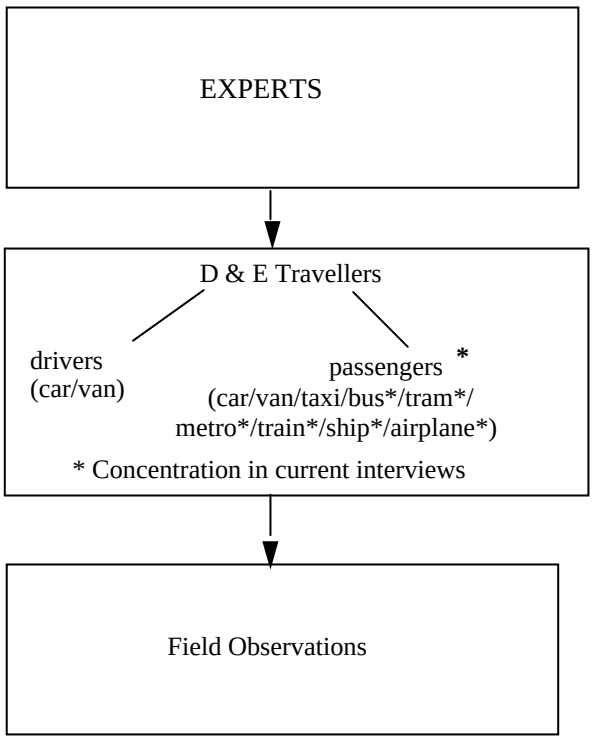
Figure 3

Cascade Model for Data Collection



The Functional Classification of E&D Travellers (See Section 4 and Appendix 4) was used to help us select a range of impairment groups to include in the interviewing process, and also as a prompt when speaking with experts. Due to resource limitations, it was decided that each partner in the workpackage should concentrate on one user group, identified with the aid of the E&D Functional Classification and agreed with the other partners. The selections would cover a range of physical, sensory and cognitive types of impairments, with the resultant disabilities and potential areas of difficulty whilst travelling.

Cranfield -	Skeletal - Motion of lower limbs
HUSAT -	Vision
INRETS-Lesco -	Hearing
	Language and Speech (Communication)
UTL/FMH -	Intellectual/Psychological/Cognitive
Lund -	Elderly

Following a functional classification, it is clear that elderly people do not form a separate group for data capture or analysis. However, expert opinion suggests that the requirements of an elderly person with mobility problems can be very different from a young wheelchair user, both in the type of assistance required and whether or not it is even thought necessary (for example, see interview with the Train Supervisor, Appendix 3.A, top of page 74). For this reason, TELSCAN included further

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investigation specifically on the needs of elderly travellers, covering a gradual deterioration of physical, perceptual, and cognitive abilities. This also enabled a wider coverage of impairments from the Functional Classification, including for example, a loss in co-ordination, dexterity or force, and the resultant difficulties in using an information system (See Appendix 3.C, Observations).

5.2 Data collection with Experts

Much knowledge already exists through the Consortium's previous work, through the literature and through earlier and on-going projects across the Telematics Applications Programme and other programmes. To supplement this data, selected individual interviews were held with experts, covering a range of special requirements for E&D travellers in relation to ATT systems (See Appendix 3.A). This data has been summarised in the presentation of results (Section 8 and Appendix 6).

5.3 Data collection with Users

The method of gathering data from users was mainly through focus group interviews. Telephone interviews were also conducted with people with lower limb impairments to increase the sample size, as they comprise 51% of the disabled population. This high percentage had been one of the main reasons that people with lower limb impairments had been the subject of the TELAID simulator testing (Veenbaas, October 1995).

The focus group, or roundtable discussion, is a type of group interview used in order to quickly obtain opinions on a certain topic which can then often be employed as the basis for further analysis (e.g. in-depth interviews). The size of the group usually varies from 5 to 10 people. The presumption is that in a group of this size there are usually a couple of people who express themselves easily and can talk in a group, thereby inspiring the other participants to speak up. The composition of the group also offers some possibilities for stimulating interest and opposing views by producing provocative opinions.

Thus the round-table discussion is used in situations in which

- one aim is to quickly obtain broad information about the potential features involved in a specific topic and
- another aim is to achieve a situation in which the interviewees are inspired to express both factual and emotional opinions without major impediments (social facilitation).

Roundtable discussions can be conducted in various ways, from the very structured, in which everyone, in a designated order, expresses themselves on a well-formulated issue, to the very open, where only one clue is provided (certain main points) and the discussion is allowed to take its own course. The form chosen for the discussion depends in part on the leader's own confidence about the topic at hand, i.e. if s/he knows, and has also decided in advance, what topics are to be broached, or if s/he contemplates what features might be relevant to take up as the discussion is underway.

For both the TELSCAN focus groups and telephone interviews we chose a combined form:

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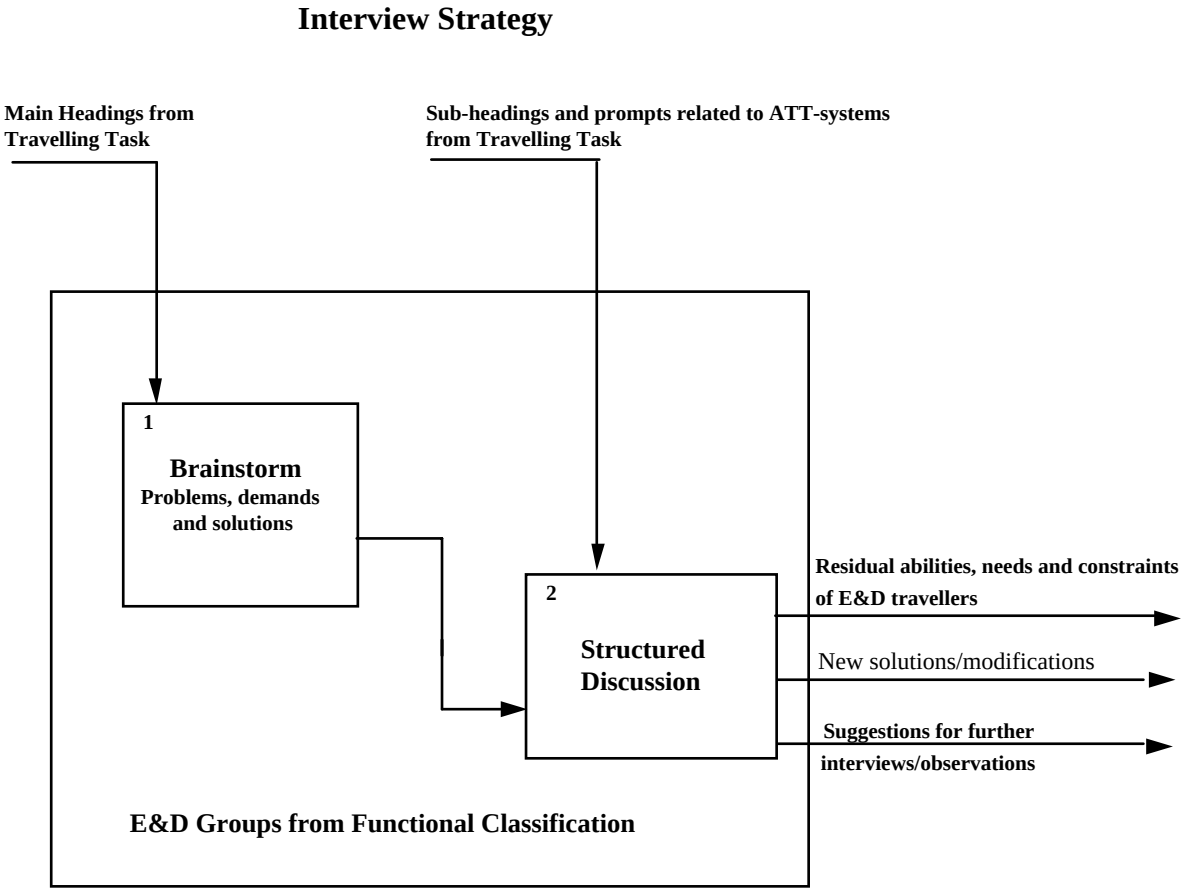
- brainstorming on the main headings of the Definition of the Travelling Task focusing on problems and demands, and then

- a more structured discussion, using selected subtasks and prompts, with particular emphasis on the impact of ATT-systems.

An overview of the strategy for the interviews is given in Figure 4 below.

Figure 4



This method would elicit problems, wishes and requirements with the overall travelling task, and then highlight any requirements specific to ATT systems, suggesting new solutions or possible modifications to existing systems.

Three outputs would emerge:

- clarification of the needs and constraints of E&D travellers,
- new solutions or modifications to existing systems, and
- suggestions for further interviews or observations.

all resulting in (Section 8 and Appendix 6):

- a specification of user requirements, in general and those specific to telematics, and

- to what degree advanced technologies fulfill the requirements of elderly and disabled travellers

Given time constraints, it was possible that we would not get through all the modes of public transport. In order to identify the areas of most concern, focus groups would identify and discuss the reasons for choosing or not choosing a certain mode of transport, noting what might make that mode of travel easier or more suitable for their

needs. It would then be clearer which modes of transport and/or which type of ATT-systems to focus on for that user group. For example, in the focus group with blind travellers (See Appendix 3.B), the users were asked to identify the modes of public transport they used and the relative frequency of travel, which helped to indicate trains and buses as their priorities:

9 travelled on buses regularly (local trips only)
9 travelled on trains (for longer distance trips)
8 have travelled on a plane at some time (just on holiday)
8 have travelled on a ship at some time (just on holiday)

The focus groups covered:

- the problems people with different types of impairments have when using a specific mode of public transport
- to what extent these problems might be overcome using advanced technology systems
- the types of existing advanced technologies users are aware of, and the special requirements of elderly and disabled travellers when using those systems
- Suggestions for improvements or new solutions to make travelling easier

The following Figure 5 provided some additional prompts for interviewers when discussing specific components of the travelling task, but it was not intended that the "answer" boxes were actually completed for each prompt.

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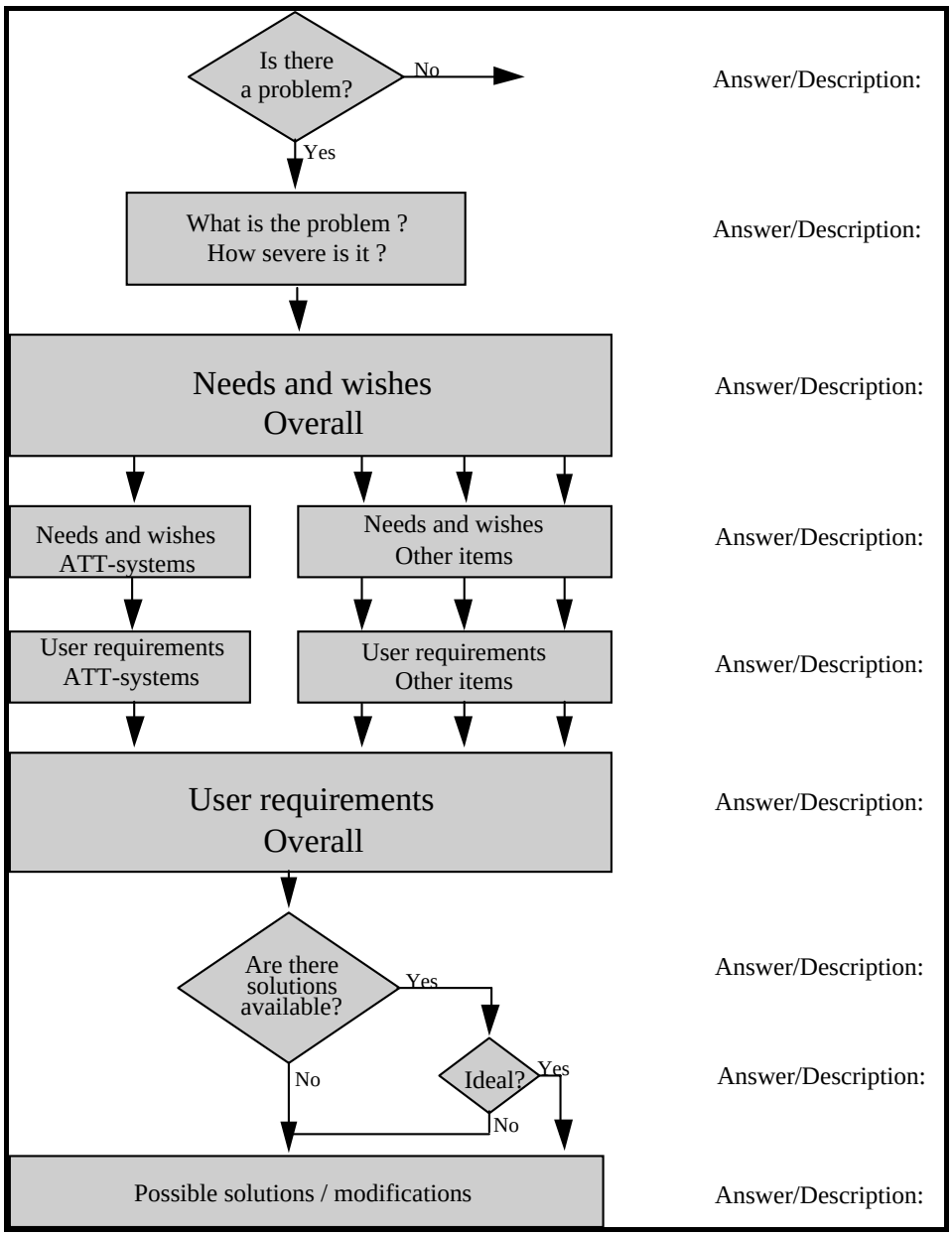
Figure 5

Level of detail for interviews and focus groups

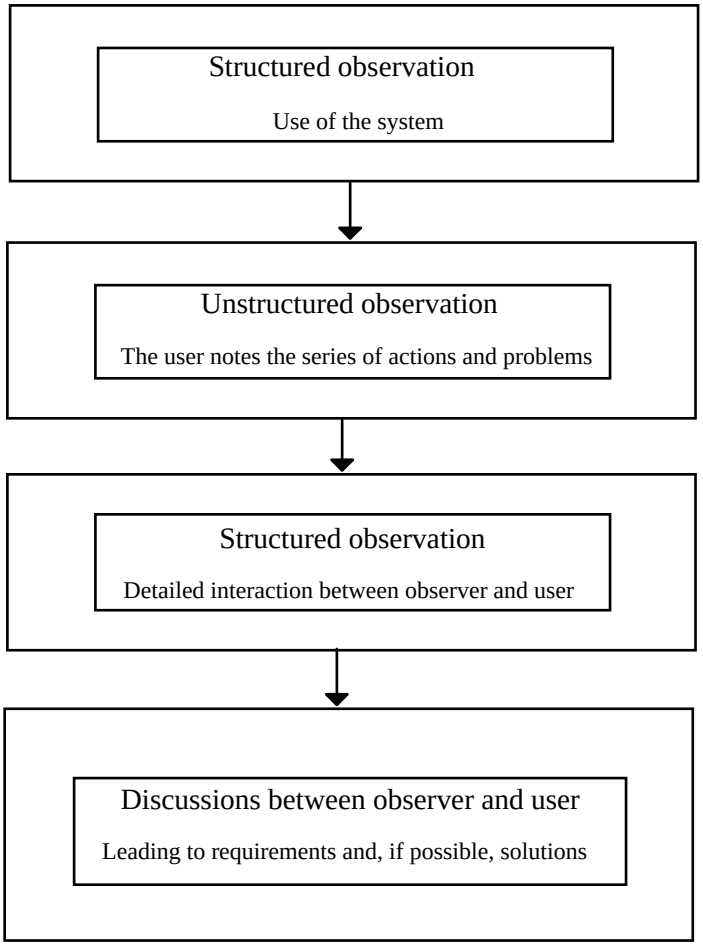


5.4 Observations

Each partner tried to select one ATT-system related to public transport, already in use in their country for direct observation of E&D users. For example, Lund chose a PC-based system in a public hospital for traffic information on how to travel between destinations with public transport (Appendix 3.C).

Figure 6

Observation strategy



Following the strategy in Figure 6 above, the observation of an information system with elderly users (Appendix 3.C) involved 3 stages:

- The first stage contained a highly **structured** element. The interviewees were asked to try to use the information system.

- The second stage was extremely **open**. In connection with testing the system, the subjects were asked to register everything they thought was disturbing or difficult and make a note of it without any pre-structured questions being provided.

- The third stage was once again **structured** in the form of role-playing, in which the task was to purchase a ticket.

The results of the group's constructive work, their viewpoints, suggestions and ideas can in all probability be used and have valuable significance for a future development of information systems of this kind. Specific recommendations can be found in Appendix 3.C.

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Further observational studies are still being arranged, as TELSCAN was dependent upon the evaluation timescales of other projects. A particular example involves an observation of an information system with blind travellers. As there was no telematic system within a feasible distance of the focus group location, HUSAT has accepted an invitation to observe an evaluation conducted by the TIDE OPEN project (Stephens and Longley, 1995) which is developing a system to help blind or partially sighted people find their way on the metropolitan underground systems of London and Paris. The system will be installed in the underground stations during January/February 1997 and it is anticipated that user trials will take place during March and April 1997.

Another observation under consideration is the interface of Tesco Stores' "Fastcard" service. Tesco, the largest supermarket chain in the UK, has recently introduced in some of its petrol filling stations a system whereby customers can pay, by credit / debit card, for their fuel at the pump. The facility, known as “Fastcard”, provides a means of allowing staff to read information from the card, effect the transaction and issue a receipt, without the customer having to leave the pump. In spite of the obvious attractions such a scheme might have for drivers who are elderly or have a disability, Fastcard is not currently marketed as such, and the extent to which it is accessible is not yet known. Cranfield University has therefore contacted Tesco to obtain permission to carry out observations of Fastcard to see how users with disabilities interface with the system.

Among the issues to be considered will be:

- the ease with which users can approach the facility at the pump (ie. is it mounted on a plinth, like the pumps themselves?),
- the position and operability of the call button which informs staff of a customer’s intention to use the Fastcard facility,
- human factors issues concerning the means of placing the card into a card reader mechanism,
- the ease with which users are able to write their signature in the appropriate place,
- the ease with which users can locate and collect their receipt and card,
- the legibility and clarity of instructions on usage,
- security issues.

Such future opportunities for observational studies will contribute towards the updating of user requirements (to be included in the future Cost-Benefit Analysis). These observations will also capture design guidelines and recommendations emerging from other programmes which will form part of the TELSCAN Code of good practice handbook with ATT design guidelines/standards for E&D drivers and travellers (Deliverable 5.3).

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6. Matching User Requirements from TELAID and EDDIT - for drivers

The requirements of E&D *drivers* had already been identified through the work of the TELAID and EDDIT projects (See especially Nicolle et al, 1993, and Oxley et al, 1992). Following a functional classification (See Section 4), we can see that the same types of problems can be identified, for example, for a person with a skeletal impairment, whether caused by an accident as a child (the emphasis of TELAID) or arthritis in old age (the emphasis of EDDIT). Thus, all potential areas of difficulty whilst driving have been described for each impairment group following the E&D Functional Classification.

The result of matching the user requirements from TELAID and EDDIT can be found in Appendix 2. This data was slightly updated following TELSCAN's data collection with experts and users, and then all the driver-related issues were integrated with the final inventory of user requirements (Section 8, with full results in Appendix 6).

Telematics forms the emphasis of this study; however, certain tasks are still included which the Consortium do not consider ATT-relevant. As can be seen above in Figure 5, eliciting the problems and demands of the users captured the needs and wishes overall, and only then identified those areas which are particularly relevant to ATT. To lose more general requirements could mean a lost opportunity for new system ideas which TELSCAN would wish to investigate in future.

7. Survey of Existing and Prospective E&D Travellers' Aid Systems

A survey was conducted of existing and prospective E&D travellers' aid systems with particular emphasis on telematics. The survey identified the aids using the following techniques:

- The review of current transport telematics projects
- TELDAT, the TELAID project's database of technical aids for drivers with special needs
- State of the art literature review, as described in Section 2
- Interviews, contacts and consortium experience

The sources identified systems in use or currently being developed specifically for elderly and disabled people or which would have particular benefits for them (eg from the TIDE programme).

The inventory (in Appendix 1) indicates if the development of the system has considered E&D issues, which ones are particularly relevant to TELSCAN, and further detail when that information is available. The systems are grouped under the following headings:

Under development in current telematics projects
- For Travellers
- For Drivers

Other Continuing R&D
- For Travellers - Specific systems
- For Drivers - Specific systems (Examples only)
- For Drivers - Generic systems

Under development specifically for E&D
- For Travellers - Specific systems
- For Travellers - Generic systems

Currently in use
- For all Travellers - Specific systems
- For all Travellers - Generic systems
- For E&D Travellers - Specific systems
- For E&D Travellers - Generic systems
- For all Drivers - Generic systems

As the emphasis of this work is ATT systems, car adaptation aids for disabled drivers are not repeated here but can be found in the TELDAT database of technical aids for drivers with special needs, developed during the TELAID project.

Those specific systems under the heading "Continuing R&D for Drivers" are provided only as examples. In this document it would be considered misleading to try to list all the manufacturers that are conducting research/development towards new products. They are so quickly changing and much information is not available due to commercial in confidence considerations.

The inventory of existing and prospective systems has been matched with the inventory of user requirements, forming the final results of this deliverable. For each user need in the Inventory of Requirements (Section 8, with the full results in Appendix 6), we consider to the best of the authors' knowledge if there is an ATT solution available, and if so, the number of the system from the survey is given. This may be an existing system, or if the system is currently under development the numbered system will provide simply an example of where research and development is taking place. This matching process results in a clearer indication of areas where existing solutions are available to meet user needs, where gaps exist, and where there is perhaps not even a prospective solution under development.

This system inventory will be further developed and updated during Workpackage 3, as research results emerge from other projects and new systems are identified. In Deliverable 3.2, a matrix will be developed grouping systems according to their product or service functions. The functions will be more clearly defined according to their relevance for special attention for elderly and disabled travellers, following the categories of the E&D functional classification. It will then be possible to suggest where more integrated solutions are possible to enable E&D travellers to more effectively fulfil all components of the travelling task. All these activities will lead to contributions and refinements to the TELSCAN code of good practice and handbook of design guidelines for ATT systems to ensure that the systems meet users' requirements.

8. Results: Matching E&D travellers requirements with Existing/Prospective Systems

8.1 Summary of the process

The identification and updating of user requirements of elderly and disabled travellers has resulted in a specification of user requirements, in general and those specific to telematics, for elderly and disabled travellers (for the 5 groups included in our current data collection). It also indicates to what degree advanced technologies fulfill the requirements of these elderly and disabled travellers. Of course, many of the problems identified are concerns for every traveller, but particularly for certain impairment groups in varying degrees of severity and for different reasons. This will be discussed further in Deliverable 3.2 to include all groups from the E&D Functional Classification.

The Inventory of Requirements for Elderly and Disabled Travellers is found in its entirety in Appendix 6. It combines the matching of user requirements from TELAID and EDDIT (Section 6), data collection with experts and users, observations with users (Section 5), and Consortium expertise. The table indicates if there is an ATT system available, to the best of the authors' knowledge, to meet a specific requirement, and if so, it refers to the numbered system in the inventory of existing and prospective E&D travellers aid systems (Section 7 and Appendix 1). In most cases, this is only one example of an existing or prospective system to meet a particular user requirement, and is not meant to be a comprehensive summary of all the systems in the inventory thus far which will meet this requirement. New solutions or modifications to existing solutions are proposed where suggested by the experts or users during the TELSCAN data collection process, and are considered realistic options for the foreseeable future.

During Workpackage 3, the survey of systems will be expanded through further literature and project reviews. This will lead in Deliverable 3.2 to establishing a matrix where all product functions will be grouped in relation to their relevance to the needs of elderly and disabled travellers, covering all the groups in the E&D functional classification. It will then be possible to suggest where more integrated solutions are possible to enable E&D travellers to more effectively fulfil all components of the travelling task.

The potential of ATT systems to resolve travellers' problems forms the emphasis of this study; however, certain tasks are still included which the Consortium do not consider ATT-relevant. As can be seen above in Figure 4 (Section 5), eliciting the problems and demands of the users captured the needs and wishes overall, and only then identified those areas which are particularly relevant to ATT. To lose more general requirements could mean a lost opportunity for new system ideas which TELSCAN would wish to investigate in future.

8.2 Summary of the Data

8.2.1 Car/van

A matching of requirements for disabled (from TELAID) and older (EDDIT) drivers provided the majority of the results for this mode of transport (Task A3.1). A comprehensive set of requirements can be found in Deliverable 3 of the TELAID project (Nicolle et al., 1992) and the Final Report of the EDDIT project (Oxley and Mitchell, 1995). The following emphasises the key points from these deliverables, and from further findings from the TELSCAN data capture specifically in relation to telematic systems.

Skeletal - Motion of lower limbs
Travellers with mobility-related impairments experience a number of problems in driving cars/vans, which are relevant to ATT systems, for example:-

- Trip planning - obtaining relevant information, turning pages of maps
- Toll collection - passing money through windows at toll plazas
- Primary vehicle control - turning body when viewing gaps in traffic (particularly when entering traffic, e.g. T-junctions)
- Secondary controls - finding, reaching, overload on limbs and residual mental capacity
- Vehicle maintenance - paying for fuel
- Trip information - overload on residual mental capacity, looking for information to side of road
- Parking - turning body to look behind, using ticket machines

Navigation systems/ travel and traffic information systems have the potential to benefit drivers in many of these tasks. Gap acceptance systems, speech recognition systems and parking aids may also be useful to drivers within this impairment group. The use of smart cards may enable disabled people to pay tolls, fuel costs and parking fees without getting out of the vehicle.

Vision
People with severe visual impairments cannot/are not permitted to drive. However, there are several forms of visual impairment which are permissible (e.g. reduced visual acuity, colour blindness, glare sensitivity). The visually-impaired driver subsequently has problems in the following areas:-

- Trip planning - understanding colour coding for maps
- Secondary controls - finding controls, particularly when driving at night
- Navigation tasks - seeing road signs/street names, estimating distances
- Judging gaps and viewing indicators (most important when entering/ leaving traffic and overtaking other vehicles)
- Driving in poor weather conditions (fog, heavy rain, snow etc.)
- Parking - estimating gaps between objects

A number of different ATT systems may aid in visual-related elements of the driving task, and thus aid the visually-impaired driver, e.g. in-vehicle navigation, gap acceptance, speech recognition, collision avoidance, parking aids, and vision-enhancement. However, visual accommodation between an in-vehicle display and the road ahead may cause problems for drivers with some of these systems.

Hearing/Language and Speech
Drivers in this impairment group experience numerous difficulties which are relevant to ATT systems, for example:-

- Trip planning - reading any text within travel information sources
- Hearing information relevant to the driving task (e.g. engine noise, indicators, warnings, other traffic)
- Navigation tasks - reading road signs, hearing directions from passenger
- Obtaining up-to-date traffic/weather information (e.g. radio)
- Using emergency phones, particularly on motorways

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ATT systems such as in-vehicle navigation, travel and traffic information, tactile feedback and emergency alert will be of assistance to drivers within this impairment group, if the interfaces are designed appropriately.

Intellectual/Psychological/Cognitive
The limitations that drivers with cognitive impairments have in general information processing and memory functions have a number of implications for aspects of the driving task, for example, use of complex spatial information (e.g. a map), reacting to the sudden appearance of hazards, driving over bridges and/or through tunnels (due to phobias), estimation of the speeds/distances of the surrounding traffic, navigating in an unknown area, lining up car with kerb when parking. Well-designed, easy-to-use ATT systems have the potential to aid drivers within this impairment group, for example in-vehicle navigation, collision avoidance and parking aids.

Elderly
Elderly drivers experience many of the same problems encountered by individuals within the other impairment groups. For example, in using maps, entering and leaving traffic, driving in poor weather conditions, finding their way in unknown areas, locating secondary controls (particularly at night), looking behind and estimating gaps when parking and using phones in the event of emergency/ breakdown. Various ATT systems have the potential to help the older driver, for example in-vehicle navigation, gap-acceptance, vision-enhancement, speech recognition, parking aids and emergency alert.

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8.2.2 Bus/Tram

Skeletal - Motion of lower limbs
For this mode of transport, travellers with mobility-related impairments experience greatest difficulties in entering and exiting from the bus/tram. As was found to be the case for most modes of transport in relation to this impairment group, ATT systems do not offer relevant solutions for such access problems, and current practices generally suffice or should be further extended, for example low-floor entrances/exits. ATT could assist by ensuring that relevant information on accessibility, etc., is available to make decisions, eg in trip planning.

Vision
Travellers with visual impairments experience numerous difficulties when using buses and/or trams. Timetables (whether on paper or at a stop) often utilise very small text, and it may be difficult to identify whether the desired bus/tram has arrived at a particular stop. ATT systems which utilise a speech input/output interface are of greatest relevance to this group and already exist in some countries.

Hearing/Language and Speech
Travellers with hearing, language or speech-related impairments encounter numerous difficulties in planning a bus/tram journey and buying a ticket. Furthermore, dealing with changes in the bus/tram schedule can be a particular problem, as they are usually through auditory announcements. ATT systems which employ spatial forms of communication (e.g. symbols, icons) will be of greatest relevance to this group and are under development within the current Telematics Application Programme.

Intellectual/Psychological/Cognitive
As a result of the numerous limitations that travellers with cognitive impairments possess (e.g. information processing and memory functions), the use of all modes of transport can be particularly difficult. With respect to buses/trams, individuals can encounter specific problems in various aspects of:-

- trip planning (e.g. deciding when to travel, what bus/tram changes are required, understanding timetables),
- ticketing (e.g. using machines, communicating with the driver),
- access (e.g. locating correct stop and incoming bus) and
- trip information (e.g. identifying the correct stop, dealing with changes in the bus/tram schedule).

A number of ATT systems under development are being designed to aid in alleviating such problems (e.g. computer-based trip planning systems, hand-held information systems, smart card payments).

Elderly
Many of the problems that elderly travellers face when using buses/trams are also encountered by individuals with specific impairments, notably skeletal (lower limbs), vision and/or cognitive. For example, difficulties arise when planning a trip, using ticket machines, reading timetables, identifying the stop and incoming bus/tram and entering and exiting the bus/tram. Elderly people also encounter some particular problems - travelling to and from the stop, waiting at stops and coping with bus/tram movements during the journey. Modifications to vehicles and the road environment are the only feasible solutions to some of the above problems. However, various ATT

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systems have the potential to aid elderly people in other aspects of the travelling task, for example, trip planning systems, smart card payments and information systems at the bus/tram stop and on the bus.

8.2.3 Metro/Train

Skeletal - Motion of lower limbs
Travellers with mobility impairments experience many of the same difficulties when using this mode of transport as they do with buses/trams, e.g. entering and exiting the metro/train. In addition, such individuals encounter problems in manoeuvering their wheelchairs within the metro/train to access, for example, toilet and restaurant facilities. As a general point, there appears to be a lack of awareness of existing support systems and also the potential of ATT - this is the case for all impairment groups. As for buses and trams, ATT systems have little potential to alleviate access problems for this impairment group, but could assist in other aspects, eg through providing relevant information on accessible travel routes.

Vision
The visually impaired individual encounters many of the same problems for this mode of transport as for buses/trams, e.g. using timetables. In addition, differences in station environments (e.g. platform length, positioning of ticket machines/windows) and the design of metros/trains (e.g. number of steps, location of doors) can cause numerous problems, particularly when travelling on novel journeys. Standardisation of stations and metros/trains would be the most helpful solution for this group. ATT solutions are also feasible, for example trip planning systems that provide information regarding the layout of stations and metros/trains, and ticketing systems that utilise speech input/ output.

Hearing/Language and Speech
Individuals from this group encounter many of the same difficulties for this mode of transport as for buses/trams, for example communicating with ticketing staff and other passengers and dealing with changes in the travel schedule. In addition, specific problems are experienced in hearing and comprehending announcements, both at stations (particularly during poor weather conditions) and whilst travelling on a metro/train. ATT systems which present complementary visual announcements at the station and on the metro/train would resolve such concerns. The use of symbols and icons would greatly increase the usability of such systems for this group.

Intellectual/Psychological/Cognitive
Travellers with cognitive impairments encounter most of the same difficulties in using metros and trains as they do for buses and trams, for example, deciding when to travel, what changes are required, using ticket machines, identifying the correct station and dealing with changes in the travel schedule. ATT systems under development (e.g. computer-based trip planning systems, hand-held information systems, smart card payments) will help to resolve such problems.

Elderly
Older travellers experience many of the same difficulties with this mode of transport as encountered for buses and trams and by other impairment groups, for example, planning a trip, reading timetables, using ticket machines, waiting on platforms, entering and exiting the bus/tram and hearing announcments on the metro/train. ATT systems, such as trip planning systems, smart card payments and visually-based announcements will aid in alleviating some of these problems. A specific difficulty encountered by elderly people when using metros and trains concerns their wish to

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retain independence despite their need for help. Support where needed without accentuating 'disabilities' will assist these individuals.

8.2.4 Ship

Skeletal - Motion of lower limbs
No specific problems were identified during data collection for mobility-impaired travellers using ships. This was due to time constraints and the priority areas established by the travellers given their most significant and most frequent problems.

Vision
Visually-impaired travellers experience considerable difficulties in finding their way within the open plan layout of ships. Improved means of navigation (e.g. tactile signing) on ships would aid these individuals. ATT navigation systems may also be of assistance, although difficult to implement on a moving base such as a ship. Travellers with visual impairments are also fearful of falling overboard on ships - more secure and obvious perimeters to ship's decks will reduce such concerns.

Hearing/Language and Speech
The majority of problems encountered by this group when making journeys by ship arise because verbal communication is required (e.g. when planning a trip, purchasing a ticket, seeking assistance). Hearing and comprehending announcements whilst on the ship can also be a problem, as can be dealing with changes in the regular travel schedule. Hand-held communication devices for use in planning and obtaining trip information (utilising symbols and icons) are examples of ATT systems that have the potential to aid this impairment group.

Intellectual/Psychological/Cognitive
Problems encountered in using ships by travellers with cognitive impairments are similar to those found for other modes of transport. For example, it can be difficult to make and summarise travel-related decisions such as departure and arrival time or understand instructions given by a ticket machine. Computer-based trip planning systems and improved means of purchasing a ticket (e.g. smart card automatic debiting) are examples of ATT systems which may aid this impairment group.

Elderly
Older travellers experience similar problems in using ships as do those with cognitive impairments, for example in trip planning and using existing ticket machines. Computer-based planning systems (either hand-held or accessible from home) and smart card payment systems could also aid the elderly traveller.

8.2.5 Airplane

Skeletal - Motion of lower limbs
Travellers with mobility-related impairments encounter specific difficulties in establishing the procedures and layout of airports prior to making the journey. Information systems accessible from home or at travel agents may help alleviate this problem, particularly if virtual reality technology is employed to provide 'dry runs'. Individuals within this impairment group also experience difficulties in gaining access to toilets on the airplane - improved airplane design is the most likely solution to this problem.

For this mode of transport, problems are also experienced by the airport organisations themselves which affect travellers with a mobility impairment (and disabled and elderly

people in general). For example, airports are often not informed as to an elderly or disabled person's special needs, and subsequently staff cannot organise the most efficient assistance. Intelligent booking systems are a potential solution to this difficulty, so that impairment details are logged at the ticket purchase stage.

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Vision
Visually-impaired travellers often experience problems in finding their way within airports and in finding toilets on the airplane. Sources of navigation information (e.g. tactile flooring, braille on signs) will help in these tasks, although it must be remembered that only a small minority of people with visual impairments can read braille. Portable navigation systems may also assist. Concerns also exist regarding procedures employed for emergency situations. For example, visual alarms warn that fire shutters are dropping in the airport, an illuminated strip is used on the airplane to indicate the location of emergency exits, and safety instructions cannot be read. Use of auditory and/or tonal information and braille safety instructions will assist the visually-impaired traveller in these situations.

Hearing/Language and Speech
Travellers within this group experience difficulties in trip planning and the purchasing of tickets, since verbal communication is often required. Computer-based planning systems and smart card-based ticketing systems are examples of ATT systems which will aid such individuals. Hearing and comprehending announcements on airplanes can also be a problem for this group, since most information is provided using the auditory modality - complementary visual information would ensure announcements are accessible.

Intellectual/Psychological/Cognitive
Few specific problems were identified during data collection for cognitive-impaired travellers using airplanes. Disabled people with cognitive impairments often travel by airplane with friends/colleagues, thus eliminating any potential problems. This was found to a lesser extent with other impairment groups.

Elderly
Elderly people encounter a number of the same problems experienced by other impairment groups (e.g. finding way within the airport, accessing toilets on the airplane, hearing announcements). In addition, similar to mobility-impaired travellers, elderly people like to be sure of procedures at the airport prior to travel. Information systems accessible from home or at travel agents are a potential solution to this problem. Elderly travellers also experience problems in booking taxis in advance for when they return from a destination. A longer-term booking system or an easy-to-use, short-term booking system accessible from abroad is required.

9. Conclusions and Next Steps

The Inventory of Requirements for Elderly and Disabled Travellers provides an overview of the main impairment groups having difficulties with components of the travelling task, and what their requirements are, in general and those specific to telematic systems. By scanning the table, we can see:

- Where there are no solutions existing
- Where current solutions/systems need adaptation or enhancement
- Where new system ideas may emerge

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Those user requirements relevant to ATT will be extracted and condensed in Deliverable 3.2, and a new table will more precisely suggest where there is a need for modifications, where there are gaps, and where new or integrated solutions are possible to enable E&D travellers to more effectively fulfil all components of the travelling task.

The system inventory will be further developed and updated, as research results emerge from other projects and new systems are identified through a continued literature and project review. In Deliverable 3.2, a matrix will be developed grouping systems according to their product or service functions. The functions will be more clearly defined according to their relevance for special attention for elderly and disabled travellers, following the categories of the E&D functional classification.

The matching of user requirements with system functions in Deliverable 3.2 will be used as the basis for the updating of User Requirements in Deliverable 3.3 at the end of the project. These updated user requirements will also be included in the future Cost-Benefit Analysis. All these activities will contribute and help to refine the TELSCAN code of good practice and handbook of design guidelines for ATT systems to ensure that the systems meet users' requirements.

This generic user requirements specification, based on TELAID and EDDIT's previous work and TELSCAN's data capture with experts and users, can guide the design of all transport telematics systems so that they do not exclude elderly and disabled people. Projects should still, however, also capture a more detailed definition of user requirements for their specific application area or system. This same methodology for the identification of needs can be followed by projects to capture their system-specific data.

The inventory also serves to inform the transport telematics community of the general public's lack of awareness of available or prospective systems to meet specific travelling needs, and especially the needs of elderly and disabled people, who are in many cases most able to benefit from telematics towards their greater mobility and independence.

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Appendix 1

Inventory of Telematic Systems for E&D Drivers and Travellers

Under development in current telematics projects
- For Travellers
- For Drivers

Other Continuing R&D
- For Travellers - Specific systems
- For Drivers - Specific systems
- For Drivers - Generic systems

Under development specifically for E&D
- For Travellers - Specific systems
- For Travellers - Generic systems

Currently in use
- For all Travellers - Specific systems
- For all Travellers - Generic systems
- For E&D Travellers - Specific systems
- For E&D Travellers - Generic systems
- For all Drivers - Generic systems

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Appendix 2

Matching User Requirements from TELAID and EDDIT

Appendix 3

Qualitative reports

A. Data collection with Experts

Appendix 3

Qualitative reports

B. Data collection with Users

Appendix 3

Qualitative reports

C. Observations

Appendix 4

E&D Functional Classification

Appendix 5

Definition of the Travelling Task

Code:
x in the columns overleaf = an element of the travelling task is relevant to a particular mode of travel.

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Appendix 6

Inventory of Requirements for Elderly and Disabled Travellers

Please Note: This Inventory includes the requirements for 5 user groups and will be developed in Deliverables 3.2 and 3.3 to include all impairment groups from the E&D Functional Classification.

Source of the data:

Data in this inventory of requirements has been captured in the following ways:

- From results of the earlier TELAID and EDDIT projects
- From interviews with relevant experts in the field during the TELSCAN project
- From focus groups and individual interviews with users during TELSCAN
- From expert opinion within the TELSCAN Consortium

Meaning of "ATT relevant" in the table:

Yes = To the best of the authors' knowledge and given current technological developments, a telematics-based solution to the problem identified in the table can be predicted for the near future.

No = To the best of the authors' knowledge and given current technological developments, a telematics-based solution to the problem identified in the table cannot be foreseen. A solution may exist though, which does not require the use of a telematics system.

NA = Not applicable, i.e., the task of using advanced technology cannot be described as "relevant or not relevant to ATT."

Meaning of "ATT available" in the table:

Numbers in the "ATT available?" column refer to systems in the Inventory of Telematic Systems for E&D Drivers and Travellers.

Yes = To the best of the authors' knowledge, an existing or prospective (R&D) system is available to meet a specific requirement. Only 1 or 2 systems will be given as examples, and this is not meant to be a comprehensive summary of all the systems which will meet this requirement.

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No = To the best of the authors' knowledge, an existing or prospective (R&D) system is not available to meet a specific requirement.

NA = Not applicable, i.e., it is not possible to say that an ATT system is available or not to assist in the task of using advanced technology.

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Inventory of Telematic Systems for Elderly and Disabled Drivers and Travellers

	Under development in current telematics projects (Framework IV)	Considering E&D / Relevant E&D Issues	Project name or Reference TR = Transport UR = Urban & Rural Areas LE = Language Engineering
	For Travellers		
1	Personal mobile multi-modal travel and traffic information system, with facility to also for ticket reservations.	Considering E&D in User Needs Analysis.	PROMISE (TR 1043)
2	Multi-modal applications of telematics on short-sea links. Includes in-port passenger information. Mainly directed at intermediate users	TELSCAN may participate in the on-site evaluations in the Patras-Ancona ship line. TELSCAN will assist TILEMATT in the design of information terminals (usability aspects) and the content of information provided to users.	TILEMATT (TR 1057)
3	Intermodal (mainly rail and flight) baggage systems, and information and guidance systems for passengers		EUROTRACS (TR 1024)
4	Multi-modal transport information systems for use in rural communities		SCRIPT (TR 1048)
5	Various information systems for travellers - info-kiosks, personal digital assistants, road-side warnings	End users survey of 1000 persons. Elderly, occasional travellers expected free information, simple service, detailed instructions (*from presentation at concertation meeting*).	INFOTEN (TR 1032)
6	Mobility and Traffic Information systems (both fixed and mobile) for use by travellers		ENTERPRICE (TR 1020)
7	Integration of existing systems for use by travellers (information at bus stops, on-board the bus, VMS, identification of users' expected benefits).	Collaborative evaluation planned in Gothenburg pilots (Spring 97 and 98.) Under definition is also the co-operation in QUARTET PLUS pilots in Stuttgart and Athens. In-depth interviews conducted for bus, train car, parking, using 500 randomly chosen criteria. Noted the need for low floor buses, and for elderly that security was a problem (*from presentation at concertation meeting*).	QUARTET PLUS (TR 1044) (ARENA tests)

8	Adaption and integration of existing systems - VMS, public info. terminals	Consultation with local user groups, extension of pedestrian crossing green times, integration of urban and surrounding services for public transport and road users.	TABASCO (TR 1054)
9	Various multi-modal based traveller systems - e.g. booking, passenger info., smart cards for payments	Provision of integrated Demand Responsive Transport Services (DRTS) using mobile data communication, GPS location systems, booking and reservation systems, passenger information systems and smart cards for payment and user authorisation.	SAMPO (TR 1046)
10	Real-time Information systems for carpooling	E&D noted in their UR specification, but seeking advice from TELSCAN to implement. Possible restrictions for E&D, or any type of information relevant to carpooling is required on subscription form, eg Type of car (enough legroom, space for a wheelchair, etc.) Time of day available for travel Guaranteed ride home in the same type of car. Design of the interface whereby the user communicates this information or need for information. Need for alternative modes of communication or interfaces to meet individual needs and preferences (but no interface being designed in current project).	CARPLUS (TR 1008)
11	Portable devices that provide various services for public transport users, including ticketing and emergency calls		ICARE (TR 1029)
12	Various systems for travellers on private and public transport - smart cards, info./ticketing terminals	Supplementary E&D user requirements survey is planned in Thessaloniki. This survey will take place during the first three months of 1997 before the CONCERT demonstration planned for May 1997.	CONCERT (TR 1013)
13	Auto debiting and electronic payment for public transport - parking information and use of smart cards, Internet, VMS and other services.	End users included in project. Complementary E&D user requirements specification survey in relation to ADEPT systems is planned in the Thessaloniki site. This survey will take place during the first two months of 1997, before the ADEPT II demonstration which is planned for April 1997. Collaborative evaluation planned at Thessaloniki and Gothenburg sites. Tests in Gothenburg concern automatic debiting of parking fees - disabled are free of charge, but elderly can be recruited as subjects.	ADEPT II (TR 1002)
14	Incident response using on-line sensing. Aimed at intermediate users.	TELSCAN considers the content of information related to E&D for the Emergency Centre. Also the relevant feedback policy in relation to E&D will be determined.	IN-RESPONSE (TR 1030)

15	Trans-modal information & communications management for public transport, mainly modelling work	The project agreed to include a special part in the TRANSMODEL data structure concerning information relevant to E&D. TELSCAN works to define this information content and structure for TITAN 1&2.	TITAN 1&2 (TR 1058 / TR 1107)
16	Information systems via cable TV and kiosks providing variety of services, incl. public/private transport information	Need to consider the type of information required by E&D, and the design of the interface to meet their requirements and abilities. E&D issues being investigated by INCLUDE project.	INFOSOND (UR 1017)
17	Multimedia information systems for tourism	Need to consider the type of information required by E&D, and the design of the interface to meet their requirements and abilities. E&D issues being investigated by INCLUDE project.	EVENET (UR 1011)
18	Various systems allowing visitor to city to plan visit, be guided along tour, and be assisted (incl info. on public transport)	Need to consider the type of information required by E&D, and the design of the interface to meet their requirements and abilities. E&D issues being investigated by INCLUDE project.	CICERO (UR 1002)
	For Drivers		
19	Collision avoidance systems for drivers of vehicles	E&D considered in User Analysis. Joint simulator experiment planned for Spring 97 and issues being discussed now between AC ASSIST and TELSCAN.	AC ASSIST (TR 1004)
20	A driver status monitoring system which can undertake vehicle handling in an emergency situation	E&D mentioned specifically in User Needs workpackage as a separate driver category to be investigated. System very useful for all E&D drivers as they are more susceptible to sudden impairment. Also notification of an emergency centre is taken into consideration which will also be of great importance for E&D.	SAVE (TR 1047)
21	A system which provides in-vehicle speed recommendations to drivers		UDC (TR 1060)
22	Adaption and integration of existing systems - multi-modal trip planning terminals, real-time route guidance, RDS-TMC		EUROSCOPE (TR 1023)
23	ATT to improve traffic management cross-border, including various information systems for drivers - e.g. traffic, guidance, weather and tolling	The project's relevance to E&D and co-operation are under discussion.	HANNIBAL (TR 1028)

24	Adaption and integration of existing systems - traffic info. systems, smart cards for road/parking payments		CAPITALS (TR 1007)
25	Adaption and integration of existing driver systems - route guidance, VMS, cooperative and assistive driving		CLEOPATRA (TR 1012)
26	Various systems based on RDS-TMC technology - e.g. in-vehicle traffic info., VMS		FORCE 1/2 (TR 1026 and TR 1106))
27	Adaption and integration of existing systems - e.g. Variable Message Signs (VMS), multimedia information services, parking info.	ATT systems for public transport will have relevance for E&D, including: bus priority at crossings; dynamic scheduling of public transport, including real-time rescheduling and Demand Responsive Systems (DRS) for the elderly and disabled; dynamic information to users.	AUSIAS (TR 1006)
28	In-vehicle systems directed by the human voice	E&D issues being investigated by INCLUDE project.	VODIS (LE)
29	Trans-European inter-operability of motorway tolling	The project's relevance to E&D is under reconsideration	MOVE-IT (TR 1105)
	Other Continuing R&D		
	For Travellers - Specific systems (R&D)		
30	Real- time traffic information for bus passengers	Trials with fleet of coaches on an intelligent corridor. E&D needs will be considered.	UK FORESIGHT-Challenge, Road Traffic Advisor (R.T.A.), funded by EPSRC
31	VINCENT (new version) (Germany)	Public Interactive Terminal. Continuing R&D with 1 terminal. Wayfinding, choice of the better bus service (optimization in terms of time) to reach the destination. Touch screen, printing available, voice output possible. Potentially useful for people with speech/hearing/visual impairments, and the elderly.	INFOPOLIS project (TR 1031) Deliverable No. 3.
32	SIT (Spain)	Public Interactive Terminal. Continuing R&D, and starting use for all travellers. Wayfinding, choice of the optimum path when walking, using bus and metro. Visual only. Potentially useful for people with speech/hearing/mobility impairments and the elderly.	INFOPOLIS project Deliverable No. 3.

33	QUEST (UK)	Public Interactive Terminal. Continuing R&D, and starting use for all travellers. Optimum travel, public transport timetable (QUARTET). Text and print out. Potentially useful for people with speech/hearing impairments. Evaluation indicated problems for elderly users (+60) to use the system.	INFOPOLIS project Deliverable No. 3.
33 A	AMMOS (PT)	This project is developing a tactile input system, that contains all the information needed to plan a trip and to carry out travel successfully. The system contains information about arrival/departure points, schedules, transfers of transports, changes in networks, etc. It must be accessible to all people, especially those who have some impairments, not only in relation to the type of information presented but also in the way the system is controlled.	
33 B	ICARE (PT)	This project will facilitate the ticketing task, i.e., creating a system that avoids the use of a ticket machine and ticket stamping. The person enters the vehicle and the ticket is automatically paid by using a special card ("free-hand card") detected by a specific device	
33 C	Carris & Rodoviária (PT)	This project will make the use of existing ticket machines easier. To achieve this, it is necessary that specific conditions, as the presentation of information, the luminosity of the characters, the function of the system, etc., must be fulfilled. Therefore, people are able to can the ticket autonomously and successfully.	
33 D	Carris & Rodoviária (PT)	This system will give specific information about points of departure/arrivals, the localisation of stops and gates, schedules, etc. In this way, subjects can plan the trip they intend to do autonomously, in terms of time, type of transport, departure and arrival point, transfers needed, etc.	
34	INFOBUS (France)	Handheld terminals. Continuing R&D, and starting use (demonstration) for all travellers. Real time information on the waiting time of the next buses at a stop; info on traffic condition of the network. Text only. Potentially useful for people with speech/hearing/mobility impairments, and the elderly. Evaluation with elderly in progress (INFOPOLIS/TELSCAN)	INFOPOLIS project Deliverable No. 3.
35	PTA (personal travel assistant) (Germany)	Handheld terminals. Continuing R&D, all travellers. Portable version of the EFA-win system; info on road traffic, weather conditions. Text only. Potentially useful for people with speech/hearing/mobility impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.

36	PAKOS (Germany)	Station/Bus stop display. Continuing R&D, starting use, all travellers. Real waiting time of next vehicle for public transport network. Visual info only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
37	TIP (Spain)	Station/Bus stop display. Continuing R&D, all travellers. Waiting time, services messages. Visual only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
38	SIP (Spain)	Station/Bus stop display. Continuing R&D (prototype), all travellers. Waiting time, info on service regularity. Visual only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
39	HELSINKI TRANSPORT ROUTE (Finland)	Station/Bus stop display. Continuing R&D (prototype), all travellers. Real time info on bus departure/arrival. Visual only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
40	HELSINKI METRO (Finland)	Station/Bus stop display. Continuing R&D (prototype), all travellers. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
41	SIP (Spain)	Onboard displays. Continuing R&D (prototype), all travellers. Bus service number, next stop, time/date, possible connection, messages from operator. Visual only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
	For Drivers - Specific systems (R&D) (Examples only)		
42	EUROSCOUT (Germany)	Multimodal systems, including dynamic route guidance system, park and ride, bus service number, timetables, fares, name of connections. Visual only, can be taken out of the car. Potentially useful for speech/hearing/mobility impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
43	"Eye-Cue" System of Delco Electronics presents information on windscreen such as velocity, feedback from car alarm signals, etc.	Probably will increase driving task complexity for E&D drivers	SAVE Deliverable 3.1
44	Toyata lamp-based intervehicle information transmission system transmits driver's intention and vehicle condition.	Transmission methods must be tested with E&D drivers, so that it does not confuse E&D driver	SAVE Deliverable 3.1

45	Real time Traffic and travel Information	A real time system will be trialled. A variety of information types and technical systems will be tested. User reaction, including E&D will be assessed.	UK FORESIGHT-Challenge, Road Traffic Advisor (R.T.A.), funded by EPSRC

	For Drivers - Generic systems (R&D)		
46	Vision enhancement systems and infra-red night vision systems	Elderly people and people with reduced visual acuity could benefit but these systems have not been sufficiently tested with these user groups. Human factors evaluations carried out on infra-red night vision system by Cranfield University as an on-going part of the product development process. Elderly drivers have taken part in these evaluations both as part of a balanced, all-aged sample of volunteers and as part of a series of human factors trials dealing specifically with elderly drivers. This research is currently taking place.	Stahl, A., Oxley, P., Berntman, M. and Lind, L., 1994.
47	Adaptive Cruise Control	Parameters of the system and the interface need more testing with various disability groups and elderly people.	Peters, B., (1995b), TELAID Deliverable No. 9.
48	Lane keeping support	Especially useful for elderly and disabled drivers.	
49	Head-up displays	Testing required with elderly and disabled drivers.	
50	Automated rider identification (smart) cards and mobile data terminals.	These can identify a person and could provide inforation to assist the system's operation, eg on type of disability, specific vehicle requirements, length of time in/on vehicle, etc.	Schweiger, C.L. and McGrane, J., 1994, in Guthrie and Phillips, 1995.
51	Advanced Traveller Information Systems (ATIS)	Necessary not only to contain information required by disabled and elderly people, but the interface also needs to be accessible.	
52	Trans-modal debiting service	Would allow travellers to pay for different transport services by using a device which charges an account in their name. Debit cards or smart cards could be used.	Parviainen, J.A., 1994, in Guthrie and Phillips, 1995.
53	Automatic Collision Intervention Systems	Warning to the driver most to be tested with E&D drivers	SAVE Deliverable 3.1

	Under development specifically for E&D	Considering E&D / Relevant E&D Issues	Project name or Reference
	For E&D Travellers - Specific systems (R&D)		
54	MoBIC Travel Aid (MoTA) consisting of: MoBIC Pre-journey System (MoPS) to assist users in planning journeys and MoBIC Outdoor System (MoODS) to execute these plans by providing users with orientation and navigation assistance during journeys.	Essential information expressed by users for MoPS included basic maps and routes, and ability to dictate the level of detail required. Desirable to have an option to add more detail including more on public transport, and to be able to request area maps or specific routes. Ideally, up to date information was required concerning transient obstacles, and also the user should be able to edit the journey plan with own comments and memos. General information people wished to have in the MoBIC aid: directions to required destination (no of streets), name of streets, travellers current location (direction currently facing), shops (especially with stands outside), information about current roadworks, pedestrian crossings (and whether it has an auditory signal), useful buildings and landmarks (eg banks and their ATMs), layout of environment (steps), street furniture (lamp posts), and useful items in the street (public telephones). The most popular output option was synthetic speech with other sounds and vibratory information significantly less popular.	TIDE MoBIC project - Petrie, H. & Johnson, V., 1995 Strothotte, T., Petrie, H., Johnson, V. and Reichert, L., 1995 Petrie, H. and Johnson, V., 1996
55	Infrared Information and Orientation System (IRIS)	Uses transmitters which broadcast coded infrared information. Uses predefined codes for different pieces of information so is language independent. Language of the message is determined by language the receiver is set to. By listening to the transmitted information and by comparing this information with the mental map of the street-environment or building the blind user will know his or her position. Trails have taken place in Vienna where the system gave information about the colour of traffic lights.	Zagler & Mayer Whitney, G., 1995
56	BILOS	Infra-red beacon system - when user points device at the beacon, direction information or information about destinations of the trains arriving at the platform is spoken to the user. Trials have taken place in the Hamburg-Barmbek railway station in Germany.	Whitney, G., 1995
57	Seal Pilot Light System	Infra-red beacon system, designed and built in Italy, consisting of fixed beacons and a small hand held user device which gives a spoken message when the user device is pointed at a beacon, telling them eg colour of traffic lights or to help find or avoid certain features.	Whitney, G., 1995

58	ROMANSE	Radio-frequency beacon system set up to enable the user to obtain audible next bus information from adapted bus stops in Southampton, UK.	Whitney, G., 1995

59	OPEN system: An Orientation and Navigation System for Blind and partially Sighted People	The system will help users find specific features of the underground system such as ticket areas, barriers, stairs, escalators, platforms and other obstacles. Collected data from 20 Belgian, 40 UK and 30 French visually impaired users of the underground in Paris, London and Brussels. Most common problem concerned the difficulty of finding correct platforms, and most respondents had difficulty finding station entrances. There were various complex reasons for the differences between countries, eg variations in architectural design, and whether the person was travelling with or without a companion. Significantly more Belgian respondents had trouble finding the escalators than in Paris or London (escalators in the Brussels Metro are activated by the approach of passengers, but those in Paris and London operate continuously and therefore provide audio feedback). Most of the Belgian respondents would prefer to wear an activating device, whereas nearly a quarter of French or UK interviewees said they would prefer to carry the device. Majority of all respondents said they would find the OPEN system useful for providing guidance (eg to find ticket offices, ticket machines, electronic and manual gates in station foyers, lifts escalators, stairs) and information, and improving access to the underground railway systems.	TIDE OPEN project - Gallon, C. Stephens, R. and Whitney, G., 1995 Stephens and Longley, 1995
60	NEWT (Tyne and Wear Transport Initiative for Disabled People)	Many people who have difficulty with communication will avoid public transport. Using a Touchcard design provides a series of icon-driven question and answer point-boxes to enable passengers to express their transport requirements and for staff to understand what these are.	NEWT project (EC Transport Directorate General)
61	TURTLE (Transport Using Rehabilitation Technologies Leads to Economic Efficiency) - Real-time public information system for disabled and elderly people.	Real-time information services are already available, but not accessible to elderly and disabled people. TURTLE uses system platforms which are already widely available and used (Teletext television, Internet and PCs) and provides a low cost method of providing information directly from service providers into people's homes.	TIDE TURTLE project
62	Isaac - A Personal Digital Assistant for the Differently Abled (Sweden)	Aims to support people with cognitive impairments, and enable them to do more on their own. Facilities include: A map, managed by a Geographical Information System, with the position of the user, and the ability to select pictures for guiding sequences and personal telephone directories. Has the potential for much wider use for other target groups or other applications.	Jönsson B. and Svensk, A., 1995

63	ASMONIC	Autonomous System for Mobility Orientation, Navigation and Communication. 3 year TIDE project to produce a portable GPS system to help the user avoid obstacles, to choose right path, get feedback on current position, and to communicate via a mobile phone to get help.	Whitney, G., 1995
64	Responsive Environment project (U.S.)	The system aims to increase the independence of visually impaired, blind, and cognitively disabled people who are navigating through unfamiliar surroundings. Status of project is being investigated to identify relevant issues for travellers.	Jaffe, D. L.; Sabelman, E. E.; Curtis, G. E., 1992
65	NEC Magnetic Guidance System	Magnetic Guidance system which enables a blind or partially sighted person to follow a pre-set route. The traveller follows a magnetic trail with an adapted cane which gives audible or tactile feedback as it is held over the route. Track systems can also enable a wheelchair user to follow a metal track using an adapted chair within an itnernal environment. Set up at a number of railway stations in Japan and trials also in Sweden.	Whitney, G., 1995.
66	Robot dog	Signals when the user is on the right route. Results and status are being investigated in Japan.	Tachi, S. and Komoriya, K. 1984.
67	Sonar headset for blind people	Gives the wearer a “bat-like sixth sense” to build up a more detailed picture of the surroundings.	BBC, Tomorrow’s World, Centre for Independent Living, Yokohama, Japan
68	Arkstone’s Orientation Tools: Atlas Speaks and Strider	Combined talking map and GPS system, in the U.S., designed to help the traveller pre-plan their journey and then undertake it using the GPS to give route information on where to turn left/right.	Whitney, G., 1995

	For E&D Travellers - Generic systems (R&D)		
69	Smart cards and self-service machines	Ability to adapt services to individual needs, eg text on a screen being spoken or increased in size, giving more time for operating the terminal, reducing the number of available operations. Potential problems of security, integrity, the number of cards needed. A contactless card, working at a distance of 10 cm could help those who have problems placing a card in a slot. Some contactless cards can respond to a terminal a few metres away, which could be used to help a blind person locate a self-service terminal, or to trigger an audible message giving the destination of a bus. They can also help in finding locks, using keys, and in turning on audible signals and increasing crossing time at pedestrian crossings. Visual impairments - standardisation of design of the interface, location, layout of terminal and functions; ability to differentiate by touch; all cards accepted with same orientation; and keypads provide tactile feedback. Hearing disabled people - all information presented visually, and all public telephones to have text telephony capability with smart card access to keyboard. Intellectually disabled - communication based on pictures in combination with spoken text, and identification could be by fingerprint rather than the use of PIN numbers.	As discussed in The National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992. TIDE SATURN project: Gill, J. M., 1995. Gill, J.M., 1994. Gill, J.M., (ed.) 1996. Slater, J.N. and Gill, J.M., 1995 Petrie, H. van Schaik, P., Kirby, V. and Orpe, H., 1995. Balfour, A., 1995.
70	Support for navigation, physical access and provision for information	Giving E&D more mobility within a building.	TIDE ARIADNE project
71	Paper or CD rom guides	Giving E&D information on accessible facilities.	TIDE BARRIER project
72	Noise reduction aids	Compensation for hearing impairments potentially helpful for travellers to hear announcements, messages.	TIDE SPACE project
73	Sound or spoken messages triggered by a credit card sized transmitter worn by a blind or visually impaired person.	Remote, automatic activation may be preferable in some situations.	From Zagler & Mayer (See original source)

	Currently in use	Considering E&D / Relevant E&D Issues	Project name or Reference
	In Use For All Travellers - Specific systems		
74	TAN (France)	Public Interactive Terminal. Wayfinding, timetable, public transport info, transport condition. Visual only. printing available. Potentially useful for speech/hearing impairments.	INFOPOLIS project Deliverable No. 3.
75	Digiplan (France)	Public Interactive Terminal. Wayfinding, choice of the better bus service to reach destination. Touchscreen, printing available. Potentially useful for speech/hearing impairments. Evaluation indicated difficult to use by the elderly.	INFOPOLIS project Deliverable No. 3.
76	EFA Touch (Germany)	Public Interactive Terminal. Wayfinding, choice of the better bus service (optimisation in terms of time or transfers), schedule times, fares. Touchcreen, printing available. Potentially useful for speech/hearing/mobility impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
77	FAHRINFO (Germany)	Public Interactive Terminal. Wayfinding, choice of the better bus service (optimisation in terms of time or transfers), pricing. Touchscreen, printing available. Potentially useful for speech/hearing/mobility impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
78	TouchFOX (Germany)	Public Interactive Terminal. Wayfinding, choice of the better bus service (optimisation in terms of time) to reach destination. Touchscreen, printing available. Potentially useful for speech/hearing impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
79	RIA HAFAS (Germany)	Public Interactive Terminal. Wayfinding, choice of the better bus service (optimisation in terms of time) to reach the enxt stop. Visual, printing available. Potentially useful for speech/hearing impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
80	TRIPlanner (UK)	Public Interactive Terminal. Multi-modal information system (SCOPE), optimum route using public transport. Text and print out. Potentially useful for speech/hearing impairments. Survey conducted and elderly included(?)	INFOPOLIS project Deliverable No. 3.
81	Network (UK)	Public Interactive Terminal. Time between two bus stops. Text and print out. Potentially useful for speech/hearing impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
82	Cumbria (UK)	Public Interactive Terminal. Optimum route between main settlements, alternative departure. Text only. Potentially useful for speech/hearing impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.

83	PIA (IT)	Public Interactive Terminal (Starting use). Expected travel time, timetable for public transport (planes,railways), info on parking, pollution, traffic, ticketing. Touchcreen, voice output. Potentially useful for speech/mobility impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
84	WWW	Home Terminals, WWW available (more or less) for all travellers. Trip planning, timetables, special services. Text only, printing possible. Potentially useful for speech/hearing impairments (info on accessibility of network - SNCF), and the elderly.	INFOPOLIS project Deliverable No. 3.
85	TCL (public transport operator of Lyon) (France)	Home Terminals. Info on public transport network (routes, timetables, fares, transport conditions). Text only, printing possible. Potentially useful for speech/hearing impairments (info on accessibility of network), and the elderly.	INFOPOLIS project Deliverable No. 3.
86	EFAwin (Germany)	Home Terminals. On-line system. Trip planning, timetables, fares, real time info. Special info for disabled available. Text only, printing possible. Potentially useful for speech/hearing/mobility impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
87	FARHINFOD, FARHINFO CD (Germany)	Home Terminals. Software on CD rom. Wayfinding, choice of the better bus service (time or transfers), fares. Visual only. Potentially useful for speech/hearing impairments, and the elderly.	INFOPOLIS project Deliverable No. 3.
88	Finnish time table service (Finland)	Home Terminals. Multimodal on-line system. Does not give info on public transports in cities but for intercities connection; ticketing and fares; special taxis services. Visual only. Potentially useful for speech/hearing/mobility impairments (taxi services), and the elderly. Evaluation done, but no information on sample.	INFOPOLIS project Deliverable No. 3.
89	Bus Tracker System (UK)	Station/Bus stop information system, comprising in-vehicle computer units, roadside beacons, communication links, central operations computer and bus stop displays. These Automatic Vehicle Location (AVL) and real-time passenger information systems are being installed in buses and bus passenger shelters in the UK as part of recent contracts between local authorities, passenger transport opertaors and Peek Traffic. Bus travelling public will benefit from the installation of illuminated displays at the bus stops, which will give real time data on route, destination and arrival times for approaching buses. For the visually impaired, the system will also incorporate a 'talking' display which will give arrival and route information when activated.	Rivett, Peter, (Peek Traffic Ltd., UK) Aug./Sept 96

90	COUNTDOWN (UK)	Station/Bus stop display. Display at bus stops the order of arrival of the next seven buses with service number, destination, approximate time. Visual only. Potentially useful for speech/hearing/mobility impairments. Evaluation done by BATT project (elderly and disabled in the sample?). Possibility to announce low-floor buses.	INFOPOLIS project Deliverable No. 3.
91	BIC (borne d'information clients) (France)	Station/Bus stop display (limited use). Information on waiting time of next buses at a stop (all the services concerned); destination of each oncoming bus. Visual only. Potentially useful for speech/hearing impairments, and the elderly. Evaluation done, and elderly included (?).	INFOPOLIS project Deliverable No. 3.
92	VIDEOBUS (France)	Station/Bus stop display (limited use). Indication of next bus's position on the route and average waiting time. Visual info only. Potentially useful for speech/hearing impairments, and other groups.	INFOPOLIS project Deliverable No. 3.
93	ETRA (Spain)	Station/Bus stop display (limited use). Waiting time, info on service regularity. Visual only. Potentially useful for speech/hearing impairments, and other groups.	INFOPOLIS project Deliverable No. 3.
94	RENFE (Spain)	Station/Bus stop display (limited use). Railway info: train destination, stops platform, waiting time, info on service. Visual only. Potentially useful for speech/hearing impairments, and other groups.	INFOPOLIS project Deliverable No. 3.
95	VIA (Italy)	Station/Bus stop display. Real waiting time, next arrival at a stop, operator messages. Visual only. Potentially useful for speech/hearing impairments, and other groups.	INFOPOLIS project Deliverable No. 3.
96	PAT (Greece)	Station/Bus stop display. Starting use, all travellers and E & D included. Information system on urban and interurban public transport, trip planning. Visual touch screen, printing available. Some terminals are specially designed for disabled. Evaluation in the SCOPE project (with E&D users?)	INFOPOLIS project Deliverable No. 3.
97	VISIOBUS (France)	On-board displays. Name of the next bus stop, general info about cultural and commercial events. Visual only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
98	FIS (Germany)	On-board displays. Information on next stop, destinaiton, service number. visual only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
99	RENFE (Spain)	On-board displays. Train destination, next stop, time/date, possible connection, messages from the train driver. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.

100	HELSINKI TRAM (Finland)	On-board displays. Next stop, tourist attractions. Visual only. Potentially useful for speech/hearing impairments and other groups.	INFOPOLIS project Deliverable No. 3.
101	INFOBUS (Italy)	On-board displays. Next stop, time/date, info on disturbance on the service. Visual and vocal (bus stop). Potentially useful for speech/hearing/visual impairments and the elderly.	INFOPOLIS project Deliverable No. 3.

	In Use For All Travellers - Generic systems		
102	TV monitors for departure information	Often placed too high up and text too small.	As discussed in The National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992.
103	'Autosvar,' and other similar telephone systems providing automatic information on travel times.	Impossible for people with hearing or cognitive impairments.	As discussed in The National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992.
104	Videotext systems which present equivalent information in table form on a screen.	Not always providing the kind of information E&D require; may require many buttons to be pressed. However, may make it easier for those with impaired speech to obtain information.	As discussed in The National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992.
105	Automatic ticketing . Automatic check-in at airports.	Impossible for many people with impairments. Necessary to have human assistance on hand.	As discussed in The National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992.
105 A	Automatic Teller Machines (ATMs)	Research projects into the accessibility of ATMs are taking place, where E&D issues are the theme. Although usually related to bank cash dispensers, there are many analogies with traveller information facilities.	Gill, J.M., 1994 and 1996 (TIDE SATURN project) Study conducted by the Centre for Accessible Environments, on behalf of the UK's banking and financial services community (started Jan 1997 for 18 months)

106	Contact-free electronic gates	Useful for people with functional impairments, provided there are still people to turn to for help.	The National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992.
107	Acoustic traffic signals	Helpful for people with visual impairments, but some people may require longer time to cross the road. Smart cards could activate the signalling equipment.	As discussed in The National Swedish Board for Consumer Policies and The Swedish Handicap Institute, 1992.
	In Use for E&D Travellers - Specific systems		
108	Information on barrier-free urban and interurban transport to people with disabilities through a database applied to a geographical information system for the Barcelona province (Spain).	Record cards on accessibility were used to collect data on railway, underground, bus, airport and cable car terminals from people with different disabilities. The system is already running in the metroplitan area of Barcelona and the surrounding province, BUT the user does not interact with the system. The user is advised by the operator who is aided by this dynamic system of digitised maps and other relevant information on best routes, facilities, etc., to meet the needs of the user.	Project SITPRE (DG VII, one year from May 1994)
109	Voice Label (U.S.)	Commercially available wall-mounted recorder/player actuated remotely by people with visual impairments. Being investigated for relevant E&D issues.	Voice Label, Easier Ways, 1101 N. Calvert St., Suite 405, Baltimore, MD 21202
110	Talking signs (U.S.)	Orientation and Mobility aid -Infra-red beacon system, whereby the user device is pointed at a beacon and information is transmitted and the user device gives a spoken message to the user, so the user knows from which direction the information has come. Large scale trials took place in the Bay area of San Francisco.	Whitney, G., 1995
111	Horizon Marketing (UK) Ltd. Talking signs	Audio visual signs consisting of an illuminted or non-illuminated poster case and a digital sound recorder. When the button is pressed on the display, the audio message is played.	Whitney, G., 1995

112	Orientation Assisting Device	Orientation and Mobility aid - Radio frequency beacon system designed to assist new guide dog owners to learn how to handle their dogs by removing the need for them to remember route information. The user carries a device which gives the spoken orientation information guiding the dog where to go. System can be used for other than training.	Whitney, G., 1995
113	RNIB REACT (UK)	Orientation and Mobility aid - Radio frequency beacon system whereby the person carries a small device which triggers speech from the beacon when the user comes within its range. Currently can give one of 8 20-second messages. User device and beacon can be used to trigger alternative electronic devices, eg to open door or call lift. Developed by GEC-Marconi and RNIB.	Whitney, G., 1995
114	St. Dunstan's System (UK)	Orientation and Mobility aid - Electrostatic beacon system, installed to enable the residents to find the entrance instead of walking past.	Whitney, G., 1995
115	Pathfinder (UK)	Orientation and Mobility aid - Infra-red system which transmits a message to the user's device when the user comes within range of the beacon. The user has to point the device at the beacon or can wear it on a cord round the neck.	Whitney, G., 1995
116	Nomad (UK)	Touch sensitive pad on which visible raised line maps or graphics are placed, and when the map is touched at a certain point, spoken information is given.	Whitney, G., 1995
117	ServiceCall (UK)	Infra-red user device and a remote beacon attached to an audible signal - user points trigger at beacon and presses the buton, remote beacon sets off an alarm and member of staff is called. Enables E&D to ask for help or indicate their presence remotely.	Whitney, G., 1995
118	Minitel (FR)	Minitel is the marketed in-home terminal of France Telecom; it allows the linking of simple terminals to computers (server centres) which provide information for a whole range of services (including transport).	
	In Use for E&D Travellers - Generic systems		
119	Wearable memory aids with visual and speech outputs for people with cognitive disabilities.	Being investigated for relevant E&D issues with developers.	Friedman, M., Kostraba, J., Henry, K. and Coltellaro, J., 1991.
120	Electronic mobility aids	Useful for blind travellers who cannot use a long cane or guide dog, eg, a blind or partially sighted wheelchair user.	Whitney, G., 1995
121	Talking information system/points	Push button talking information systems which give information in an audible way to people who cannot use visual information.	Whitney, G., 1995

122	Audio tactile maps	Tactile maps on their own may be difficult to use or find by blind or partially sighted people, but combining them with audible information makes them easier to use.	Whitney, G., 1995
123	Induction loops	A person with a hearing aid can hear sounds from a particular source as if they were coming directly from a loudspeaker by switching the hearing aid to the 'T' position.	Whitney, G., 1995
124	Text telephones (eg Minicom ™)	Device which allows a person with a hearing impairment to communicate with text either to another text telephone or through a relay service to a person using an audio telephone.	

	In Use For all Drivers - Generic systems		
125	Automatic comfort settings	Useful for any driver who has difficulty changing the position of the seats, steering, mirrors, etc. This may be because of mobility or dexterity problems caused by disability or age.	Guthrie and Phillips, 1995.
126	Emergency vehicle location and call	Elderly and disabled people could most benefit and would provide both safety and confidence to travel, especially longer distances.	.
127	Navigation and route guidance systems	Enable a driver to select a precise destination and compute the best route to follow based on specific criteria. Navigation information, eg "turn left" may be provided to the driver by means of a visual display and/or synthesised voice output. Necessary not only to contain information required by disabled and elderly people, but the interface also needs to be accessible.	
128	Reversing and parking aids	These systems detect and inform the driver of obstacles behind a vehicle. Further testing required with elderly and disabled drivers.	Peters, B., (1995b), TELAID Deliverable No. 9. Barham, P., et al., (Dec. 1994), EDDIT Deliverable 19A.
129	Blind spot Warning	Testing required with elderly and disabled drivers.	
130	Radio Data System (RDS)	Uses existing radio broadcasts for road traffic inforamtion. Testing required with elderly and disabled drivers.	
131	Assistance Call	Enables a driver to call for attention on arrival at a petrol station through the use of a remote control transmitter (for example, see the ServiceCall system No. 117). Even where assistance call is available, however, staff cannot always leave the till for security reasons or because of staff shortage.	
132	Systems enabling payment of petrol by credit card at the pump.	Such systems have potential benefits for drivers with disabilities, and it is essential that the user interface is accessible. For example, “Fastcard” recently introduced to some Tesco petrol stations in the UK.	

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
SKELETAL - Motion of lower limbs	Cannot use legs for walking or driving - therefore, using hand controls (with normal steering wheel)	Trip planning: Finding relevant planning information (e.g. attended petrol stations, hotels, toilets, traffic conditions, parking places, etc.) Access: Loading/unloading objects into/from car (incl. wheelchair) Storing wheelchair during journey Transferring self from wheelchair into car and vice-versa, particularly in adverse weather conditions (problems with kerbs, lack of space under steering column, opening angle of doors, etc.) Getting in and out of car seat for 'pay and display' car parks Using ticket machines at carparks Access - Pre-operative procedures: Adjusting seat - need seat to go 'full back' to get in and 'full front' to drive Seat adjustments - often don't travel far enough forward Putting seatbelt on - base too close to driver's seat and clip is out of reach Headrest adjustments - requires strength and flexibility Defreezing windscreen Vehicle control - Primary: Tiresome to drive on long journeys Accidently turning off engine whilst driving and using hand controls Fatigue in fingers - accelerator hand control requires constant pressure (similar, but reduced problem for brake and clutch hand controls) Controls often located in the safety sensitive knee clearance zone Hand-controlled brake can lock up in certain weather conditions Limp lower limbs can get beneath pedals restricting pedal actuation Steering whilst pressing accelerator hand control Turning steering wheel whilst reversing/parking Maintaining balance when looking over shoulder to reverse car Operating hand controls in cold weather conditions, particularly if driver has muscle tone problems Negotiating sharp corners and junctions - difficult to quickly turn and accelerate at same time Releasing standard handbrake with hand overload

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
	Cannot use legs for walking or driving - therefore, using hand controls (with normal steering wheel).....cont.....	Vehicle control - Secondary: Conducting pre-operative procedures whilst driving (e.g. adjusting mirrors) Finding secondary system controls whilst driving at night Overload on residual mental capacity - leads to problems in use of conventional secondary system controls (e.g. heating, radio) Overload on limbs - leads to problems in use of conventional secondary system controls (e.g. indicators, lights, windscreen wipers, windows) Vehicle Control - Other:.... Lateral support - restricted body balancing abilities Overload on residual mental capacity - less capacity to take in other information (e.g. road signs, street names) when finding way in unfamiliar area Controlling vehicle when being towed - brakes do not work properly when engine is off Routine care and servicing (checking tyres/oil/water and refueling) Handling emergency situations: Vehicle safety in the event of an accident/sudden braking - controls not subject to regulations Obtaining support from other road users, particularly in emergency situations Getting out of the vehicle in the event of an emergency/breakdown Getting to phone box in the event of an emergency/breakdown, particularly in remote rural areas Using Advanced Technology: Overload on residual abilities, making use of conventional system controls more problematic. Could result in less capacity available for visual scanning to take in secondary information (both in-vehicle and external)
	Cannot use legs for driving - therefore, using joystick controls	As for cannot use legs for driving, + Forces required to use controls Support of the underarm, wrist and hand required

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
	Can only use one leg for driving - therefore, using combination of hand and foot controls	Pressing clutch with foot whilst pulling gear lever with hand
	Uncontrolled lower limb movements	Risk of inadvertant control actuation
SKELETAL - Motion of upper limbs	Cannot use arms	As for limited use of arms, but to a worse degree, depending on situation
	Limited use of arm/s - use hand and foot controls	Trip Planning: Turning pages of map/atlases Access: Loading/unloading objects into/from car Finding hole for key and turning key Putting seatbelt on - base too close to driver's seat and clip is out of reach Headrest adjustments - requires strength and flexibility Passing money through window at toll plazas Using ticket machines at carpark Vehicle Control - Primary: Accuracy of performance in using hand controls Releasing handbrake When reversing and turning around to look cannot keep hand firmly on controls Operating hand controls in cold weather conditions, particularly if driver has muscle tone problems Using control box next to steering knob for indicators - particularly difficult when have to quickly change direction, e.g. roundabouts Controlling the steering wheel when driving in icy conditions or when holes in road Fatigue/cramp in arm, particularly if no power steering Steering and turning body at the same time - makes entering and leaving traffic difficult

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
	Limited use of arm/s - use hand and foot controls..... cont.....	Vehicle Control - Secondary: Conducting pre-operative procedures whilst driving (e.g. adjusting mirrors) Overload on residual mental capacity - leads to problems in use of conventional secondary system controls (e.g. heating, radio) Overload on limbs - leads to problems in use of conventional secondary system controls (e.g. indicators, lights, windscreen wipers, windows) Reaching secondary controls Finding secondary system controls whilst driving at night Vehicle Control - Other:.... Overload on residual mental capacity - less capacity to take in other information (e.g. road signs, street names) when finding way in unfamiliar area Routine care and servicing (checking tyres/oil/water and refueling) Handling Emergency Situations: Obtaining support from other road users, particularly in emergency situations Using phone in the event of an emergency/breakdown Pushing own car in the event of breakdown Primary vehicle safety in the event of an accident/sudden braking - controls not subject to regulations Using Advanced Technology: Overload on residual abilities, making use of system controls more problematic Use of any system controls that require tactile response, e.g. 'repeat last message' button
	Can only use one arm	As for limited use of arms, but to lesser degree, depending on situation
	Cannot move arm quickly	As for limited use of arms, but to lesser degree, depending on situation
	Uncontrolled upper limb movements	Risk of inadvertant control actuation

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
SKELETAL - Motion of upper body	Difficulties in turning head/neck	Looking for information to side of road (e.g. road signs, street names, landmarks) Turning to see through rear window or side mirrors, e.g. when reversing Looking for controls within vehicle
	Cannot turn head/neck	As for difficulties in turning head/neck, but to worse degree, depending on situation
	Difficulties in moving trunk	Turning to see through rear window or side mirrors when reversing Back pain when placing pressure on pedals Stability and balance when entering/leaving vehicle and when seated
	Cannot move trunk	As for difficulties in moving trunk, but to worse degree, depending on situation
SKELETAL - Anthropometrics	Short stature	Seeing information within road environment (e.g. road signs, street names, landmarks)
	Short legs	Reaching foot controls
	Short arms	Reaching any primary/secondary controls
SKELETAL - Co-ordination and dexterity	Difficulty using hand controls	Putting seat belt on Reaching and putting sun visor up/down Using particular secondary controls, e.g., fingertip controls for radio, integrated rotary switches, any buttons Finding hole for key and turning key Starting the engine
SKELETAL - Force	Reduced force in legs/feet	Using primary vehicle controls
	Reduced force in arms/hands	Opening vehicle door Using any secondary controls, e.g., buttons, toggle switches
	Short duration force in legs/feet	Using primary vehicle controls
	Short duration force in arms/hands	Using any secondary controls, e.g., buttons, toggle switches
VISCERAL	Sudden loss of consciousness	Sudden loss of control of vehicle - can often be predicted
	Sudden loss of awareness	Sudden loss of control of vehicle - can often be predicted
	Incontinence	Finding relevant planning information

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
VISION	Blind	Cannot drive
	Blind in one eye only	Field of vision whilst driving Distance judgements, particularly initially Turning to the side of the damaged eye

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
	Reduced visual acuity	Vehicle Control - Primary/Secondary Estimating gaps when parking Overload on residual capabilities - affects ability to look in mirrors or at secondary controls Vehicle Control - General driving tasks Obtaining information visually while driving (from maps, signs, displays) Finding way if have to change plan mid-route Changes in ambient lighting (most serious for headlight dazzle) Seeing details within road environment Looking behind, particularly in rear view/wing mirrors Choosing correct lane Seeing road signs whilst driving at speed (worse at night with reflecting signs) Perceiving and estimating distances Driving at speed (e.g. on motorways) Vehicle Control - Road-related Negotiating curves when curve is not open enough to provide good visibility and/or when speed is too fast Vehicle Control - Traffic-related tasks Viewing indicators of other vehicles (worse for oncoming vehicles) - problem at crossroads/T-junctions Maintaining headway with vehicle in front Overtaking other vehicles (checking traffic behind/in front, judging distances, seeing indicators) Entering/leaving traffic - judging gaps and seeing indicators Seeing hand signals of other drivers/pedestrians Other:... Distinguishing where to go at toll plazas Driving in fog, heavy rain or snow, and with windscreen wipers on Checking oil levels Orientation following an accident/breakdown Identifying symbols and reading text on any display

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
	Reduced field of vision	Seeing information to side of road (e.g. road signs, street names, landmarks) Choosing correct lane At crossroads/T-junctions/main road into side road - looking for vehicle left/right Negotiating curves - perceived as if video game simulation (i.e lack of 3D view feeling of depth) Railroad crossings - visual scanning (i.e. looking left/right) Seeing hand signals of other drivers/pedestrians if not in visual field Viewing an in-vehicle display
	Slow accommodation	Alternating vision between in-vehicle controls/displays and road environment
	Low contrast sensitivity	Driving at night, particularly looking behind, because road is not illuminated by vehicle lights At crossroads/T-junctions/main road into side road - problems if junction not well illuminated Finding in-vehicle controls at night (if driving with interior light off and control postions not memorised) Seeing lane markings, particularly at night for unlit roads Using an in-vehicle display at night
	Glare sensitivity	Glare on any in-vehicle displays during sunlight Glare of oncoming vehicle headlights
	Night blindness - combination of intense low contrast and high glare sensitivity situations	Oncoming vehicle headlights at night, particularly for unlit roads Exiting from tunnels Using an in-vehicle display at night
	Dark adaption	Oncoming vehicle headlights at night, particularly for unlit roads Exiting from tunnels
	Colour blindness/sensitivity	Understanding coding systems, e.g. for a paper map or in-vehicle display Traffic lights - if distracted by something else, e.g. conversation

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
HEARING	Total deafness	Obtaining up-to-date traffic/weather information (e.g. radio) Using emergency phone on motorway Warnings of other driver's emergencies Getting information on new systems via media (television, radio) Hearing:- - engine noise/feedback whilst driving - indicators - warnings/telltales - emergency services - other traffic, including horns - own horn/getting feedback - directions from passenger - conversations/children in back - auditory/tonal output from an in-vehicle system
	Partial deafness - severe	As for total deafness, but to lesser degree, depending on situation
	Partial deafness - moderate/mild	As for total deafness, but to lesser degree, depending on situation
	Disrupted hearing	As for total deafness, but to lesser degree, depending on situation
LANGUAGE AND SPEECH (Communication)	Cannot read at all	Reading text within travel information sources (e.g. maps) Reading signs in foreign language Reading any text on an in-vehicle display
	Reads very slowly	As for cannot read, but to a lesser degree, depending on situation
	Cannot understand some words	As for cannot read, but to a lesser degree, depending on situation, + Understanding voice instructions
	Cannot understand language	As for cannot read, + Understanding voice instructions
	Cannot understand abstracts	Identifying symbols on display
	No speech	Use of voice input (e.g. entering destination)
	Slow speech	Use of voice input (e.g. entering destination)
	Unclear speech	Use of voice input (e.g. entering destination)
	Low volume of speech	Use of voice input (e.g. entering destination)
INTELLECTUAL/ PSYCHOLOGICAL/ Cognitive Functions	Difficulty with understanding instructions	Following directions given by a passenger Following directions given by the ITS, for example route guidance

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
	Difficulty with new tasks	Operating an ITS for the first time
	Difficulty performing simple tasks	Using a basic ITS, in general
	Difficulty performing multiple/complex tasks	Finding way in unfamiliar area - coping with additional sources of info. Driving and using an ITS, particularly a complex in-vehicle display
	Slow response times	Reacting, generally, to driving situations Reacting to hazards, particularly when driving at speed Dealing with the timing of messages, for example route guidance
	Impaired short-term memory	Remembering instructions given by a passenger Remembering instructions given by the system, particularly voice messages
	Impaired long-term memory	Remembering routes Developing a cognitive map of an area Remembering how to use an ITS
	Limited attention span	Listening to instructions given by passenger Use of auditory instructions
	Difficulty with decision making	Making navigational decisions (which route, junction etc.)
	Limited spatial awareness	Use of complex spatial information (e.g. a paper map or map-based ITS) Lining up car with kerb when parking Estimation of speeds/distances of other traffic
	Left/right confusion	Following directions/auditory instructions given by a passenger/route guidance system
	Phobias	Driving over bridges/flyovers or through tunnels
MULTIPLE IMPAIRMENTS	Cannot use legs and arms	As for cannot use arms/cannot use legs, but to a worse degree depending on situation, + Driving in adverse weather conditions - problems with circulation Fear of breaking down, particularly at night and during winter - danger of hypothemia
	Any combination of disabilities above	Any combination of difficulties above

Impairments in UPPER CASE indicate the Impairment Categories defined by WHO in the following document:
World Health Organisation, 1980 (reprinted 1993?), "International classification of impairments, disabilities and handicaps: a manual of classification relating to the consequences of disease published in accordance with resolution WHA29.35 of the 29th World Health Assembly, May 1976", Geneva World Health Organisation 1980, 205pp, ISBN 92 41 54 12 61.

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling

WHO Impairment categories not used in the TELSCAN Classification:
DISFIGURING / GENERALISED, SENSORY, AND OTHER

Requirements of E&D Travellers
Interviews with Experts

Issues Concerning People with Mobility Impairments

Philip Barham
Cranfield University

The information contained in the following Section is an appendix of all the information gained from Expert Interviews conducted by Cranfield University with representatives of organisations providing support and services for mobility-impaired people (both wheelchair users and ambulant disabled people).

In acknowledgement of their contribution to this part of the project, TELSCAN would like to thank the following individuals,

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Brian Ellison - Mobility Advice and Vehicle Information Service (MAVIS).

ISSUES FOR CAR DRIVERS IN RELATION TO ATT SYSTEMS

General comments

A general problem with ATT systems in cars is that of reach, since many drivers with disabilities have problems reaching dashboard-mounted control mechanisms from a normal driving position. Buttons and other controls located on the steering wheel are preferable. There is, in any case, frequently a problem with operating in-car devices, since most cars adapted for the needs of the disabled driver are adapted with hand-operated controls; if, for example, the clutch and accelerator are controlled by hand, there is no hand free to change the scale on, say, a route guidance device.

Many people with arthritis suffer from limited reach, especially if they have had the condition from an early age. Since drugs administered to children with arthritis often result in their growth being severely limited so that they achieve only a very small stature in later life. Clearly this can affect the use of in-car telematic devices, as buttons and knobs positions on the car's dashboard or fascia can be impossible to operate, especially when the car is in motion, (a problem which also applies to people who have difficulty in raising their upper limbs). A good solution to this is to have the relevant controls positioned on the car's steering-wheel - Renault and Vauxhall already produced some models of car with controls for the radio/audio cassette positioned on the steering-wheel. A remote device for controlling an ATT system is also possible. An example of such a device is a remote control pad that can be used by the fingers of her left hand whilst driving to operate the car's indicators, dip

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headlights etc; an additional feature of this is that the control pad is attached to the steering-wheel with a velcro backing, so that it can be detached and relocated on the driver's knee, for comfort. The "moral" in this is that the optimum user interface is one which is flexible and adaptable.

The three most common concerns voiced by DDA members in relation to driving are (in order) : 1. vehicle reliability, 2. adequate vehicle repair facilities, and delays when having repairs done, and 3. finding an accessible parking space.

The use of ATT systems in cars was described by one expert as being rather "pie in the sky", as only a very small minority of disabled car drivers will be able to afford such technology. It should be borne in mind that drivers with disabilities represent a low-mileage sector of the driving population - the average annual mileage of a car covered by Motability is only about 6000 miles (ie approx 9600km).

A feature of modern cars is that their electronic circuitry is now very sophisticated, with many now having digital electronics; this makes it difficult to make minor adaptations, such as moving a switch to a more convenient position etc.

Generally, ATT systems are currently beyond the price-range of most drivers with disabilities. For tetraplegic drivers, in-vehicle systems are less-easily adapted, since these people already perform virtually the entire driving task with one hand. To be usable, the system would need to be either controlled from the car's joy-stick or voice-activated.

If operated from the joy-stick, a remote-control mechanism (probably using an infrared beam) would be needed. Some drivers with disabilities already have such a means of controlling the car's wipers, lights and indicators etc, and a device such as a route guidance system could be operated in the same way. Voice-activation, though preferable, implies the use of more advanced technology, and means that an in-vehicle device must be equipped with a microphone, a receiver and a speaker (so that audible feedback can be given to the user). A relatively simple system could be based on the device asking questions of the user, with the user responding with straight-forward Yes/No answers.

A further particular problem associated with arthritis is that it is degenerative; sufferers' ability to grip and manipulate will decline gradually over time, and will fluctuate from day-to-day. The implication here for ATT systems is that a device tailored to a user's requirements may need periodic adjustments and alterations.

Safety was often identified as being an overriding issue, whilst education to familiarise E&D drivers with ATT solutions was also seen as being important.

For those more interested in providing transport for groups of elderly and disabled people, the main issue appears to be organisational problems of vehicle choice and fleet management. Whereas ATT might have some role in assisting the (able-bodied) organisers, the problems are mainly seen as physical ones, and the solutions likewise.

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Route planning

The use of personal computers for route planning was supported, but it was pointed out that it is easier to encourage younger disabled drivers who already possess PC's in this respect than the older (over forties), who, by and large, are much less computer literate.

Route guidance systems

Route guidance systems certainly have their advantages, especially for people who find it physically difficult to handle a large map or a heavy road atlas. This depends, of course, on whether the system's display is legible enough to provide an adequate alternative to printed material - the problem many people have is that they drive with general purpose (long distance) glasses, and need their reading glasses to consult a map! A more subtle point is that such devices would be more suited for use by disabled people if they could be more closely tailored to their individual needs; for example, it would be useful if the system knew the speed at which the user normally drives, and the user's preferences for certain types of road.

Another view was that the status of information held regarding current road traffic conditions is frequently inadequate, as is the quality of information provided by radio programmes, although the latter provide explicit contact with the real world.

Some reservations were voiced as to the potential for route guidance systems to cause distraction and information overload, particularly to more elderly users, implying that ATT is best used when the vehicle is stationary. It was also stressed that the elderly tend to stick to well-trodden paths and seek human assistance for unfamiliar journeys. For the younger physically disabled who are mentally more active (and thus less easily distracted) ATT may have more to offer. However, doubts were cast as to the size of this market, and concerns were also expressed about cost, which may be an equally significant problem for the larger market of elderly drivers.

Mobile 'phones

Mobile 'phones are obviously useful to disabled drivers, especially when associated location beacons, and such facilities might frequently be purchased by the relatives of E&D drivers in the interests of their (the relatives') peace of mind, but there are a number of things to consider in their design.

1. **Positioning**. The mounting of the 'phone must enable it to be within easy reach, preferably as near as possible to the steering-wheel.

2. **Buttons**. Buttons must not require too much force to be exerted for them to be operable. Again, it should be borne in mind that, for many people with arthritis, the further away the buttonface, the harder it becomes to press it.

3. **Button layout**. It would be an advantage for numbered buttons (e.g. telephone key-pads) to be laid out in a standardised configuration, so that the user can key in numbers without having to look at the key-pad. It is common for the "5" button to be at the centre of a square formation of nine buttons numbered from

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"1" to "9", the central "5" button often has a small knob on it, to act as a tactile cue, which is useful.

4. **Weight**. Arthritis sufferers with limited manual dexterity will not want to have a 'phone that is too heavy, as it can make it both difficult to grip and difficult to hold up to the ear for any length of time. Of course, the ideal type of mobile 'phone for such people is one with a hands-free feature, but this feature is quite an expensive one (which is an illustration of the hidden costs of disability!)

5. **Size.** The mobile 'phone industry has tended to make their products smaller and smaller, mainly so that they can be comfortably held in the hand and then neatly stored away in the user's suit pocket or handbag. One consequence of this is that the buttons of these 'phones also need to be rather small and close together; this has implications for both the size of the numbers and symbols on the button face, and for the level of manual dexterity that is required to key in numbers.

One of the leading manufacturers of mobile 'phones offers a service whereby, in emergencies, the user can make a call to the company's "operator" who then connects the user with the Police, a breakdown service or their spouse at home etc. The connection is made free of charge, but the user must be nominated to be part of this scheme by an organisation for disabled drivers (eg the Disabled Drivers' Association, the Disabled Drivers' Motoring Club etc).

Toll booths

Many drivers with disabilities are entitled to reduced, or no, charges at tolls. Unfortunately, there is invariably no mechanism for automatically achieving this; a reduced charge can only be made manually, with manual inspections of entitlement. The result is that disabled drivers find it less of a problem to pay the full price at an automatic toll booth than fiddle about with the manual procedure. This is in spite of the fact that the technology certainly exists to enable the process to be carried out electronically, using a smart card or other means of tagging.

Parking

Finding a reserved parking space that is free is a frequently-mentioned problem among the DDA's members. These spaces are rarely signed, even within the car park! The main issue, however, is knowing which car park in a town has parking spaces available for orange badge holders at any given time. The response of most local authorities, when challenged on this, is that badge holders are usually very experienced in what facilities are available in their local area.

Another problem here is that badges are issued to people who are barely entitled to them, so that facilities are made more scarce for those in the most acute need for reserved parking space (ie people who are most severely disabled). The biggest problem facing the holders of an "orange badge" in the UK, however, is abuse by non-disabled drivers. Some supermarkets have attempted to rectify this by erecting barriers around disabled persons' reserved spaces, enabling access by means of a Smart card-type mechanism. Unfortunately, such schemes have not avoided some of

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the pit-falls mentioned above (i.e. some people have difficulty operating the barrier mechanism). Furthermore, the provision of parking "pens" is seen as stigmatising. The only universally acceptable means of physically preventing unauthorised parking in such bays is one which would enable totally automatic, hands-free operation of barriers etc by the user.

A more recent problem with orange badges is that, to prevent unauthorised use by relatives and friends of the disabled person's vehicle, users are not permitted to stick their badge onto their car windscreen. This has two major consequences : firstly, due to reasons of limited reach and manual dexterity, badge-holders have the problem of placing the badge on the fascia of their car's dashboard and then retrieving it at the end of a journey, and secondly the appearance of a loose badge in a parked car can encourage theft - the "street value" of an orange badge is approximately £250.00 in London!

Refueling

This is a very common problem, from the point of view of both physically administering fuel to the car, and then paying for the fuel. Even where an "assistance call" is available, it is not uncommon for staff not to be able to leave the till for security reasons, or for reasons of staff shortage. Filling stations with pump attendants are, of course, now virtually non-existent. The only real solution to the task of administering fuel is for this process to be fully automated, but this clearly will not happen in the foreseeable future.

Some filling stations, particularly those owned by supermarkets, offer the opportunity for customers to actually pay for fuel, by credit card, at the pump. There are several problems with this innovation:

1. The wish to use this facility must be conveyed to staff members on duty by pressing a button on the pump; current designs are both confusing (as many would-be users are not familiar with have to press the button), and fraught with various ergonomic errors (e.g. button badly positioned, too hard to press etc.)

2. The administering of fuel to the car, and subsequent payment, is still basically a manual activity.

3. Procedures for "swiping" cards, applying signatures and taking receipts during payment are also often badly designed (for many of the reasons outlined above); this is particularly problematic since the pump cannot be used by the next customer before the credit receipt has been removed from the machine, and current designs sometimes make this difficult for people who have problems with reaching, stretching and gripping etc..

An alternative view was that ATT systems have less to offer in solving refuelling problems, since these were mostly physical; fuel cap design and problems of handling petrol pumps are not amicable to ATT, while in terms of payment the problems of getting out of the car in the first place outweigh difficulties of handling money.

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Car radios

RDS is generally very useful, especially for traffic news bulletins, but is not usually marketed as something that might be particularly suitable for drivers with disabilities; this probably limits its uptake within the disabled driver community. RDS is the most appropriate type of car radio because the user does not have to fiddle with control knobs to make minor adjustments to the radios, frequency during a journey. An additional "ideal" is to have all of the radio's controls on the car's steering-wheel, but both this feature and RDS incur considerable extra expense.

Heating and air flow controls

The importance of the easy operability of heating and air flow controls is often under-estimated. Many drivers who are also wheelchair users can take a considerable time to get in and out of their car, and will have to have the door wide open during this time; in bad weather conditions, the interior of the car can get rather wet, so the ability to easily dry the car out should be given a high priority.

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ISSUES FOR PUBLIC TRANSPORT USERS IN RELATION TO ATT SYSTEMS

Philip Barham, Cranfield University
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Trip Planning

Pre-travel service information can be given in a number of ways, including at inter-active information terminals, dynamic screen displays and electronic (LED) displays. A number of interactive information systems, both on-street and at public transport terminals, are being developed as part of the Transport Telematics Programme. If these terminals are to be of use to elderly and disabled travellers with mobility impairments, the hardware and software must be designed with their needs in mind.

Pre-trip public transport information is also increasingly available in the home, via the internet. In Europe, it is train services that are most advanced in this respect, with the facility for conducting train timetable enquiries available in many European countries. For instance, it is possible to plan journeys by train anywhere in the UK - and also using the few cross-channel services - with the help of the "British Rail Journey Planner", a quite sophisiticated software package that is used increasingly by individuals with PC's.

Access to bus timetable information is less well-developed, with only a few local authorities having taken the initiative of providing information on a dedicated web-site - an example of one such authority is Buckinghamshire County Council, whose comprehensive web-site can be found at http://www.pindar.co.uk/bucks/.

The ROMANSE II - EUROSCOPE project is also in the process of developing such a web-site facility for home-based timetable information; this facility will be evaluated, in terms of its suitability for use by elderly and disabled people, by TELSCAN in early 1998. However, travellers with mobility impairments will need specific types of information in order to plan their journeys, and the sites noted above need to be evaluated from this aspect as well.

Information Requirements

User studies in Gothenburg have provided complementary and more in-depth information on passengers' attitudes towards public transport and the role information may play in the assessment of the overall transport service.

The study confirms that information is important to all categories of passengers. The passenger information system must provide information on the whole trip; on departure times, arrival times, on how to travel from A to Z, etc., as well as on disturbances and delays.

Some of the required static information may be acquired by traditional information products, such as timetables and route maps, while some of the dynamic information may be obtained via a loudspeaker system or via an information telephone service. User group interviews, however, revealed several shortcomings of the existing

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products, not least the present dynamic information media: the loudspeakers have poor output quality and it is easy to miss an announcement. The information centre has poor accessibility even though providing an important service.

Even though some of these defects can be corrected by improved technology, the same information via new IT-media (i.e. on delays and disturbances on displays and monitors at the bus and tram stops, and on travel routes over the Internet or via Teletext) should have potential for improving the information service system. Real-time information is valuable for all categories of passengers, reducing uncertainty and increasing perceived control and overview of the whole journey.

Public transport service information on the Internet, both real-time information and route planning, holds value for all categories of those passengers that have access to the net. The present services must, however, be improved. A study of the two Internet-services in Gothenburg have shown that service content is not complete and does not provide the full spectrum of answers to passengers' questions. Passengers need information on the whole trip, as well as on all aspects of the trip including route(s), time(s), costs, information on disturbances and delays, whether there are steps to climb at the station, and what wheelchair facilities are available on and off the vehicle. This may be described as the content of the information service, i.e. what is offered. Two aspects are obvious with regard to the two Internet-services in Gothenburg:

(i) Information on both services is limited to 'today's' trips, whereas the passenger's question may involve planning of an unknown trip to be undertaken tomorrow or next week. This limitation reduces the usefulness of the service. Most travellers with disabiliites need to plan ahead, and without the relevant information, may be hesitant to undertake their journey.

(ii) Both services require a fairly good knowledge about the transit system (e.g., the correct names of stops etc.) in order for the passenger to benefit from service and from the information. With its present layout, the map link is not an alternative which provides the user with a clear picture of how the routes run and what streets etc. are passed. This pre-requisite for being able to make use of the information is a great problem among non-frequent riders. Actually, even with experience of the public transit network, it is not certain that an individual can recall the correct name of a stop. Again this delimits the usefulness of the service for all passengers, but especially those with disabilities.

So availability of information on accessible vehicles and stations is required to meet the needs of people with disabilities, e.g. whether the bus is easily boarded by a wheelchair user or whether there will be assistance at the destination stop. Such information is important in choosing the most suitable form of transport mode, and such information must be easily accessible to all users. This is where telematics can play an important role.

Public Information Terminals (touch screens)

Touch screens are becoming increasingly common as the user interface for public information, as well as ticketing, terminals. They are perceived as being user-friendly towards elderly and disabled people by service providers, mainly because they

require minimal pressure on the screen for inputting instructions and requesting hard copies of tickets and other information. The absence of knobs and buttons can certainly be an advantage to some people, but the use of a touch screen interface does nevertheless raise certain issues for design.

Where a touch screen is used, it is common for the screen area to be the location of **all** of a terminal's operable parts. In such circumstances, it is particularly important for the screen to be easily reachable - to safeguard this requirement, no part of the touch screen area should be more than 1200mm from the ground. There are two reasons for this : firstly, touch screens are often associated with a problem of **parallax** when viewed from a vertical or horizontal angle, and secondly, people of small stature or those using a wheelchair might find it hard to reach some, or all, of the touch sensitive areas of the screen. Furthermore, the screen should be flush to the outer casing of the terminal that surrounds it. This is to prevent users who have difficulty in reaching the screen from having to reach into the terminal (which can be a particular problem with terminals whose screens are considerably recessed, to minimise the glaring effect of extraneous light sources).

Approaching a Facility

A major problem for many people with disabilities begins before they tackle the user interface of an information terminal or ATT device, because their problem is one of approaching the terminal or of reaching out to operate controls, press buttons or take tickets etc.

Many kiosks and information points are mounted on a plinth, or just inside a building which has a step at its entrance, thus making it impossible to use by a person in a wheelchair. Even if this is not the case, many wheelchair users are not able to efficiently use a terminal because they cannot get close enough and because the screen is located too high. Some people, with e.g. arthritis, may experience additional difficulties because the strength they might have in their hand(s), and therefore their ability to perform button-pushing, knob-turning tasks, will depend on how far away their hand needs to be from their body (which has implications for how far buttons and other features of information terminals should be set into walls, consoles, etc). In fact, the very act of extending an arm for more than a few seconds may be tiring and/or painful and require a considerable effort, due to weaknesses in the back, shoulder, elbow - or all three - with the result that little strength is left in the hand and fingers.

Buttons can be much easier to use if the user is able to get as near as possible to them, precluding the need to reach out. A simple solution to this would be to provide a foot/knee recess in the terminal - such a provision would not be to the detriment of people with other types of impairment.

Ticketing and Payment Mechanisms

The need to reach out and take a ticket - or worse, to pick up change - at entrances to train, metro or bus stations is also a problem, not just from the point of view of length of reach, but also because some people, for example with arthritis, often have limited strength and dexterity in their fingers, which may make gripping a ticket or receipt difficult.

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Advanced technology can change the options available to public transport in ways which could assist many people with disabilities. Contactless or proximity smart cards could be helpful and could also contain data on the individuals' capabilities and assistance needs, regular trip origins and destinations, etc.

Uptake of Telematic Systems

The potential of telematics to meet the needs of people with disabilities is also dependent on the awareness of the benefits that telematics can provide. It is apparent that the process of promoting telematics for disabled people needs to be accompanied by a carefully structured information dissemination programme aimed at ordinary users, not just experts or associations for disabled people. If this is not done, there is a risk that many people who would benefit from IT will remain unaware of these benefits.

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Requirements of elderly and disabled travellers

Expert Interview
Issues with regard to travel by Train

Colette Nicolle
HUSAT Research Institute

An interview was conducted by the HUSAT Research Institute with the Supervisor for Disabled Travel, at London King's Cross Railway Station. The interview is discussed below according to the main headings of the travelling task, and the data is summarised in the inventory of user requirements.

Trip Planning
The discussion centred around the use of the Disabled Passenger Reservation System (DPRS) and its effectiveness in meeting the needs of elderly and disabled rail travellers.

The DPRS details the needs of the traveller, and the computer system relays this information from one station to another. Depending on the disability, some people may need assistance with a wheelchair, embarking/ disembarking, finding their way, asking for directions, transferring to another mode of travel, etc. The system provides the following options to describe an E&D traveller:

Confined to wheelchair
Own wheelchair
British Rail wheelchair
With mobility problems
Blind
Deaf
Other disabled passenger

The system, not considered advanced or intelligent by the standards of the Transport Telematics programme, appears to be the only available system to meet E&D needs. It was emphasised that basic user needs require human assistance, which cannot be replaced by ITS. The DPRS simply ensures that the request for assistance is conveyed to the destination station. It is clear that the system is only as efficient as the quality of information given by the operator and whether this information is then efficiently conveyed to the next station and acted upon.

When a late request for assistance is made, there is more chance of human error, since the request would have to be relayed by telephone to the destination station rather than transmitted by computer overnight. This was suggested to be a problem that could be solved with more software, eg Excel by linking the short term requests together. The supervisor emphasised, however, that even if the request for assistance is not passed on, there is always staff available to help travellers in every way possible.

The DPRS was considered to be an efficient system by train personnel. This point was discussed and refuted by blind travellers (See Appendix 3.B), although they were all aware of the existence of the system and how assistance can be requested. The

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Station Supervisor claimed that travellers with hearing impairments were always able to locate Minicom, the text facility for telephone use. This point needs further verification with user groups having hearing difficulties.

The Train Supervisor suggested that some E&D people may find it difficult to express their needs, or they may not feel that this service is meant for them. For example, elderly people want to be independent and do not consider themselves disabled, but still could often use some assistance. Train personnel are trained to be aware of their needs and watch for ways in which they can assist. The Supervisor suggested that TELSCAN's functional classification should keep elderly people as a separate category. Their requirements and motivations are different from a younger person with the same functional disability and they often do not recognise their need for assistance.

Access - Transfer Wheelchair
The Train Supervisor described an incident whereby a regular traveller was given a new wheelchair, presumably by his local authority, but the new wheelchair would not fit through the internal door to the space allocated for wheelchairs. Perhaps the train door is of inadequate width; however, the Supervisor was quite sure that it was the responsibility of the wheelchair manufacturer to ensure that the wheelchair was of the right proportions. British Rail are now investigating, but it is also important that user groups are interviewed further to see if any other problems occur across Europe.

Hearing Announcements
People with hearing impairments require all auditory information to be complemented by a visual display. The Supervisor indicated that all important information in the station is given on visual displays, but a survey of the station following the interview confirmed that not all other types of messages were displayed visually (See below). Although Station Personnel feel that the mix between auditory and visual information is adequate and there are no problems, this needs to be further verified with user groups with visual, hearing and communication difficulties. A person may miss information important to him/her if not able to hear a message, for example, to report to Customer Relations or to remove a bicycle chained to the railings .

Handling emergency situations - Leave vehicle
Train Personnel emphasise that they watch for elderly or disabled people in case of emergency. People may need help to evacuate and this should have been recorded on the DPRS.

Handling emergency situations - Inside the station
The Train Supervisor said that if there is a need to evacuate the station, auditory warnings would be given, as well as screens providing a visual display. If a person with a hearing impairment is in the toilet, he/she would not be able to see the display, but station staff are instructed to check all toilets in case of emergency. It was suggested, however, that some form of backup warning would be advisable, although a simple form of technology would probably be adequate, eg a warning light. On reflection, however, the Supervisor was concerned both by the fact that people might not react quickly enough to a warning light or that vandalism might be a problem.

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Conclusion of the Interview

The Train Supervisor was grateful for the opportunity to describe the strategy used to support the needs of E&D travellers. He also expressed interest in hearing results of the TELSCAN study and the development of new technologies for E&D rail travellers. It was clear that the need for human assistance seemed paramount for E&D; however, it was also evident that the communication of these needs could be made more efficient by the use of ATT applications and a greater awareness of their potential.

The DPRS is prone to human error, and interviews with user groups have noted that the DPRS is not adequate to record and support their needs. The level of assistance given to an E&D person may be dependent on awareness within the train of the traveller's special requirements, both from staff and other passengers. Given the level of possible error within the DPRS, a request for assistance may be known only at the destination point and not on board the train all along the journey. This would need to be investigated; however, only an analysis of critical incidents would be able to gather the right detail of information and this is out of the scope of this study. Possibly an ATT system could help to ensure continuity of information and awareness.

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Survey of Systems at St. Pancras Mainline Train Station and King's Cross Underground Station

Following the interview with the Train Supervisor for elderly and disabled travellers, TELSCAN conducted a survey of the types of existing systems which can be found at St. Pancras Mainline Train Station in London. The definition was kept very broad, in order to include any technological system, whether or not considered advanced telematics. This is the result of that observational survey:

Visual displays for train departures.

Displays were high; text would be difficult to see for people with visual impairments.

Auditory announcements.

Auditory announcements were made for all train departures. However, there were other types of annoucements which were made over the loud speakers, and were not given in any visual form. These included a message for someone to report to the Customer Relations Desk, and for someone to remove a bicycle chained to the railings. This type of message could be quite important for a traveller to act upon, and the information would have been lost if that person had a hearing impairment.

System for creating business cards.

This computer-based system showed a welcome screen to the Express Card Service. It requested the user to insert 3£ for 50 small cards or 25 large cards. The user is asked to: Select quantity of cards, insert coins, and then follow simple on-screen instructions.

Positioning of the system and reflection on the screen made it difficult to see for all people, but especially for people with visual impairments. A touchscreen qwerty keyboard was available to compose the required information, but without user testing with wheelchair users or people with dexterity problems, it is not clear if the height, positioning and sensitivity of the input mode is appropriate.

British Telecom telephones.

A traveller is able to use either a BT phone card or a chargecard to make a telephone call. In St. Pancras station, the telephone kiosk was in a very noisy location, whilst at King's Cross Underground station, telephone were found in a quiet,private purpose-built telephone room (following major renovations which were required followed the disastrous fire some years ago.)

All users, but especially people with a hearing difficulty, would have problems using the telephone kiosks in the noisy location at St. Pancras station. People in wheelchairs or those with coordination or dexterity problems may also have access problems with some of the telephones.

Ticket Machines.

These are available for purchasing tickets at the Underground station. The user must choose the type of ticket (single or return), then the destination, by pressing the appropriate keys in succession. The display indicates the cost, the user inserts the money and then takes the ticket. These ticket machines may be unusable for: People in wheelchairs, unable to reach high enough to press the appropriate keys. People with dexterity/coordination problems, who cannot press the appropriate

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keys, or cannot manipulate coins and insert them into the slot.
People with visual impaiments, who cannot identify the right keys.
People with cognitive impairments, who cannot understand the instructions.
Elderly people, for all the above reasons and who may feel threatened by a crowd standing behind them and waiting their turn.

In this survey of a London train station and an underground station, there was no system which we could call an advanced or intelligent transport telematics system. The systems described above should still be considered, as they have implications for the design of ATT systems.

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Requirements of elderly and disabled travellers

Issues with regard to travel by Eurostar

Colette Nicolle
HUSAT Research Institute

The following report has been produced from a cassette audio-tape produced as part of the Channel Tunnel Project, produced by the European Passenger Services, the international travel business which operates Eurostar, in partnership with college students. Blind and partially sighted students from Daughton College of Further Education in Sevenoaks, Kent, went on the journey and participated in user trials. The project won a gold medal and certficate in H.M. National Challenge.

Comments on the tape especially relevant to people with visual impairments are discussed below according to the main headings of the travelling task, and the data is summarised in the inventory of user requirements. TELSCAN's own comments are given in *italics* following details from the tape. At the time of writing, however, it was not possible to follow up the queries with Eurostar staff, due to their workload and time pressures, financial difficulties, closely followed by the Eurotunnel fire.

Trip Planning
Eurostar Telesales prefer requests for assistance at least 24 hours before travelling. The telephone number is given, *but it is not clear how people come to know the number. If through a travel agent, presumably the travel agent would be able to make all the arrangements and request assistance for the E&D traveller.*

The traveller should state if visually impaired, blind, travelling alone or with a companion, and whether assistance is required. The following information should be provided:
Date of travel and departure of train
Destination station
How arriving at Waterloo station
What special needs are and what assistance is required
Whether travelling with a companion or alone
Any other information that will explain the level of assistance required
Smoking or non-smoking.

Not clear if all people can input and hear output. *Does Telesales operator prompt for this information? Will elderly people feel they need assistance?*

Access - Reach point of departure
In locating Waterloo International Station, partially sighted person said it was not difficult to get to Waterloo "if you know the way." The station is accessible by escalator or lift from the domestic concourse. It is accessible by rail, underground, bus, taxi, car or on foot. There are dedicated car-parking spaces available for people with disabilities.

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Overall layout of Waterloo Station:
The ticket controls are automatic but customer service personnel are there by each machine to help. The ticket is put into the machine on entering and it is returned to the traveller, as in the underground stations in London.

Access - Waiting
In the departure lounge, a partially sighted person said "impression is grey, but there are rows of brightly red seats and brightly lit buffet areas. Signs are above your head, not highlighted, and so it's important to get assistance from Customer Services. Boarding announcements are clear."

Access - Entry/Exit vehicle
The end of the platform is clearly marked with about 30 cms of tactile paving. When boarding, it helps to recall that when boarding at Waterloo, there are 2 steps. It is necessary to locate the right carriage and seat, but Customer Services are there to help.

The tape gives locations of flip-top tables, reading lights, footrests, etc.

How many people have this cassette with pre-boarding hints and instructions? Perhaps an ATT solution would be appropriate here to convey information to a wider audience.

Travelling in the vehicle
There are two train managers on board each train, helping to ensure that safety and customer care are always available. The train managers' advice to blind or partially sighted travellers is to let them know of your needs when booking and to contact terminal staf on arrival.

Before departure, the train manager is handed a report of those with reservations and special needs passengers are identified in that report but only in number not by name (See DPRS in Appendix 3.A).

When travellling at top speed, blind and partially sighted students noticed only that the train rocked more. While in the tunnel, there were more echos, and then their ears popped a little. Otherwise it was difficult to know they were in the tunnel. An announcement is made just before entering the tunnel.

Automatic doors on board open at a light touch and do not recognise the presence of a person, so they will close at a set time.

This could be dangerous or frightening for an elderly or disabled person.

The doors are made of see-through glass, with round white dots at eye level.

Useful for people with some visual impairment, but not suitable for people of short stature with visual impairment.

Carriages are approximately 20 strides long.

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Arriving at Gare du Nord in Paris, when disembarking, it is necessary to descend 3 steps. This is particularly important as the stairs are all silver and not easy to distinguish. Blind student remembered walking up 2 steps on boarding at Waterloo and disembarking with 3 steps and found this a little disorienting.

When arriving at Bruxelles Midi, lighting is lower than at Waterloo and there are 3 steps down from the carriage to the platform. There are blue pillars and blue signs in the middle of the walkway, an uneven floor surface and polished marble floor. Travelling to or in the underground is very dark. Doors on each carriage are difficult to see, and a partially sighted traveller noted that the dots on Eurostar made it easier to recognise.

Perhaps an ATT solution could convey this information more effectively to all travellers, especially E&D. Many of these issues, however, are basic architectural design and accessibility issues which should in fact be solved before ATT can enhance the service.

Hearing anouncements

Auditory announcements are made while on board the train. There are no visual displays with the same information. The information is made in 3 languages: French, English and Dutch.

There are 4 telephones in eact set of carriages, but telephones cannot be used while in the tunnel itself. They use the cellular system, so they will work in the UK or France, but not in between.

Will this have implications for the use of ATT systems?

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Requirements of elderly and disabled travellers

Expert Interview: Issues with regard to travel by Airplane

Colette Nicolle
HUSAT Research Institute

Introduction

An interview was conducted by the HUSAT Research Institute with an Airport Duty Manager at East Midlands Airport in the UK. The interview is discussed below according to the main headings of the travelling task, and the data is summarised in the inventory of user requirements.

Trip Planning

Elderly travellers sometimes telephone or write to ask questions directly from the airport before they travel. One would expect that the travel agent or tour operator would have already told them many of these details. Some common questions are:
Where are the disabled parking spaces?
How much does it cost to park?
How to physically get bags to the terminal?
What happens if they are the only person driving?

Switchboard staff at the airport also work on the Information Desk, so they know the procedures and can usually answer their questions. The airport is aware that if a person has not flown before, an airport can be an intimidating place. Elderly people may sometimes even perform a "dry run" before taking a trip, ensuring that they know where to park and what to do.

These comments refer mostly to elderly travellers, as the younger disabled tend to be more independent. She in fact could not remember a younger disabled person or a blind traveller travelling on his/her own. They usually tend to travel with other people, and the travelling companion would be asking/receiving the information. More elderly people travel on their own, especially in the wintertime, going away for 3 months over Christmas and returning in February. People may book a taxi for their return journey in 3 months' time and are upset when it doesn't turn up because taxis are used to only 1-2 weeks' notice.

ATT solution?: An information system which could stop this breakdown in communication between taxis and long-term travellers.

Signage

The airport is able to send a map of the airport facilities before travel, but usually they need to only give directions, eg "Come in front entrance and take first left." The airport tries to lessen the distance disabled travellers need to cover, eg the disabled parking bays which are within easy reach of the entrance.

The biggest problem the airport finds for E&D is the use of the disabled parking bays in the short stay car park by non-disabled people, even though they are well signed. Apparently there is a similar problem in other airports, and no one has found a

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suitable solution. East Midlands Airport is introducing wheel clamping of cars left at the terminal front, and they are investigating the possibility of clamping in the disabled bays if there is no response after 2-3 calls. A difficulty, however, is that there are some very "grey" areas, where someone is not registered as disabled but still may be so on a particular journey, eg because of a broken leg. The airport and security staff must use their discretion.

When travellers are seeking information, they tend to ask the closest person, and if that person cannot help, they go the nearest information desk.

The airport are discussing whether to put braille signage all along their main signs, but they will probably decide not to do so. There is already braille in the lifts, but since there is only ground and first floor, not a lot can go wrong.

Since the vast majority of blind or visually impaired people cannot read braille, and would need to know where the sign is anyway even if they could read it, it would appear not to be a sensible option.

Hearing announcements
Auditory departure calls provide the same information as the visual signs.

There was a move a couple years ago to turn the airport into a "Silent Airport", although it never came about. A silent airport makes no auditory departure calls in the main concourse, but only once the travellers get through to the lounges. Their reasoning was that the brain switches off when there is so much auditory information , and if there were an emergency, the auditory call might not be so meaningful. This airport used to make 4 calls per departure. This has now been reduced, but they are reluctant to reduce it any further, because visually impaired people, unable to see the visual signs, would be disadvantaged. Other travellers too require the auditory departure calls, eg if in the cafeteria.

It was emphasised that the layout and size of the terminal is small enough so that communication is facilitated, not only between staff (tour operators, security, etc.) but also with the travellers. This is more difficult in a larger airport with a much larger infrastructure.

ATT solution?: ATT was discussed as a means of providing information to E&D travellers. The Airport Manager wondered if people would prefer to speak with someone face to face, especially if they are elderly or disabled. She felt that an elderly person in particular would always opt for face-to-face information.

With regard to moving around the airport and catching a flight, there is not a great deal of information that would be needed on a system. However, the system might have benefits in advertising, or in describing what the airport at the destination point is like. Still, though, she felt that elderly people would find the technology a bit daunting, although the younger disabled would be more used to using such technology. The system would need to be accessible for different types of impairments.

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Buying a ticket

Travellers usually buy their tickets at the travel agent, although it is possible to buy it at the airport. It was strongly suggested that travel agents could be more proactive in offering information to elderly and disabled people. For example, people sometimes would ask at the airport how to request an aisle seat because of an inability to move their leg. The travel agent could easily have told the handling agent and they would make a note to save an aisle seat.

There was a case of an 80 year old, confused man, hardly able to walk, who had left a nursing home and bought a ticket to Spain from the travel agent. No hotel had been booked, and the man had no friends there. The Airport staff felt an obligation to dissuade him from travelling, but wish that the travel agent had tried to assess the situation better.

ATT solution: A more intelligent link, not just a database, between travel agents and the airports (and other modes of travel). It was suggested that there must be thousands of travel agents sending people to this airport, but a smarter technology might be able to cope with this. At the moment, travel agents use a prompt and answer computer system, eg "Which airports? A B C D." There is a need for more options, not just "Does the passenger require other services." Perhaps they are not asking all the right questions in order to elicit enough information about the person and his/her special needs.

When someone visits a travel agent, there is so much to take on board (tickets, accommodation, insurance, car hire, etc.), and sometimes it is only later that other special requirements become apparent. The travel agent has a great responsibility to capture these special requirements and pass the information on to the handling agent. E&D people also need to know who to ask for help, as there are so many different bodies involved:

Travel agent: those with whom you book your holiday.
Handling agent: those who do the check-in, look after the aircraft when it is on the ground, look after passengers once checked in, look after refuelling.
Tour operator: company that the travel agent buys the holiday from.
Airlines themselves.

The travel agent is an important link in the chain, what information it gives out and what information it receives from the traveller. There is then a need for better communication between the travel agent and the handling agent, who would be in a position to inform the ground crew of special requirements. If requests get to the handling agent, there is usually no problem, eg organising a lift to help a disabled person on board, or arranging pre-boarding for slow movers.

Late requests, eg for an aisle seat, if not taken earlier by the travel agent, can be given directly from the airport staff to the handling agent, but it is not the normal route. It is much better for such requests to be organised early through the travel agent, as on the day there might be 20 people who cannot move their legs easily. There is always too the danger that some people ask for an aisle seat, making travelling a bit easier for them, whereas it might be essential for an elderly or disabled traveller.

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Access
The airport offers certain facilities to help E&D enter the airport departure areas. A call sign is found on the terminal front, which is activated when a disabled person points a transmitter at it. An alarm will then sound at the information desk, and the airport will send someone out to assist.

ATT solution?: Such a transmitter could be used to start a tape which would relay information directly into the car.

Handling emergency situations - in the airport
In the first few seconds of an emergency in the airport, the alarms are auditory, so there would be a problem for people with hearing impairments. There are also two visual alarms to warn people that the fire shutters are dropping (a problem for visually impaired?) Security staff will sweep the building, including the toilets. All the fire exits have ramps. Slow walkers would be spotted. The same procedure would be used for fire, bomb threats or other emergencies.

Handling emergency situations - on the plane
People with mobility problems are not seated next to the exit doors. However, there is more legroom there, and disabled people often will ask for that seat. It became apparent during the interview that the handling agent might not be aware of other disabilities, eg co-ordination/dexterity problems, reduced force in hands/arms (to open the door), reading difficulty (to read the instructions for opening emergency exit).

ATT solution?: Fully computerised check-in and any such special need could be flagged, issuing a "smarter" boarding card which could record all special needs or difficulties, to benefit both the traveller and the emergency procedures.

However, some people with disabilities may be reluctant to volunteer this information, or they might not realise they have a special need, eg not enough force to open the emergency exit. So a vital component of the system is awareness-raising to demonstrate the reasons for and confidentiality of the information as recorded in the system.

Transporting Mobility Aids - on the plane
A person can bring his own wheelchair onto the plane, or it is possible to use the airline's wheelchair and put his own into the hold. This does not appear to be a problem.

ADL activities - on the plane
The toilets are always at one end of the plane, and E&D people sometimes ask to sit nearby or may ask for assistance to use the toilet before getting off the plane. However, there is not much space if a carer is required to help. The only solution would be more available space.

Hearing Announcements - On the plane
All information is broadcast through the speakers, eg when the captain speaks to the passengers. In some of the more modern aircraft, however, television screens above the seat in front can offer visual displays, but this is more likely to be on the long distance flights (mentioning specifically the Virgin flight to the U.S.)

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Sometimes emergency procedures are displayed on a television screen as well as being demonstrated by the stewardess. It became apparent that the "lighted strip down the aisle" that should be followed in case of evacuation could not be followed by people with visual impairments. The airport duty manager did not think that ATT would be able to take the place of human assistance.

Existing ATT systems

The Duty Manager was familiar with the video screens in the lounges at Heathrow, although they could not be considered interactive or particularly advanced. She was not aware of any other advanced systems, eg smart cards, etc., in any airports in the country.

Her example of how a smart card could be used in an airport: Visually impaired person puts smart card in slot (having located the machine and slot of course). The system would give information about, for example, where to go, how to get there, what is available here and in the lounge, where are the toilets and how to get there, what is going to happen (metal detectors, etc.). However, other passengers are not given all that information beforehand; instead they see (or experience) it as they go along. For a visually impaired person this information might be especially useful, and would provide additional confidence to embark on the journey. People with cognitive impairments might have particular problems, although these people cover such a wide area of needs and difficulties, and it is difficult to see where ATT could help.

Although she would be interested to know more about any specific ATT systems which become available, she does prefer the human contact to technological solutions. Any technology would have to be an addition to the service the airport already offers, not a replacement. This is not being anti-technology, but she knows that her customers like the personal contact. Any system should have information for everybody to use, but it needs to be designed so that elderly and disabled people will be able to use it, as well as other people with special needs, eg mothers with small children.

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Requirements of E&D Travellers in Public Transport Interviews with Experts

Issues Concerning People with Cognitive Impairments

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Interviews were conducted with experts in the area of disability and rehabilitation from FMH (UTL), and with transport operators from CARRIS (Bus and Tram) METRO (Subway) and RODOVIÁRIA DE LISBOA (Bus on surrounding areas).

People with cognitive impairments, despite having a certain autonomy, usually have some difficulties, as a consequence of the lack of accessibility to the environment. The travelling task is one example of the many difficulties that the elderly and people with cognitive impairments face on a day-to-day basis. Today it is essential that the transport system can be accessible to all people, being accessible to children, the elderly and people with physical, sensory and cognitive impairments.

Relative to the definition of the travelling task, most of the subjects with a cognitive impairment have difficulties in almost of all its sub-tasks. They encounter difficulties in trip planning, in the ticketing task, in access to the vehicle and access to the departure/arrival point, as well as in trip information and, consequently, in the use of advanced technology. These several difficulties are related to the problems that these individuals face. These problems are specifically difficulties concerning the abilities to understand instructions and to perform simple and complex tasks; difficulties in memory, attention, spatial representation, response times, etc. There are several mental and physiological abilities that are diminished, and that limit the capacity of the subject to carry out a specific task.

These difficulties concerning the travelling task can be surpassed through the use of adequate interfaces in information presentation systems, which should use reduced, simple, concise and explicit information, as well as symbols/pictograms, which have the aim of reinforcing and clarifying the information presented in the text. These systems should also use spatial and temporal repetition of information. Associated to this, the use of different colours, as well as previous information and human help, will increase the possibilities that these people can successfully use the many opportunities that society offers.

Some possible solutions are being developed, in order to achieve accessibility. These systems are related to specific vehicles:

Bus

Travelling by bus appears to be difficult for the elderly and people with cognitive impairments, since they have some limitation in almost of all the sub-tasks of the travelling task. To compensate for these limitations, some ATT solutions are being developed in Lisbon. There are four principal projects of ATT systems:

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a) project AMMOS - this project is developing a tactile input system that contains all the information needed to plan a trip and to carry out travel successfully. This system contains information about arrival/departure points, schedules, transfers of transports, changes in networks, etc. It must be accessible to all people, especially those who have some impairments, not only in relation to the type of information presented but also in the way of its control;
b) project ICARE - this project aims to facilitate the ticketing task, i.e., creating a system that avoids the use of a ticket machine and ticket stamping. The subject enters the vehicle and the ticket is automatically paid by using a special card ("free-hand card") detected by a specific device;
c) another project, developed by Carris & Rodoviária, aims to make the use of existing ticket machines easier. To achieve this it is necessary that specific conditions, such as the presentation of information, the luminosity of the characters, the function of the system, etc., must be fulfilled. Therefore, subjects can buy the ticket autonomously and successfully;
d) the last project concerns information systems, and is being developed by Carris & Rodoviária. This system gives specific information about points of departure/arrivals, the localisation of stops and gates, the schedules, etc. In this way, subjects can plan the trip they intended to do, in terms of time, type of transport, departure and arrival point, transfers needed, etc., autonomously.

Tram

Difficulties in using the tram are identical to the ones' that were mentioned on the bus. Since these two types of transport are very similar, the possible solutions under development are the same. Therefore, this type of transport presents two systems that buses do not have. One of them is concerned with a ticket machine that gives to the subject the opportunity to buy and to stamp a ticket inside the vehicle, avoiding the contact with the driver. The other system is more general and it concerns trip information, i.e., this system notifies the driver of the desire to stop at a specific point and notifies the passengers about the next station. This system uses visual and audible information.

For example, one of the difficulties concerns the entry and exit of the vehicle, since it is necessary to open the door by pressing a button, which is not specified and is not usual in our country. On the other hand, the use of the ticket machine is not easier, since it is necessary to use only coins, and there is no information about that to the user.

Metro

The use of the metro presents fewer difficulties, since there are more systems that help the traveller in the travelling task. The principal difficulties are concerned with trip planning and with the ticketing task. It is still difficult, to some people, to plan and to have a representational image of our metro network. For example, in some stations the displacement is difficult, since the information about the various gates is not always clear, leading to confusion.

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To compensate these difficulties two systems are being developed, in the AMMOS and the ICARE projects, as already mentioned above. Relative to the trip information task, there is a system that enables people to know about arrival and departure stations, stations changes, the name of the next station, all network changes, etc. This system provides not only visual information but also audible information, and is located at the gate and inside the vehicle.

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Requirements of elderly and disabled travellers

Focus Group with Users
Issues with regard to travel by People with Visual Impairments

Colette Nicolle and Gary Burnett
HUSAT Research Institute

A focus group interview was held at the RNIB Technical College in Loughborough on 11 December 1996, and a copy of the agenda is attached.

11 blind or partially sighted students attended the focus group. They all resided at the college, although their homes covered a wide area, eg from the south and west coasts to North Wales and the Midlands. Although the number of users was at first considered too large, it proved to be suitable as 6-7 students participated more fully, and the others tended to confirm or then dispute what was said - a good balance to get a fuller picture of the problems and requirements.

Participants were asked to identify the modes of public transport they used and the relative frequency of travel:

9 travel on buses regularly (local trips only)
9 travel on trains (for longer distance trips)
8 have travelled on a plane at some time (on holiday)
8 have travelled on a ship at some time (on holiday)

Their Underground experiences were slightly different, and very varied.

Problems - TRAINS

Access - Entry/exit vehicle

One man spoke of an incident where he was put in wrong carriage, the train stopped short of the platform, and when the door opened his guide dog fell down the gap. He noted that the length of platforms is inconsistent in the UK, and would like to see an electric gangway and ramp for trains.

With Regional trains, opening doors is real problem. It seems ridiculous that you have to lean out of the train to open the door, and automatic doors are much better (but have to find button). One person commented that she wouldn't have any hands free, with a dog lead in one hand and a bag in the other. As the door swings open the dog jumps out. All the guards are however very helpful.

Standardisation is the biggest problem - trains vary considerably, so one cannot learn where aspects of train are - steps, doors, button for opening door, toilets etc.
It would be helpful to have something to indicate where the step for the train is, with some form of contrast.

Access - Reach point of departure

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Announcements are made on intercity trains, but only sometimes on regional trains - therefore visually impaired travellers have to ask how many stops to their destination. Even this can cause problems, since a train can stop in between stations. A number of those in the group had experienced this problem - some had tried to get off when there was no station, and others had got off at the wrong station. When there is an announcement, it is not always possible to hear it due to slamming doors, etc. It was mentioned that a recording would be useful to make an announcement before the train pulls into the station, to give the person enough time to walk to the exit.

It is possible to arrange for someone to help you off and meet you at destination - however, there is not always someone there. This is known as the 'Assistant travelling scheme' and necessary to give them 48 hrs notice and book. There seems to be inconsistency, possibly blamed on errors in computers. They found it is better to ask that day- the urgency helps to ensure that help is there.

The bigger the station the more help that is available for disabled people, although another traveller noted that bigger stations can also have problems. Many small stations are unmanned after a certain time, so there will inevitably not be anyone to help.
When changing trains, it is necessary to rely on someone else.

Points were made about poor state of bridge for Loughborough - narrow tread, and one of the travellers knew someone who had fallen on the bridge.
Lights on steps/edge of platform would be useful.
'Mind the gap' announcements were found to be useful
Having a guard on the train is extremely useful for asking help.

ATT solutions: An announcement to indicate what platform the trains are on.
Discussion about developing technologies, using satellites, that can warn the traveller of obstacles.
New technology would have to be cheap and small enough to easily carry. Perhaps the system could be picked up at the beginning and turned in at the end of a journey. Would be particularly useful for people who have never done the journey before, but the regular travellers would get used to the journey and not need the system anymore.

A feeling that this is the age of the computer, but that the transport system has not kept up. Some trains have sliding doors where you have to be on the platform before it can be opened.

General view that technology cannot overcome all difficulties, and we need to remember that the technology can break down.

Ticketing
Tickets can be bought directly from the travel agent (although some people did not know this).
Queues can be big in rush hour.
Auto-ticket machines are not suitable for them, as they are not set up people with visual impairments.
It was mentioned that speech output together with large print on terminals would be ideal.

Travelling on the train
It can be a problem to get a seat. Also, people leave things on the seat or their luggage in the aisles.

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ADL during the journey
Using toilets during journey can be a real problem - finding toilet, opening door, finding tap, and getting out - all can be difficult especially with a dog. Toilets are often very small.
With a wheelchair using train toilets is impossible.

Change in regular travel schedule
If you miss a train, it can be real problem.

Handling emergency situations
They do worry - but feel there is little that can be done. Travellers are not told where the exits are.
Seatbelts are a possibility, but it was pointed out that unless this is enforced people would still fall on you. The possibility of an emergency will not stop them from using the train.

Problems - BUSES

Access - Entry/exit vehicle
One young lady, also a wheelchair user, uses her power wheelchair for longer distances, but cannot get on buses with it, therefore she does not use buses. She was not aware of the low-floor buses in this area. She does not travel on the trains, because she has not had much of a need, and does not feel confident.

Trip information
Better information is needed when waiting for a bus.
It is impossible to read timetables - very small font - and no one had ever seen a braille timetable.
It was pointed out that in London you can get speech announcements, and it was thought to be good idea.
Information given at the top of a pole or top of the bus shelter is difficult to see.
Buses sound like lorries, and one traveller has tried to get on a lorry, thinking it was a bus.
It was noted by several of the group that they would like to know aurally the number of bus as it pulls up.

Travelling on the bus
It is a problem to establish which stop the bus is at. Normally they ask the driver to let them know when they have reached their stop, but sometimes the driver forgets, and the travellers often end up asking again.
They would like an announcement just before the stop.
They wondered if the local low-floor buses were more expensive.
The wheelchair user noted that buses with hoists can be acceptable for her.

Problems - PLANES

There were generally positive views about flying.

Trip information
Announcements giving flight information are found to be good.
It is impossible to get information visually, as the screens are too high.

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The travellers were asked how many read braille. Of the group, 5/11 do not read braille.
This compares favourably with general visually impaired population:
Only 4/5% of people with visual impairments read braille, bearing in mind that 70% of people who are visually impaired are over 70.
Only 11 of a group of 53 students at the RNIB College can read braille, and the students felt that the numbers were decreasing as more information is available on tape.

Access - Entry/Exit
The traveller can ring up in advance and help will be available all the way through.
They put travellers with visual impairments on the plane 10 minutes beforehand.
It was noted that there were no stairs to climb at some airports, making it much easier. (Stanstead, Birmingham)
In most cases they travel with another. Only one person had travelled on her own (an internal flight) but there were no problems. She booked in advance and was helped on and off the plane.

Passport control - no real problems.

Handling emergency situations
In an emergency, travellers are told what to do and positioned such that airport staff can see the person.
They were not aware of the lights that should be followed to the nearest exit, and so were not aware of any particular problems.

They noted that the safety procedure should be provided in braille, and only a few would be needed per plane.

ADL during the journey
On planes, using the toilets is a problem.
One traveller thought he was flushing the toilet and pressed the emergency button instead.

Problems - SHIPS

Travelling by ship had generally negative responses.

Access - Entry/Exit
Staircases to get on and off a ship can be (used to be?) steep and narrow.
Open plan can be difficult to find one's way around.
There should be more than a railing, as there was a fear to fall in. The railing should be solid.
Someone is needed to help you on trip, and it is easy to get lost on board.
One traveller had heard of a ship that had been designed for visually impaired, but she did not have more detail.

Travelling on the ship
All the travellers felt that travelling by ship was more dangerous and difficult than flying.

Asked which mode would be preferred to cross the Channel to France:
Most said plane, as they feel safer (6/11), but noted that it was expensive. 1 said she would use Eurotunnel (but only because she had never used it before), and 2 would prefer to use the ferry. The others would prefer not to go at all.

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Their decision on which mode of travel to use was in many cases based on personal preferences/fears/money and not necessarily based on their visual impairment.

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Agenda for Focus Group Interviews at RNIB 11/12/96

1. Introductions:
Personal
Project

2. Objectives of Interviews

Definitions of ATT

3. Modes of Travel

- Identify modes and frequencies of travel.
- Reasons for choosing or not choosing a certain mode of transport.
- What might make that mode of travel easier or more suitable for their needs.
- Which mode of transport to focus on?

4. Main headings of travelling task

- Problems
- To what extent problems might be overcome with ATT
- Does/can ATT fulfill their requirements
- Suggestions for improvements / new solutions

5. Wrap-up
Possible follow up interview or observations?

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Requirements of Disabled Travellers in Public Transports While Using Telematic Systems

Focus Group with Users
Issues concerning people with Cognitive Impairments

Anabela Simões; José Carvalhais; Catarina Trindade
Universidade Tecnica de Lisboa
Faculdade de Motricidade Humana

Interviews were conducted with a focus group of people with cognitive impairments from an association (Liga Portuguesa dos Deficientes Motores) in Lisbon.

Cognitive impairments were considered as: Brain Damage, Stroke, Mentally Handicapped, Cerebral Palsy and Down Syndrome. These impairments are not profound, allowing a certain autonomy for the subjects. There is no estimation of the percentage of subjects that suffer from this type of impairment, but it is known that nearly 300 subjects/day enter a hospital in Lisbon with brain damage. In this study we have also considered the illiterate, as a special category of cognitive situation handicap.

Brain Damage
In a general way, people with brain damage cover a wide variety of conditions. Its characterisation depends, essentially, on the time that the subject spent in coma and the cerebral area that was affected. However, these subjects do not lose intellectual ability, presenting only some limitations in certain abilities. The abilities that become more affected are:

* memory, particularly the short-term memory;
* attention, leading to a certain difficulty in maintaining concentration for a long period of time, and
* some changes in the behaviour of the subjects, being the people who are emotionally unstable.

It is also possible that these subjects present some motor and sensorial problems, as for example some speech or vision difficulties. Relative to this impairment the main difficulties that the subjects will have when using transport systems are concerned with:

* trip planning, once it is difficult to memorise certain type of information, especially in the short-term;
* trip information, and
* the use of advanced technology.

Associated to this, subjects will have difficulties in terms of spatial representation and also in terms of direction. The difficulties that the subject may encounter concerning trip information are related not only to the poor capacity of memorising information, but also to some limitations in terms of vision. The use of advanced technology will lead to the same difficulties in terms of perception of information as well as in terms of memorising that specific information. It seems that the ATT system that can compensate for these types of difficulties is the public transport information system developed under the AMMOS project

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(See Inventory of Systems, No. 33A). The project AMMOS intends to develop a tactile information system that contains all the information needed to carry out, successfully, the travelling task. It is important that this system, or a similar one, produces a printed output to help the subject in terms of retention of the information given by the system. When these subjects present some vision difficulties, it is also important that the information systems use both visual and auditory information, with the aim of reinforcing the information presented.

Stroke

The consequences of a stroke depend on its gravity and also of the area affected. In a general way, the problems are essentially motor. The memory is, generally, not affected. The sensorial abilities that may become affected are equilibrium, vision and, especially, speech. Rarely, hearing becomes affected. In terms of the use of transport systems, it could be said that these subjects may have some difficulties in:

* tasks that require communication with other people, for example, asking some information, or buying a ticket;
* tasks that require some precision of movements, as a ticket machine for stamping, or the use of an interactive system, and
* tasks where it is required the reading of some information, and, sometimes its memorisation.

To reduce these limitations, the use of two systems is essential:

* the system that is being developed under project AMMOS, and
* the system that is being developed under the ICARE project.

(See Inventory of Systems, Nos. 33A and 33B)

Since the AMMOS information system is a tactile one, which contains all the information required for the travelling task, the subject can avoid personal contact, in terms of speech, once this ability is usually affected. However, if the subject has some vision difficulties, it is important that the information presented be accessible. Associated to this, it is also important that the system uses both visual and auditory information, as well as a printed output, that can be later used by the traveller. The ICARE project concerns the “free-hand card”. This is a card that the traveller can use when entering the vehicle. The subject does not need to buy a ticket (avoiding, one more time, the communication with the driver), neither to stamp it, once this task becomes difficult, especially if the subject presents some motor spasms. It is important to say that the card is detected automatically by a specific device.

Cerebral Palsy

People who have cerebral palsy have essentially motor problems. They present a lack of co-ordination as well as certain muscular spasms. This will make the ticketing task, as well as the use of advanced technology, a problematic task. In terms of cognitive limitations, they present:

* light mental weakness;
* slow information procedure, and
* some speech difficulties.

In the travelling task, these subjects may encounter some difficulties in terms of:

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* using systems that require precise movements, as the ticket machine and some tactile information systems;
* asking some information from someone, and
* understanding, rapidly, the information given or presented by the system.

The AMMOS project as well as the ICARE project will increase the ability of these subjects to travel successfully. The information system developed by AMMOS will give all the information that the subject needs in order to travel, avoiding the contact and the need to ask for the information. This type of system has to consider its control, making possible its use by subjects with limitations of movements, when these subjects have difficulties in performing precise tasks. It is essential that the system offer several ways of functioning. On the other hand, once these subjects have some problems in terms of information processing, it is important that this system also presents some symbolic information, with the aim of reinforcing and clarifying the information already presented in text. Finally, it is also important that the system presents a printed output, that can be read at any time by the subjects. It is necessary to take into account the quality of the output, being important that the information presented in text be also presented by symbols. The "free-hand card" will free the subject from buying a ticket from the driver, as well as its stamping, which is a precise and difficult task for these subjects.

Down Syndrome

Subjects with down syndrome may be those who have major difficulties in carrying out, autonomously, the travelling task. These subjects present several major functional limitations:

* they have diminished intellectual ability, making the learning process difficult;
* they have difficulties in reading;
* they have a reduced capacity of attention and concentration, and
* they present slow information processing.

All these handicaps will make the travelling task more difficult, especially concerning:

* trip planning;
* ticketing;
* access to the vehicle, and the access to the departure/arrival point;
* trip information, and
* the use of advanced technology.

When these subjects have several limitations in terms of major functions, it is essential to take into account several requirements, that both the AMMOS and the ICARE projects have considered. In terms of information systems, it is important that these systems:

* present simple, concise and explicit information;
* use symbols as well as colours, being an alternative to text;
* produce a printed output, with the symbols that were presented to the subject;
* do not present several sequential tasks;
* use both visual and audible information, and
* if possible, have human help, when the use of advanced technology poses a difficulty to these subjects.

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The “free-hand card” will avoid the use of the ticket machine, as well as the stamping machine, making the ticketing task very easy for them.

Mental Handicapped

Despite this type of impairment not being the same as down syndrome, it is very similar, since the difficulties that these people present, in terms of major functions, are basically the same. Therefore, they have difficulties in terms of:

* memory;
* reading capacity;
* comprehension of information presented, and
* use of advanced technology.

Consequently, performance of almost all sub-tasks of the travelling task model are limited. The use of an information system may be difficult to these subjects, and it is important to consider aspects about the presentation of the information (as mentioned above concerning down syndrome). Also, in this case, it is important that the subject has some human help. The use of a “free-hand card” will avoid the use of a ticket machine, making the ticketing task much easier.

Illiterate

Finally, we consider the illiterate as a particular category of cognitive situation handicap. Associated to this group, we also include foreigners, especially those who have a completely different alphabet. When these subjects do not know how to read or may not understand our language, they will encounter several difficulties in terms of accessing all types of trip information, and consequently the travelling task may be compromised. The way that these people attempt to access information is by asking someone about it. For this reason it is important that the use of information systems takes into account this population by means of:

* using both visual and auditory information;
* using symbols that are directly related to specific places;
* in terms of auditory and visual information, the system can be flexible in terms of choosing a specific language;
* presenting a printed output, with the text and the symbols presented. They also can present schematic diagrammes to simplify the task, and
* using simple controls, to have access to the information, especially in the case of illiterate people, who would have great difficulties in using this type of technology.

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Requirements of elderly and disabled travellers in public transports while using Telematic systems

Issues concerning people with hearing/speech impairments

Claude Marin-Lamellet
INRETS-LESCO

Interviews were conducted with experts from SNCF, INRETS and one association of disabled people (only hearing/speech).

Overview

It is estimated that in France over 7 % of the population have auditory impairments (from minor problems to no hearing at all). Despite a real variability, it seems also that the aging process decreases the hearing abilities; it is estimated that one out of two persons over 80 years old express hearing difficulties.

A local survey undertaken in the Rhône Alpes region (by the GIHP organisation) on a sample of elderly and disabled travellers showed that if 45 % of them have problems when travelling, 15 % of these problems are due to hearing/speech disabilities.
In Europe, more than 500000 people communicate using sign language.

Hearing impairments are not always associated with speech impairments, it depends on when the disability appears. If it is after adolescence, then language ability will be affected but not completely; in such a case, the impairment will concern mainly the reception of information. If the loss of hearing ability occurs during childhood or is present at birth, then the impairment will concern both hearing and speech.
These disabilities do not seem to be considered as the most important in comparison with vision and motor impairments by operators of transport systems.

Results

See table for the results according to specific aspects of the travelling task.

Admittedly the following general results are apparent to most people; however, the users interviewed expressed the need to emphasise the following fundamental problems. Generally speaking, therefore, it can be said that :

- Travellers with a hearing impairment will have problems in hearing/understanding vocal announcements and emergency requests. This type of problem emphasises the need for visual presentation of the same information or enhancement of auditory information, e.g. through auditory loop systems. In an emergency situation, the inability to hear evacuation instructions becomes even more crucial, as such travellers may not even be aware of the need to evacuate a station or vehicle. Visual indication of the nature of the emergency and action to be taken would give control to the traveller without reliance on station staff. However, although telematics may be a solution, it is also clear that staff on- and off-board public transport must be aware and trained to deal with such situations.

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- Travellers with a speech impairment will have problems in asking for information and answering questions. These users require other non-verbal methods of communicating with staff and other passengers, whether it be by sign language, written or electronic text. During busy travel periods, these travellers have increased communication difficulties due to reduced availability of staff and increased time pressure and stress. Hand-held, portable communication devices or public access terminals, with up-to-date travel information in both visual and auditory form, would have a role to play in such situations.

- Travellers with both hearing and speech impairments will have problems both in getting information and in asking for information, thus magnifying the problems noted above when each impairment is experienced in isolation. In particular, serious difficulties may be experienced in trip planning, on trip information, buying tickets, communicating with driver or other passengers, coping with emergency situations, and with the use of telematics to overcome some of these problems. Hence, a flexible interface with alternative modes of input and output is necessary to give these travellers easier mobility and access to information.

Thus, these disabilities in transport situations will be very difficult to manage in case of non-expected changes in the initial travelling plan. The disabled traveller will have to reconsider the trip, to get information on what is happening and what are the new possibilities.

ATT applications could be helpful in these situations if these systems could provide real time and easy to understand visual information. These systems will need to be portable (as Nokia 9000 or pagers for example).

Some safety aspects could be improve concerning the automatic closing of the doors in subway for instance. In many systems of transport, there is only a tonal warning that the doors will be closed in few seconds.

Internet and multimedia computers could have a significant help for these travellers in trip planning for country where systems like Minitel does not exist. It could be possible to have video sequences with messages translated in sign language (this was done in a TIDE project but not for a transport application).

It is essential also that information are clearly available on the localisation of services for hearing/speech disabled travellers. Visual information should be improved in order to avoid uncertainty for the traveller. As for these travellers visual information are the only input available, care must be taken that the messages can be read easily in all circumstances, despite the weather (summer time), the presence of glare, etc.

Another problem which I had difficulty to put in the table is the situation of asking for a taxi at home or at desk where only a phone is available (no staff). In this case, Internet or computer network could be very useful.

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Role of IT Systems In Assisting Elderly & Disabled Travellers

Issues With Regard To Travel By People With Mobility Impairments

Philip Barham
Cranfield University

1. INTRODUCTION

A telephone survey was carried out with the aim of identifying problems experienced by elderly and disabled (E&D) persons when making journeys. It was hoped to establish whether and how IT systems could assist in alleviating these problems. Twenty four interviews were conducted using a sample of E&D persons previously contacted by Cranfield in connection with a survey into problems of wheelchair users driving cars. Of the sample used for this survey, half were car drivers and half did not drive.

2. SURVEY

The survey was conducted in three parts.

2.1 The first part was concerned with establishing features of the travellers and of the journeys made. Respondents were asked which modes of transport they used which they did not use, and what reasons lay behind the choice. They were prompted to consider the modes car driver, car passenger, taxi (including special services such as Dial-a-Ride), bus and train. Factors influencing trip planning were discussed, including choice of destination and route and the relevance of special facilities, such as parking, toilets. Finally in this section questions were asked regarding their ability to manipulate and use technical aids.

2.2 The second part concerned problems associated with driving and/or using a car. Problems of access were addressed, including step height, stowage of luggage, seating arrangements etc. The arrangement of driving controls and ancillary equipment (radio, heating) were considered. Questions were also asked regarding any difficulties encountered with driving in bad weather or at night.

2.3 A similar set of questions was posed with respect to public transport use. Access to the vehicle is again an issue, but in this case also included getting to the bus stop/rail station and waiting for service. Methods of ticket purchase raised the problems of handling money and whether credit/cash cards offered helpful solutions. In addition to consideration of problems with bad weather or night times travel, the question of travelling in the rush hour was raised.

3 FINDINGS

The three parts of the survey are considered here in turn.

3.1 Both for car drivers and non-drivers the car dominated mode choice. The drivers naturally drove themselves and the non-drivers found somebody to do the driving for them. The problems associated with public transport use made the car a favourite if at all possible. Occasional taxi use was reported, with some ambivalence regarding black cab as opposed to hire car use. Some large (ie taller) respondents found black cabs difficult to access and preferred hire cars, while smaller persons took the

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opposite view. Trains were also occasionally used for longer journeys, albeit with careful forward trip planning. Inter-city trains were much preferred as providing a good standard of service; regional trains (eg Network SE) consign wheelchair passengers to the guards van.
Trip planning did not appear to raise problems, as long as it was (vide supra) sorted out in advance. Almost all of the younger (under 40 years) respondents were enthusiastic computer users while their more senior colleagues resorted to old fashioned maps. Parking availability was naturally a key issue in trip planning. as was the location of toilet facilities. This latter feature was no real problem for regular journeys but raised difficulties on unfamiliar journeys in terms of finding where the facilities were located.
In terms of the use of technical aids, no respondents had trouble with sight or sound messages. Several however mentioned difficulty with manipulating keys, buttons and accurately using touch screens.

3.2 Difficulties associated with access to the car varied with severity of the disability. Either the E&D person relied on help from a carer, or was using a vehicle with adaptation. Such adapted vehicles were greatly appreciated except with respect to their cost (a factor which was frequently remarked). These adaptations also alleviated problems with vehicle operation and control.
Bad weather and night driving was not reported to be a problem, largely because the respondents tended not to travel in such circumstances. Furthermore almost all respondents had a mobile phone available in case of emergencies.

3.3 It has already been noted that no respondents used buses. There was also a fairly negative response to the use of special services such as Dial-a-Ride. Either such services were not available or if they were they required considerable advance booking arrangements to be made, and where provided the services were frequently erratic. A couple of horrific stories in this last respect were recorded. Several respondents mentioned difficulties in manipulating cash for payment for public transport services (as did car drivers when paying for parking). Card facilities were much preferred, so long as the equipment was located within the reach of the E&D person. A final adverse comment on public transport related to its cost. While costs might be acceptable for a single traveller, they became exorbitant if the E&D person had also to pay for an accompanying carer.

4. SUMMARY

It was clear from the survey - and indeed would be expected - that physical aids are considered essential. Without appropriate adaptations to primary driving controls in cars or the ability to travel by wheelchair in public transport many of the respondents would not be able to travel at all.

In the opinion of the respondents, the areas in which IT systems and services could be helpful were payment (for fares or for parking) because handling money is not easy; information on journey planning particularly when the journey to be made is one they are not familiar with, and information on special facilities, particularly accessible toilets.

The survey also raises a further question about the awareness of disabled people of the potential for assistance that IT may provide. The people interviewed were not experts; they were a sample of the ordinary disabled public. It is apparent from the interviews that the process of developing IT aids for disabled people needs to be accompanied by a carefully structured information dissemination programme aimed at ordinary users, not just experts or

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associations for disabled people. If this is not done, there is a risk that many people who would benefit from IT will remain unaware of these benefits.

Protocol Focus Groups

Mode of transport: **Bus, Information system for trip planning**

User group: **Elderly persons**

Main task **Prompts**	**Problem**	**User needs**	**User requirements**	**Desired modifications**
Find destination Town Area	Difficult to understand that you must find destination before you choose bus stop. Difficult to find destination in the list. Difficult to mark the desired destination.	Short instruction on how to find destination. Easy to mark destination.	Printed step by step instruction shown on the screen. Suitable size of letters.	Instruction in a red box on the screen: "Choose your destination Mark destination by pulling with your finger in the list of destinations" When destination is chosen, show in a red box on the screen: "Execute"
Find bus stop	Difficult to find the bus stop in the list. Difficult to mark the desired bus stop.	Short instruction on how to find the bus stop. Easy to mark the bus stop.	Printed step by step instruction shown on the screen. Suitable size of letters.	Instruction in a red box on the screen: "Choose your bus stop Mark bus stop by pulling with your finger in the list of bus stops" When bus stop is chosen, show in a red box on the screen: "Execute"
Input the date you want to travel	Difficult to read the date. Difficult to understand how to change date. Difficult to activate the correct buttons on the screen.	Short instruction on how to change date. Show date with larger size of figures. Large buttons on the screen that are easy to find and easy to activate.	Printed instruction on the screen. Suitable size of letters. Well defined and marked buttons of suitable size.	Instruction in a red box on the screen: "Input date Push on the arrows in the upper left hand corner to change date"

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Input the time you want to leave	Difficult to read the time. Difficult to understand how to change time.	Short instruction on how to change time. Show time with larger size of figures. Large buttons on the screen that are easy to find and easy to activate.	Printed instruction on the screen. Suitable size of letters. Well defined and marked buttons of suitable size.	Instruction in a red box on the screen: "Input time Push on the button TIME" When the figure board is on, show a new instruction in a red box on the screen: "Input hour and minute Push the buttons to input desired time"
Choose direction From here to home From home to here	Difficult to understand the term "home".	Be able to choose a desired destination, not only "home".	Provide choice of destination or origin.	Instruction in a red box on the screen: "Input direction of the trip, from here to the chosen destination or from the chosen destination to here. Push the desired button"
Study the proposed travel scheme and decide whether departure time and trip are suitable	No serious problems. Somewhat difficult to understand departure and arrival times as well as waiting time (hours or minutes)	Easy understandable marks at departure and arrival times. Print out "hours" and "minutes".	Mark departure and arrival times as well as "hours" and "minutes". Suitable size of letters.	Mark departure and arrival times as well as "hours" and "minutes" on the printed document.
Revise the search if you want other proposals of travel schemes	No serious problems.	An easy way to get the trip before and after the one presented.	Well defined and marked buttons of suitable size with the functions to search for the departures before and after the one presented. Printed instruction with suitable size of letters on the screen.	Instruction in a red box on the screen: "Input your choice Push the desired button" The following buttons are shown: Print Change time Next Previous

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Print the travel scheme	No serious problems.	A schedule of a suitable bus route that is easy to read and follow.	Printed schedule with all information on departure times, bus stops, interchange points, travel time, etc. Correct order of information Suitable size of letters.	Mark departure and arrival times as well as waiting time in "hours" and "minutes" on the printed document.

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Experiences Gained from the Focus Group in Lund, 16 November 1996

1 BACKGROUND AND PURPOSE

One particular part of this project was to produce an interface in the form of a touchscreen for the County Transit Authority's information system. This was performed by Forsler & Stjerna, with a certain amount of assistance from the Lund Institute of Technology's Department of Traffic Planning and Engineering. The touchscreen, which was installed at the reception desk at the University Hospital in Lund, provided information about how one could travel to or from the hospital at a certain desired time. The evaluation of the touchscreen was conducted by means of interviews with people who spontaneously used this system at the hospital, as well as by talking with a special focus group (roundtable discussions) involving elderly people.

The point of the focus group was to allow elderly people to try to use the system and to register their opinions about it, primarily with regard to function, comprehension, ease of handling and accessibility to the system, but also the usefulness of such a system. The intention was to be able to employ the results to provide the foundation for continued development of an interface for information about public transportation.

2 TEST SUBJECTS

In order to acquire a qualitative assessment of the information system, a group of retired people was invited to a meeting at the Lund Institute of Technology. The participants were recruited through a service center in Lund, where it was possible to register interest in participating in a meeting whose purpose was to discuss public transportation in the county. The information concerning what the meeting was about was intentionally very vague. Hence no information was provided in advance that the focus of the meeting was to test a computer-based information system. The reason was that we were concerned that, in that case, only people accustomed to computers would sign up.

This tactic turned out to be very successful. Only one person among those who signed up had experience with computers. The other participants had only come in contact with them through their grandchildren's computer games, for example. The group was made up of 6 people — 2 women and 4 men between the ages of 65 and 75. In our judgement, they constituted an ideal group for the discussion.

3 METHOD AND PROCEDURE

3.1 Method

The focus group, or roundtable discussion, is a type of group interview used in order to quickly obtain opinions on a certain topic which can then often be employed as the basis for further analysis (e.g. in-depth interviews). The size of the group usually varies from 5 to 10 people. The presumption is that in a group of this size there are usually a couple of people who express themselves easily and can talk in a group, thereby inspiring the other

participants to speak up. The composition of the group also offers some possibilities for instrumentalizing interest and opposing views by producing provocative opinions.

Thus the round-table discussion is used in situations in which

- one aim is to quickly obtain broad information about the potential features involved in a specific topic and
- another aim is to achieve a situation in which the interviewees are inspired to express both factual and emotional opinions without major impediments (social facilitation).

Roundtable discussions can be conducted in various ways, from the very structured, in which everyone, in a designated order, expresses themselves on a well-formulated issue, to the very open, where only one clue is provided (certain main points) and the discussion is allowed to take its own course. The form chosen for the discussion depends in part on the leader's own confidence about the topic at hand, i.e. if s/he knows, and has also decided in advance, what topics are to be broached, or if s/he contemplates what features might be relevant to take up as the discussion is underway.

For this particular focus group we chose a combined form and proceeded gradually from there.

- The first stage contained a highly **structured** element. The interviewees were asked to try to use the information system we were testing.
- The second stage was extremely **open**. In connection with testing the system, the subjects were asked to register everything they thought was disturbing or difficult and make a note of it without any prestructured questions being provided.
- The third stage was once again **structured** in the form of role-playing, in which the task was to purchase a ticket.

The information obtained from employing roundtable discussions is usually used as the basis for proceeding further with new analyses. But the method can also be used to quickly acquire a diagnosis pertaining to a specific topic or question. In such cases, however, it is important to carefully consider the selection of subjects and to decide whether the material and experiences achieved are adequate for such a quick diagnosis. In the present case, our collective impression was that a relatively reliable quick diagnosis could be made, and it is that diagnosis which is presented below.

3.2 Procedure

The focus group was conducted on a Saturday afternoon at the Department of Traffic Planning and Engineering at the Lund Institute of Technology, where the information system had been installed. The meeting was opened with **information** on how this particular project figured in the research work of the Department. This was followed by more detailed information about this particular project and the specific purpose of this meeting.

Next, each of the test subjects in turn was asked to conduct a **search** on the computer concerning a trip to or from any place in the county. They were informed that one of the destinations of the journey was the Lund University Hospital. The subjects were asked to

try to follow the written instructions about how to use the system that had been compiled for use at the Hospital. These instructions were located next to the system. The subjects were asked to register any questions and uncertainties encountered when making the search, both by mentioning them out loud while the search was in progress and by writing them down after completing the search. This request applied both when the subjects were themselves conducting the search and when they were merely observing the other participants in the group.

After this practical stage, there followed a **discussion** in which the group was first asked to submit spontaneous, more comprehensive viewpoints on how they experienced the system and the search, and what features they found either difficult or uncomplicated. The procedure here was for everyone first to give their viewpoints without interruption. This was followed by a more systematic discussion in which each detail in the search was thoroughly considered.

Over coffee, the subjects used **role-playing** to describe how they go about either phoning the Swedish State Railways for placing an order or going to the station to buy a ticket. They assumed the role of either a customer or a salesperson. The purpose of this stage was not to ask about what procedures or activities are involved in purchasing a ticket, but to spontaneously determine the kinds of information the customers seek in connection with buying a ticket and in what order they ask their questions. The aim was to compare this with the search process of the information system being tested.

The meeting, which lasted ca. 3 hours, was brought to a close by asking each of the test subjects to fill in a form with the answers to three short **questions** about the information system.

4 VIEWPOINTS ON DIFFERENT DETAILS IN THE SEARCH

4.1 Choice of place and stop

When the system starts up, there are two windows on the right of the screen. One shows the places included in the information area, and the other shows the stops for the place which is currently selected; see **Figure 1**.

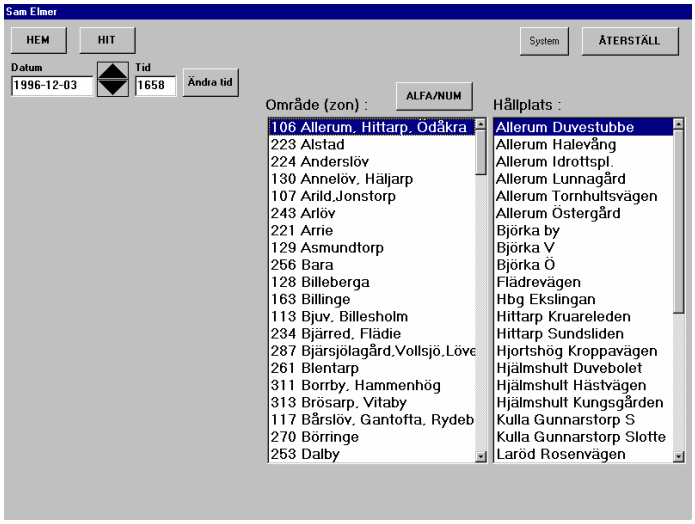

Figure 1 The information system's search window

The results of the focus group show that most of the test subjects had difficulty understanding that it was possible to choose other places than those shown on the screen at start-up. The system is a little hard to activate by drawing your finger along the list. Often nothing happens. It turns out that you must begin by placing your finger on the place that is selected (in blue) in order for the system to work.

Many of the test subjects also found it difficult to understand how to select a stop. They did not realize that the window to the left — showing places — had to be positioned on the right place before the stops for that place could be shown in the window to the right. Some confusion arose from not being able to find the stops for the desired place. Clearly, the subjects were thinking in terms of travelling to a certain stop in a certain place.

The desires of the test subjects were to

- modify the content so that only the window showing places came up first on the screen;
- (after having chosen a place) having the available stops shown in a window beside the places.

4.2 Choice of date

Among other things, the upper left-hand corner of the screen shows the date and the time. Unless something else is specified, these are given in current time; **Figure 2**.

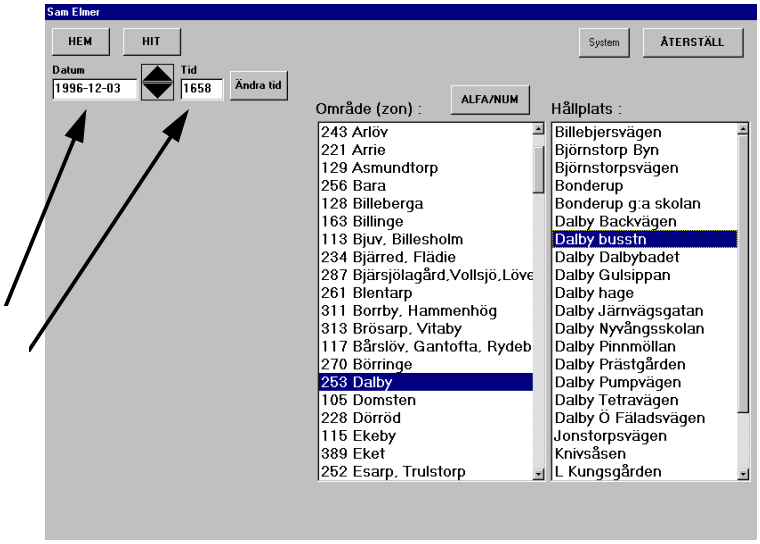

Figure 2 Functions for choosing date and time

Selecting the date was the one feature of the system that caused the most problems for the test subjects, regarding both understanding and management. Even if they had read the written instructions for the system, they could not understand how to alter the date. The system shows today's date. If you want to travel on another date, the date shown must be changed. In the written information, you were told to press the arrows. The problem was that you saw no arrows on the screen. What were supposed to be arrows showed up more like two triangles. That caused confusion. Furthermore, the cursor (the white arrow) sometimes appeared on the screen. Then people thought that it was that they were supposed to select — and nothing happened.

Once you had realized that the triangles were supposed to be arrows, they were very difficult to activate. When the subjects selected one of them, nothing happened. The arrows were located very close to one another, and that is why they are hard to activate. The UP arrow (in order to go forward in time) is the one most easily activated. Usually, that one was activated by mistake — the subject really wanted to select the DOWN arrow (in order to go back in time in relation to what was shown on the screen).

Another problem in this context was the problem of selecting one day at a time. The subjects pressed their fingers and held them there, but usually nothing happened. Then they pressed harder and moved their fingers. Sometimes nothing happened, but

sometimes a number of dates began to fly past, before you were aware of it. The technique involving a quick movement, precisely on a little dot on the respective arrows, leafing forward one day at a time, does not work for the elderly user with fingers that are hard to move and perhaps a bit clumsy.

The desires of the test subjects were as follows.

- **First**, the "arrows" must look like arrows for the sake of clarity.
- **Second**, they must be clearly separated from one another.
- **Third**, they must be easier to activate than they are at present.
- **Fourth**, the system should move forward only one day at a time, regardless of how long you hold your finger on the arrow.

4.3 Choice of time

The current time is shown in a window on the screen. Beside it there is a function "change time" if you want to travel at a different time than the one shown. If another time is desired, you press your finger on this box; **Figure 3.**

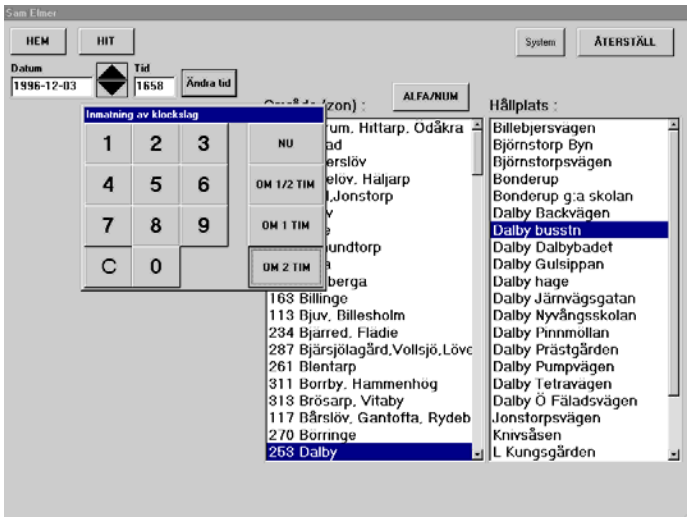

Figure 3 Window for choosing time

The test subjects also had certain problems with this feature. In the first place, the box showing the time entered was much too small. The subjects had some difficulty realizing that they could continue directly if this time was acceptable for the trip in question.

In the second place, it was hard to know that you were to activate this function if you wanted to change the time. This is shown by means of a "double square" around the function button, but it is hard to see because of poor contrast. If you wanted to change the time and this information was activated, a picture appeared on the screen allowing you to indicate the time by pressing on new numbers. The test subjects thought this was very simple and functioned well. The numbers were large and clear.

The desires of the test subjects were therefore as follows.

- There should be only one TIME function button that you press to go directly into the system and indicate your desired travel time.

• The pre-set selections shown beside the numbers (Travel NOW, in 1/2 hour, in 1 hour) were regarded as hard to understand and hence unnecessary.

4.4 Searching

Farthest up in the left-hand corner of the screen there are two functions, HOME and HERE. When either of these functions is pressed, the computer starts searching for the trip in question; **Figure 4**.

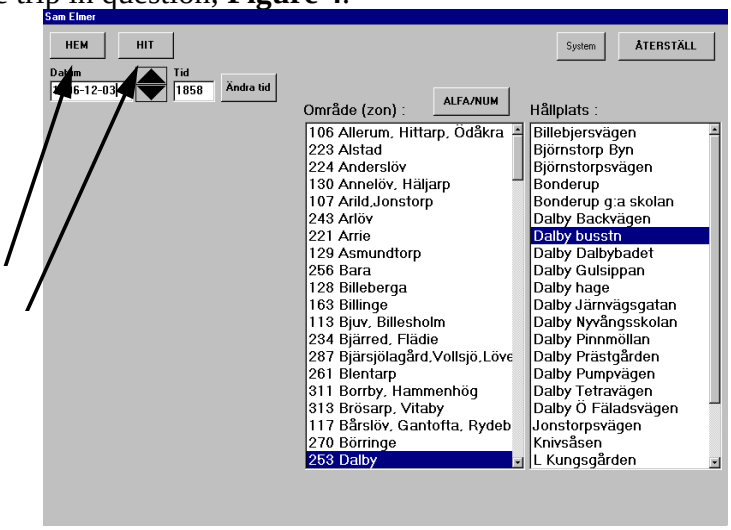

Figure 4 Functions for activating a search

The test subjects had a brief discussion among themselves about what HOME and HERE actually meant. Once they had made up their minds and activated one of the functions, however, they were very pleased that the message “Searching” appeared in a large box on the screen, bordered by a distinct red line.

The desire of the test subjects was as follows. • The information throughout the entire search process on the computer screen should be presented like that in the function “Searching”, i.e. in a box bordered by a distinct red line. See more about this below.

4.5 Trip information

Once the desired trip has been selected, the search begins, and after a while the information concerning the trip appears in a window on the right of the screen. Three different boxes simultaneously appear on the left of the screen: CHANGE TIME, PRINT OUT, NEXT; **Figure 5**.

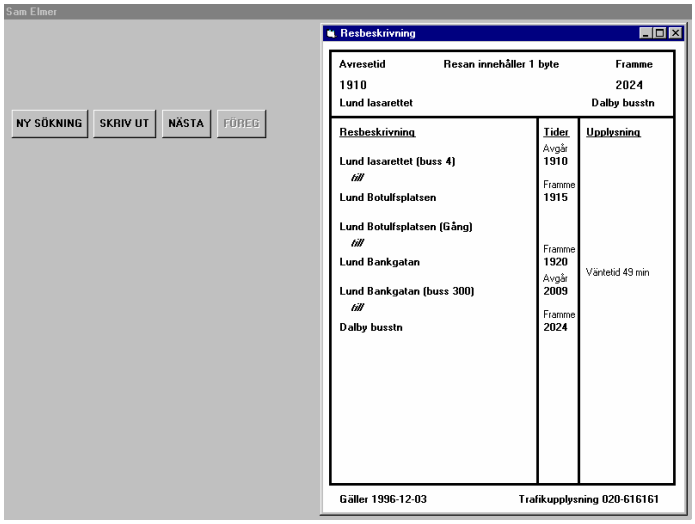

Figure 5 Window for presentation of trip information

The latter three functions caused no particular difficulties for the understanding of the test subjects. What they wanted, however, was a fourth function, PREVIOUS. If they felt that the departure time presented was somewhat late, they wanted to be able to quickly change to an **earlier** departure and check it, just as it is possible to use the pre-set selections to see the **next** departure. In the system's present design, you have to press CHANGE TIME and then go in and enter a new time for the desired trip.

The test subjects were quite pleased with the trip information itself, both on the screen and on the printed ticket, but they did have a few suggestions.

The desires of the test subjects were thus as follows.

- The numbers in the upper part of the information showing Departure and Arrival times should be preceded by "Time" for the sake of clarity.
- Also, the information about waiting times in the right-hand column should be similarly presented. If it is only a matter of minutes, this is indicated by "12 minutes", for example. But if it is a matter of hours and minutes, this is indicated by "1:15" for example. This was confusing. You don't exactly know what it means (minutes or hours). The information should be clearly presented, e.g. "1 hour, 15 minutes".

4.6 Instructions

The test subjects were not at all pleased with the written information located beside the screen to provide help in using the system, and they had many ideas about it. Above all, there was too much text. Nor did they think it was good to have the information on the side: it should appear sequentially and be shown on the screen.

The desires of the test subjects were as follows.

- After completing one step on the screen, you should receive instructions pertaining to the next step.
- The instructions should appear above the picture on the screen and be shown in a box with a distinct red border (as with SEARCHING at the end of the program).

The group's viewpoints have been compiled as a proposal for how the search process should occur in an information system constructed according to the principles tested here in order to fulfil the desires of the elderly. This is presented below.

5 OVERALL VIEWPOINTS

In addition to the comments submitted by the test group concerning the actual search routine in the information system which have been presented above, the discussions also produced a number of other viewpoints about the interface.

- Most of the test subjects found it **difficult to see the screen.** This included sharpness, contrasts and the size of the type used to present certain information. With regard to contrasts, some of the subjects suggested that the blue color used to indicate the place selected and the stops should be more sharply contrasted against the grey background, e.g.. yellow or orange. If you have impaired vision, blue on grey is hard to discern on a computer screen.

- Another viewpoint concerned **size of text and various functions** on the screen. The test subjects had no opinions about the size of place names and stops. On the other hand, they were very negative about the way information and functions were presented on the left half of the screen. Although there is a lot of space available, all the information is gathered in the upper left-hand corner. The numbers and letters are very small and difficult to read. They should be at least 3 to 4 times larger in order for a person with rather large fingers, which are also perhaps a bit shaky, to be able to use the system.

- **Poor contrasts** were another problem. All text should be in a more clearly contrasting color, e.g. yellow, orange or green.

- However, the greatest objections to the interface involved **design of the "arrows".** They must be changed so that they really look like arrows, and they must be clearly separated from one another. In their present design it is very hard to activate the lower "arrow". Usually, when anything at all is in fact activated, it is the upper "arrow".

- Another viewpoint about the information on the left side of the screen was how you were supposed to **activate searching**. At present there are two functions, HERE and HOME. Most of the subjects thought that HOME could be misinterpreted. It is not at all obvious that you should go home rather than to some other activity. For lack of another alternative, the group suggested that HOME be changed to THERE.

- Finally, the test subjects desired that all **instructions** about what a user should do should be presented step-wise on the screen. These instructions should be framed in a box with a red border.

There were some other comments as well. For example, the test subjects also wanted to be able to access information about "red [cut-rate] departures" and the cost of a ticket. They also wondered whether transfer times as short as 2 minutes were

adequate. Even if the transfer occurs in the same terminal, so short a time can, for many elderly people, give rise to insecurity about the trip and perhaps entail not daring to choose that alternative or, as an ultimate consequence, not even daring to try at all.

6 SUGGESTIONS FOR THE SEARCH PROCESS

The following examples constitute the proposal for how the entire search process should occur, and results from the viewpoints presented by the test group and the discussions they had about how the system should look in order to be user friendly from their standpoint. It should be pointed out that the proposal for how the information might be made clear is based on how the search process is presently constructed and should hence not be viewed as the optimal solution for the search process. This is further developed below.

When you sit down at the screen, you see on the right a list of places (and stops). In a box with a red border there is currently the following instruction:

Indicate the place to/from which you want to travel. ***Change the place by drawing your finger along the list.***

When you have selected the place, a new instruction appears in a box with a red border:

Do it.

Now the list of stops for the selected place comes up on the screen. At the same time there is a new instruction in a box with a red border:

Indicate stop. ***Change the stop by drawing your finger along the list.***

When you have selected the stop, a new instruction appears in a box with a red border:

Do it.

Now the names of the place and stop are placed in their respective windows on the right side of the screen, and a new instruction appears in a box with a red border:

Indicate date. ***Press the arrows in the upper left-hand corner to change.***

When you have indicated the date, a new instruction appears in a box with a red border:

Indicate time. ***Press the time.***

When the numbers come up on the screen, a new instruction appears in a box with a red border:

Indicate exact time. ***Change by entering the desired time***.

When you have indicated the exact time, a new instruction appears in a box with a red border:

Start search. ***Press THERE for trip from hospital.*** ***Press HERE for trip to hospital.***

New instructions now appear in a box with a red border:

SEARCH IN PROGRESS

After the search is complete, the desired trip option is shown on the right side of the screen. Beside it there is the following text:

PRINT OUT, CHANGE TIME, NEXT, PREVIOUS

Now the following instruction appears in a box with a red border:

PRESS DESIRED ALTERNATIVE

The search terminates.

7. COMMENTS AND FURTHER RESEARCH

In conclusion, it can be observed that the test subjects participated in the group discussions with great interest and tested the system with enthusiasm. The experiences provided by the focus group regarding the user-friendliness of the information system from the perspective of older people revealed that there was a good deal to be desired, and the group had many ideas and constructive comments.

It should be emphasized that the interface tested in no way claimed to represent a state of perfection. The object of developing the touchscreen within the framework of this project was precisely to obtain viewpoints on how a touchscreen should be designed in order to be user friendly from the standpoint of the elderly. In this perspective, the results obtained from the focus group are extremely interesting and valuable.

The results of the group's constructive work, their viewpoints, suggestions and ideas in general, can in all probability be used and have valuable significance for a future development of information systems of this kind. The round-table discussion method used should provide a very practicable tool in such a future research project. It should prove advantageous to develop the method so that the same group of subjects met to

discuss and comment on the information system on a number of occasions while it is being developed, i.e. a repeated design study .

The concluding comments from several people in the group are nevertheless worth noting. The general perception was that such an information system was indeed pleasant to test, but as far as they were concerned its usefulness was rather doubtful. **The opinion of the group was, however, that in the future such a system may prove interesting even for the elderly, since new generations of elderly people will probably have more experience with and be more accustomed to new technology and computers.** Yet this presumes that the system will take greater heed of the needs of the elderly, in both design and handling, than does the current information system in its present design.

In closing, the group emphasized that for many elderly people, the human factor is of great importance for security in this type of situation and is difficult to replace with mechanical devices.

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
SKELETAL - Motion of lower limbs	Cannot walk	Reaching departure points for transport.
	Slow walking	Time required for transfer between modes
	Limited walking time	Transferring between different modes of transport
	Cannot stand	Transfer from wheelchair to seat
	Cannot stand quickly	Disembarking from public transport
	Limited standing time	Waiting for arrival of transport or standing when overcrowded
	Cannot climb step(s)	Moving through infrastructure
	Cannot sit	Fatigue on long journeys
SKELETAL - Motion of upper limbs	Cannot use arms	Use of ticket machines
	Can only use one arm	Operation of traditional driving controls
	Cannot move arm quickly	Operation of traditional driving controls
	Cannot use arm for long periods	Operation of traditional driving controls
SKELETAL - Motion of upper body	Cannot turn head/neck	Restricted scanning of road environment as car driver
	Cannot turn head/neck easily	Use of head restraint mounted controls in car
	Cannot turn head/neck repeatedly	Parking car
	Cannot move trunk	Reaching seat belt
	Cannot move trunk easily	Transfer between wheelchair and transport
	Cannot move trunk repeatedly	Loading/unloading luggage
SKELETAL - Anthropometrics	Short stature	Reaching ticket machines
	Short legs	Reaching conventional driving pedals
	Short arms	Reaching conventional driving controls
SKELETAL - Co-ordination and dexterity	Difficulty using foot controls	Operating conventional driving pedals
	Difficulty using hand controls	Using telephone keypads
SKELETAL - Force	Reduced force in legs/feet	Operation of brake pedal
	Reduced force in arms/hands	Opening doors
	Short duration force in legs/feet	Operation of vehicle pedals
	Short duration force in arms/hands	Turning steering wheel, esp. parking

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
VISCERAL	Sudden loss of consciousness	Obtaining help/making strangers aware of condition
	Sudden loss of awareness	Maintaining safety of travelling task
	Reduced stamina (breathing/circulation)	Transfer between modes
	Incontinence	Access to sanitary facilities. planning of route for such
VISION	Blind	Obtaining written information
	Blind in one eye only	Field of vision whilst driving
	Reduced visual acuity	Identifying symbols on displays
	Reduced field of vision	Seeing approaching traffic (on foot or in vehicle)
	Slow accommodation	Alternating between in-vehicle displays and road environment
	Low contrast sensitivity	Reading some written material
	Glare sensitivity	Glare of oncoming vehicle lights at night
	Night blindness	Travelling in darkness
	Colour blindness	Understanding coding systems, e.g. for train routes
	Low colour sensitivity	Understanding coding systems, e.g. for train routes
HEARING	Total deafness	Hearing PA announcements
	Partial deafness - severe	Hearing warning messages
	Partial deafness - moderate/mild	Understanding voice messages
	Disrupted hearing (e.g.tinnitus)	Concentration on tasks
LANGUAGE AND SPEECH (Communication)	Cannot read at all	Obtaining written travel information
	Reads very slowly	Obtaining written travel information
	Cannot understand some words	Understanding complex instructions for equipment operation
	Cannot understand language	Obtaining written travel information
	Cannot understand abstracts (e.g. symbols)	Understanding/acting on warning symbols on control panels
	No speech	Telecommunications
	Slow speech	Asking for information
	Unclear speech	Asking for information
	Low volume of speech	Telecommunications, particularly in noisy environment

Impairment	Disability	Potential Areas of Difficulty/Need whilst Travelling
INTELLECTUAL/ PSYCHOLOGICAL/ Cognitive Functions	Difficulty with understanding instructions	Following directions to destination
	Difficulty with new tasks	Operating new technology
	Difficulty performing simple tasks	Obtaining refreshment en route
	Difficulty performing multiple/complex tasks	Operating vehicle and new technology
	Slow response times	Dealing with traffic conflicts whilst driving
	Impaired short-term memory	Remembering travel plan
	Impaired long-term memory	Understanding codes. symbols etc.
	Limited attention span	Operation of complex equipment
	Difficulty with decision making	Choice of transport mode/route
	Limited spatial abilities	Use of complex spatial navigation information, eg map displays
	Left/right confusion	Use of auditory route guidance instructions
	Phobias	Using certain modes of travel

Impairments in UPPER CASE indicate the Impairment Categories defined by WHO in the following document:
World Health Organisation, 1980 (reprinted 1993?), "International classification of impairments, disabilities and handicaps: a manual of classification relating to the consequences of disease published in accordance with resolution WHA29.35 of the 29th World Health Assembly, May 1976", Geneva World Health Organisation 1980, 205pp, ISBN 92 41 54 12 61.

WHO Impairment categories not used in the TELSCAN Classification:
DISFIGURING
GENERALISED, SENSORY, AND OTHER

Traveller Task Model
IV. Passenger
Airplane

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Trip planning		choosing destination	
		choosing type of transport	
		consult map or other source (route information)	
		choose travel scheme departure/ arrival/ changing	
		identify facilities and accessibility en route (toilet, parking areas, transfers ..)	
		summarize route/ travel scheme	
		planning rest pauses en route	
		reservation (ticket, trip)	
		timing of medication	
Ticketing	Buying ticket	approach ticket window/ desk	
	Ticket stamping/ inspection	approach ground personnel	
Access	Loading unloading/ storage	luggage handling facilities/ equipment	
	Reach point of departure (from point of origin or when changing)	move horizontally (distance, irregular terrain, corridors, obstacles)	
		move vertically (stairs, lift steps, escalator)	
		reading busstop info, departure screens etc.	
		hearing announcements (e.g. stop changes etc.)	
		locate the stops/ station/ terminal	
		choose the right gate	
		determining and requiring the right position for entry and exit	

Traveller Task Model
IV. Passenger
Airplane

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
	Waiting (bridging time difference arrival - departure time)	determine view of location (weather, waiting accommodation)	
		wait standing, sitting	
	ADL during the journey	use sanitary facilities	
		eating & drinking (on board/	
	Entry/ exit vehicle	bridging step height (lift, ramp, steps)	
		pass through passageway (dimensions, obstacles)	
		identify and move to seat	
		taking along other aids/ luggage	
		acquire assistance for boarding/ alighting the transport	
	Obtain seating position	sitting down/ standing up (dimensions, support points)	
		use seat belt	
		transfer mobility aid <-> chair (dimensions, support)	
		reduce size of mobility aid	
		place mobility aid into luggage area	
		position mobility aid	
		secure mobility aid & occupant	
Travelling on/ in vehicle		maintaining seating position (accommodate to the motion of the vehicle)	

Traveller Task Model
IV. Passenger
Airplane

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
		communicating with passengers (speech, sign language)	
		comfort of seats	
		accommodate entrance and egress movements of others	
-Trip information	Determine whereabouts	hear & comprehend announcements	
	Change in regular travel schedule	get info route changes	
		get info change of departure/ arrival time	
		get info change of departure/ arrival point	
Dealing with weather and environmental conditions	Weather	use umbrella, rainproof clothing (rain)	
		puddles (rain)	
		use mobility aid in stormy weather	
		hear + understand auditory information in degraded sound conditions (e.g. heavy rain, high wind)	
		deal with airpollution, (dust, tobacco smoke, pollen)	
Handling emergency situations	Post accident responsibilities	unlock seatbelt	
		leave airplane	
		use emergency equipment	

Traveller Task Model
IV. Passenger
Airplane

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Handling during rush hour		entering a vehicle with a mobility aid (queue)	
		handle time table deviations, (connecting services)	
Using advanced technology	Visual displays	black & white	
		colour	
		text	
		symbols	
	Sound output	tones	
		speech	
	Tactile input	keys/ buttons	
		touchscreen	
	Sound input	speech	

abreviations: ADL Activities of Daily Living

Traveller Task Model
III. Passenger

Bus - tram

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Trip planning		choosing destination	
		choosing type of transport	
		consult map or other source (route information)	
		choose travel scheme departure/ arrival/ changing	
		identify facilities and accessibility en route (toilet, transfers ..)	
		summarize route/ travel scheme	
		planning rest pauses en route	
		reservation (ticket, trip)	
		timing of medication	
Ticketing	Buying ticket	approach ticket window/ desk	
		approach driver	
		use ticket machine	
	Ticket stamping/ inspection	approach driver/ ticket machine	
		stamping ticket	
Access	Loading unloading/ storage	luggage handling facilities/ equipment	
	Reach point of departure (from point of origin or when changing)	move horizontally (distance, irregular terrain, corridors, obstacles)	
		move vertically (stairs, lift steps, escalator)	
		reading busstop info, departure screens etc.	

Traveller Task Model
III. Passenger

Bus - tram

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
		hearing announcements (e.g. stop changes etc.)	
		locate the stops/ station/ terminal	
		identify correct incoming vehicle	
		determining and requiring the right position for entry and exit	
		being detected by transport provider	
	Waiting (bridging time difference arrival - departure time)	determine view of location (weather, waiting accommodation)	
		wait standing, sitting	
	ADL during the journey	use sanitary facilities	
		eating & drinking (on board/	
	Entry/ exit vehicle	opening access doors (handles, weight of door)	
		bridging step height (lift, ramp, steps)	
		pass through passageway (dimensions, obstacles)	
		identify and move to seat	
		taking along other aids/ luggage	
		acquire assistance for boarding/ alighting the transport	
	Obtain seating position	sitting down/ standing up (dimensions, support points)	
		use seat belt	

Traveller Task Model
III. Passenger

Bus - tram

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
		transfer mobility aid <-> chair (dimensions, support)	
		reduce size of mobility aid	
		place mobility aid into luggage area	
		position mobility aid	
		fastening- disengaging WTORS (secure mobility aid & occupant)	
Travelling on/ in vehicle		maintaining seating position (accommodate to the motion of the vehicle)	
		communicating with passengers (speech, sign language)	
		comfort of seats	
		accommodate entrance and egress movements of others	
-Trip information	Determine whereabouts	hear & comprehend announcements	
		identify visual display (stops/ location/ VMS)	
		detect arrival point	
		notify driver of desire to stop	
	Change in regular travel schedule	get info route changes	
		get info change of departure/ arrival time	
		get info change of departure/ arrival point	

Traveller Task Model
III. Passenger

Bus - tram

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Dealing with weather and environmental conditions	Weather	see, read, understand signs in degraded visual conditions (e.g. fog, snow, rain)	
		use umbrella, rainproof clothing (rain)	
		puddles (rain)	
		use mobility aid in stormy weather	
		hear + understand auditory information in degraded sound conditions (e.g. heavy rain, high wind)	
		deal with airpollution, (dust, tobacco smoke, pollen)	
	Night	locate the stops/ station/ terminal	
		identify correct incoming vehicle	
Handling emergency situations	Post accident responsibilities	unlock seatbelt, WTORS	
		leave vehicle	
Handling during rush hour		lacking of seats/ wheelchair space	
		waiting time, for a vehicle and in a vehicle	
		entering a vehicle with a mobility aid (queue)	
		moving mobility aid in a crowded vehicle	
		handle time table deviations, (connecting services)	

Traveller Task Model
III. Passenger

Bus - tram

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Using advanced technology	Visual displays	black & white	
		colour	
		text	
		symbols	
	Sound output	tones	
		speech	
	Tactile input	keys/ buttons	
		touchscreen	
	Sound input	speech	

abreviations:	ADL	Activities of Daily Living
	WTORS	Wheelchair Tiedown and Occupant Restraint System

Traveller Task Model
II. Passenger

Car/Van, taxi, special transp service (van/minibus)

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Trip planning		choosing destination	
		choosing type of transport	
		consult map or other source (route information)	
		planning rest pauses en route	
		reservation (ticket, trip)	
		timing of medication	
Ticketing	Buying ticket	approach driver	
Access	Loading unloading/ storage	on passenger seat/ back seat	
		fitting child seats, seating child	
		reduce size of mobility aid	
		load/ secure mobility aid	
		load/ secure objects (shopping)	
	Pre-operative	adjust seat position	
		adjust head restraints	
	Reach point of departure (from point of origin or when changing)	move horizontally (distance, irregular terrain, corridors, obstacles)	
		being detected by transport provider	
	Waiting (bridging time difference arrival - departure time)	determine view of location (weather, waiting accommodation)	
		queueing at a taxirank	
		wait standing, sitting	
	ADL during the journey	use sanitary facilities	

Traveller Task Model
II. Passenger

Car/Van, taxi, special transp service (van/minibus)

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
		eating & drinking (egress)	
		use of service stations	
	Entry/ exit vehicle	opening access doors (handles, weight of door)	
		bridging step height (lift, ramp, steps)	
		pass through passageway (dimensions, obstacles)	
		taking along other aids/ luggage	
	Obtain seating position	sitting down/ standing up (dimensions, support points)	
		use seat belt	
		transfer mobility aid <-> chair (dimensions, support)	
		reduce size of mobility aid	
		place mobility aid into luggage area	
		position mobility aid	
		fastening- disengaging WTORS (secure mobility aid & occupant)	
Travelling on/ in vehicle		maintaining seating position (accommodate to the motion of the vehicle)	
		communicating with passengers (speech, sign language)	
		comfort of seats	
		accommodate entrance and egress movements of others	

Traveller Task Model
II. Passenger

Car/Van, taxi, special transp service (van/minibus)

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
-Trip information	Determine whereabouts	identify visual display (stops/ location/ VMS)	
		notify driver of desire to stop	
	Change in regular travel schedule	get info route changes	
		get info change of departure/ arrival time	
		get info change of departure/ arrival point	
Dealing with weather and environmental conditions	Weather	see, read, understand signs in degraded visual conditions (e.g. fog, snow, rain)	
		use umbrella, rainproof clothing (rain)	
		puddles (rain)	
		use mobility aid in stormy weather	
		hear + understand auditory information in degraded sound conditions (e.g. heavy rain, high wind)	
		deal with airpollution, (dust, tobacco smoke, pollen)	
Handling emergency situations	Post accident responsibilities	unlock seatbelt, WTORS	
		leave vehicle	
Handling during rush hour		lacking of seats/ wheelchair space	

Traveller Task Model
II. Passenger

Car/Van, taxi, special transp service (van/minibus)

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
		waiting time, for a vehicle and in a vehicle	
Using advanced technology	Visual displays	black & white	
		colour	
		text	
		symbols	
	Sound output	tones	
		speech	
	Tactile input	keys/ buttons	
		touchscreen	
	Sound input	speech	

abreviations:	ADL	Activities of Daily Living
	WTORS	Wheelchair Tiedown and Occupant Restraint System

Traveller Task Model
IV. Passenger
Ship

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Trip planning		choosing destination	
		choosing type of transport	
		consult map or other source (route information)	
		choose travel scheme departure/ arrival/ changing	
		identify facilities and accessibility en route (toilet, parking areas, transfers ..)	
		summarize route/ travel scheme	
		planning rest pauses en route	
		reservation (ticket, trip)	
		timing of medication	
Ticketing	Buying ticket	approach ticket window/ desk	
		use ticket machine	
	Ticket stamping/ inspection	approach ground personnel	
Access	Loading unloading/ storage	luggage handling facilities/ equipment	
	Reach point of departure (from point of origin or when changing)	move horizontally (distance, irregular terrain, corridors, obstacles)	
		move vertically (stairs, lift steps, escalator)	
		reading departure screens etc.	
		hearing announcements (e.g. dep. times etc.)	
		locate the terminal	
		identify correct incoming ship	
		determining and requiring the right position for entry and exit	

Traveller Task Model
IV. Passenger
Ship

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
	Waiting (bridging time difference arrival - departure time)	determine view of location (weather, waiting accommodation)	
		wait standing, sitting	
	ADL during the journey	use sanitary facilities	
		eating & drinking (on board)	
	Entry/ exit vehicle	bridging step height (lift, ramp, steps)	
		pass through passageway (dimensions, obstacles)	
		identify and move to seat	
		taking along other aids/ luggage	
		acquire assistance for boarding/ alighting the ship	
	Obtain seating position	sitting down/ standing up (dimensions, support points)	
		transfer mobility aid <-> chair (dimensions, support)	
		reduce size of mobility aid	
		place mobility aid into luggage area	
		position mobility aid	
Travelling on/ in vehicle		communicating with passengers (speech, sign language)	
		comfort of seats	
		accommodate entrance and egress movements of others	

Traveller Task Model
IV. Passenger
Ship

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
-Trip information	Determine whereabouts	hear & comprehend announcements	
		identify visual display (stops/ location/ VMS)	
	Change in regular travel schedule	get info change of departure/ arrival time	
Dealing with weather and environmental conditions	Weather	use umbrella, rainproof clothing (rain)	
		puddles (rain)	
		use mobility aid in stormy weather	
		hear + understand auditory information in degraded sound conditions (e.g. heavy rain, high wind)	
		deal with airpollution, (dust, tobacco smoke, pollen)	
Handling emergency situations	Post accident responsibilities	abandon ship procedure	
		use emergency equipment	
Handling during rush hour		entering a vehicle with a mobility aid (queue)	
		handle time table deviations, (connecting services)	
Using advanced technology	Visual displays	black & white	
		colour	
		text	
		symbols	

Traveller Task Model
IV. Passenger
Ship

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
	Sound output	tones	
		speech	
	Tactile input	keys/ buttons	
		touchscreen	
	Sound input	speech	

abreviations: ADL Activities of Daily Living

Traveller Task Model
IV. Passenger

Metro - train

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Trip planning		choosing destination	
		choosing type of transport	
		consult map or other source (route information)	
		choose travel scheme departure/ arrival/ changing	
		identify facilities and accessibility en route (toilet, parking areas, transfers ..)	
		summarize route/ travel scheme	
		planning rest pauses en route	
		reservation (ticket, trip)	
		timing of medication	
Ticketing	Buying ticket	approach ticket window/ desk	
		use ticket machine	
	Ticket stamping/ inspection	approach ticket machine/ conductor	
		stamping ticket	

Traveller Task Model
IV. Passenger

Metro - train

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
Access	Loading unloading/ storage	luggage handling facilities/ equipment	
	Reach point of departure (from point of origin or when changing)	move horizontally (distance, irregular terrain, corridors, obstacles)	
		move vertically (stairs, lift steps, escalator)	
		reading departure screens etc.	
		hearing announcements (e.g. stop changes etc.)	
		locate the stops/ station/ terminal	
		identify correct incoming vehicle	
		determining and requiring the right position for entry and exit	
	Waiting (bridging time difference arrival - departure time)	determine view of location (weather, waiting accommodation)	
		wait standing, sitting	
	ADL during the journey	use sanitary facilities	
		eating & drinking (on board)	
	Entry/ exit vehicle	opening access doors (handles, weight of door)	
		bridging step height (lift, ramp, steps)	
		pass through passageway (dimensions, obstacles)	

Traveller Task Model
IV. Passenger

Metro - train

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
		identify and move to seat	
		taking along other aids/ luggage	
		acquire assistance for boarding/ alighting the transport	
	Obtain seating position	sitting down/ standing up (dimensions, support points)	
		transfer mobility aid <-> chair (dimensions, support)	
		reduce size of mobility aid	
		place mobility aid into luggage area	
		position mobility aid	
Travelling on/ in vehicle		maintaining seating position (accommodate to the motion of the vehicle)	
		communicating with passengers (speech, sign language)	
		comfort of seats	
		accommodate entrance and egress movements of others	
-Trip information	Determine whereabouts	hear & comprehend announcements	
		identify visual display (stops/ location/ VMS)	
		detect arrival point	
	Change in regular travel schedule	get info route changes	
		get info change of departure/ arrival time	

Traveller Task Model
IV. Passenger

Metro - train

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
		get info change of departure/ arrival point	
Dealing with weather and environmental conditions	Weather	see, read, understand signs in degraded visual conditions (e.g. fog, snow, rain)	
		use umbrella, rainproof clothing (rain)	
		puddles (rain)	
		use mobility aid in stormy weather	
		hear + understand auditory information in degraded sound conditions (e.g. heavy rain, high wind)	
		deal with airpollution, (dust, tobacco smoke, pollen)	

Traveller Task Model
IV. Passenger

Metro - train

Main Task	*Sub Tasks*	*Prompts*	*Data from Interviewees - Comments/Problems*
	Night	locate the stops/ station/ terminal	
		identify correct incoming vehicle	
Handling emergency situations	Post accident responsibilities	leave vehicle	
Handling during rush hour		lacking of seats/ wheelchair space	
		waiting time, for a vehicle and in a vehicle	
		entering a vehicle with a mobility aid (queue)	
		moving mobility aid in a crowded vehicle	
		handle time table deviations, (connecting services)	
Using advanced technology	Visual displays	black & white	
		colour	
		text	
		symbols	
	Sound output	tones	
		speech	
	Tactile input	keys/ buttons	
		touchscreen	
	Sound input	speech	

abreviations: ADL Activities of Daily Living

I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip planning	Finding relevant planning information (e.g. attended petrol stations, hotels, toilets, traffic conditions, parking places, accessible road service, etc.)	Improved accessibility of planning information for E&D travellers	√				√	Yes	Yes 5, 127	In-vehicle Navigation/ Travel and traffic information systems - exist in limited form, but need to provide information more relevant to disabled drivers
	Turning pages of map/atlases	Improved means of navigating Single page maps Assistance from passenger	√				√	Yes	Yes 127	In-vehicle navigation systems are needed which consider needs of E&D people
	Understanding colour coding systems for maps	Non-reliance on colour for coding		√		√		Yes	Yes 127	In-vehicle navigation systems are needed which do not place a reliance on colour coding
	Reading text within travel information sources (e.g. maps)	Non-reliance on text within travel information sources		√	√		√	Yes	Yes 127	In-vehicle navigation systems are needed which do not place a reliance on text
	Use of complex spatial information such as a map	Improved means of navigating		√		√	√	Yes	Yes 127	In-vehicle navigation systems are needed which do not place a reliance on map-based information
Access - loading/ unloading/storage	Loading/unloading objects into/from car (incl. wheelchair)	Assistance from passenger	√				√	No	NA	
	Storing wheelchair during journey	Improved car space design	√				√	No	NA	
Access - pre-operative	Putting seatbelt on - base too close to driver's seat and clip is out of reach	Improved seat belt design	√				√	No	NA	
	Headrest adjustments - requires strength and flexibility	Improved headrest design	√				√	No	NA	

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
	Defreezing windscreen	Automatic defrost setting Alternative means of controlling defrost setting	√				√	Yes	Yes 28 (R&D)	Use of speech recognition technology within vehicles
Access - entry/exit vehicle	Transferring self from wheelchair into car and vice-versa, particularly in adverse weather conditions	Improved road/kerb layout Improved car design (space under steering column, opening angle of door etc.)	√				√	No	NA	
	Finding hole for key and turning key	Alternative door opening systems		√			√	No	No	
Access - obtain seating position	Adjusting seat to get in and then to drive	Greater range of adjustment for car seats More easily adjustable seats	√				√	No?	No	
Toll collection - toll plaza	Passing money through window at toll plazas	More accessible toll booths Automatic debiting	√				√	Yes	Yes 13, 69 (R&D)	Smart card systems are required to enable E&D people to pay tolls without having to stop
	Automated toll booths are generally not available for those with disabled persons/senior citizens discounts	Automated systems that can account for discount rates Automatic debiting	√				√	Yes	Yes 13, 69 (R&D)	Smart card systems are required to enable E&D people to pay tolls without having to stop
	Distinguishing where to go at toll plazas	Improved means of signalling correct toll booth		√		√		Yes	No	In-vehicle navigation systems are needed that are linked to toll plazas, thus signalling which booth to approach
Vehicle control - primary	Accidently turning off engine whilst driving and using hand controls	Improved control design	√					No	NA	

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
	Fatigue in fingers - accelerator hand control requires constant pressure (similar, but reduced problem for brake and clutch hand controls)	Improved control design	√					No	NA	
	Controls often located in the safety sensitive knee clearance zone	Safer positioning of controls	√					No	NA	
	Hand-controlled brake can lock up in certain weather conditions	Improved control design	√					No	NA	
	Difficult to steer whilst pressing accelerator hand control	Improved control design	√					No	NA	
	Operating hand controls in cold weather conditions, particularly if driver has muscle tone problems	Car heating	√					No	NA	
	Limp lower limbs can get beneath pedals restricting pedal actuation	Modification to vehicle	√					No	NA	
	Uncontrolled limb movements - Risk of inadvertant control actuation	Means of accommodating inadvertant limb movement	√					No	NA	
	Releasing standard handbrake (with upper limb impairment or overload)	Alternative handbrake controls	√				√	No	NA	
	Difficult and tiring to use joystick controls	Improved joystick control design, incl. support of the underarm, wrist and hand	√					No	NA	
	Using hand and foot controls - Pressing clutch with foot whilst pulling gear lever with hand	Improved control design	√					No	NA	

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
	Accuracy of performance in using hand controls	Improved control design	√					No	NA	
	Using a control box which is next to steering knob for indicators - particularly difficult when have to quickly change direction, e.g. roundabouts	Improved layout of controls	√					No	NA	
	Controlling the steering wheel when driving in icy conditions or when holes in road	Improved steering performance of car	√				√	No	NA	
	Fatigue/cramp in arm/s	Power steering	√				√	No	NA	
	Steering and turning body at the same time - makes entering and leaving traffic difficult	Means of spotting gaps in traffic	√				√	Yes	Yes 19 (R&D)	Gap acceptance collision-avoidance systems
	Back pain when placing pressure on pedals	Improved seat design Reduced pressure required for pedals	√				√	No	NA	
Vehicle control - secondary	Reaching secondary system controls	Improved layout of controls Alternative means of accessing secondary controls	√				√	Yes	Yes 28 (R&D)	Use of speech recognition technology within vehicles
	Finding secondary system controls, particularly whilst driving at night	Improved layout and lighting of controls Alternative means of accessing secondary controls	√	√			√	Yes	Yes 28 (R&D)	Use of speech recognition technology within vehicles
	Overload on residual capabilities - affects ability to look in mirrors or at secondary controls (e.g. indicators, lights, radio, wipers, heating)	Improved primary and secondary control design Alternative means of accessing secondary controls	√	√		√	√	Yes	Yes 28 (R&D)	Use of speech recognition technology within vehicles

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
	Overload on limbs - leads to problems in use of conventional secondary system controls (e.g. indicators, lights, windscreen wipers)	Improved primary and secondary control design Alternative means of accessing secondary controls	√				√	Yes	Yes 28 (R&D)	Use of speech recognition technology within vehicles
	Using an in-vehicle telephone - reach, use of buttons, holding, etc.	Improved telephone design (positioning, button size, weight, etc.) Hands free telephones	√				√	No	No	
	Using an in-vehicle radio/ entertainment system - reach, buttons, etc.	Improved system design RDS radio Alternative means of accessing system controls	√				√	Yes	Yes 28 (R&D)	Use of speech recognition technology within vehicles
Vehicle control - general driving tasks	Looking behind to see through rear window or side mirrors (problem with turning head/trunk and/or visual acuity)	Improved accessibility of mirrors Alternative means of obtaining information regarding surroundings	√	√			√	Yes	Yes 128, 129	Parking aids/Blind spot detection systems that do not require driver to turn head/trunk and/or accurately focus on details
	Changes in ambient lighting (most serious for headlight dazzle)	Improved headlamp design All-lit roads, incl. tunnels		√			√	No	No	
	Choosing correct lane	Improved means of obtaining lane information		√		√	√	Yes	Yes 127, 48 (R&D)	In-vehicle navigation systems that are able to recommend a lane choice
	Seeing road signs whilst driving at speed (worse at night with reflecting signs)	Improved road sign design Reduced need for use of road signs		√			√	Yes	Yes 127	In-vehicle navigation systems that do not require use of road sign information
	Perceiving and estimating distances	Driver support to perceive and estimate distances		√		√	√	Yes	No	
	Generally, driving at speed (e.g. on motorways)	Driver support at higher vehicle speeds		√		√	√	Yes	Yes 21 (R&D) 42 (R&D)	

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
	Incorrectly identifying traffic light status, if colour blind and distracted by something else, e.g. conversation	Non-visual means of providing traffic light status information		√			√	Yes	No	In-vehicle communications with traffic light status
	Hearing:- - engine noise/feedback - indicators - warnings/telltales - emergency services - other traffic - own horn - conversations	Non-auditory means of providing feedback/status information			√		√	Yes	No	Information may be represented via the visual and/or tactile senses
	Reacting, generally, to driving situations	Alternative means of providing support for the driving task		√	√	√	√	Yes	No	
Vehicle control - road related	Negotiating curves when curve is not open enough to provide good visibility and/or when speed is too fast	Improved road/junction designs Alternative means of providing advanced warning of oncoming manoeuvres		√		√	√	Yes	Yes 127	In-vehicle navigation systems are needed that warn driver of sharp bends ahead
	At crossroads/T-junctions/ main road into side road - looking for vehicle left/right (worse if junction not well illuminated)	Improved lighting at junctions Alternative means of obtaining information regarding gaps in traffic		√		√	√	Yes	Yes 19 (R&D)	Gap acceptance collision-avoidance systems
	Negotiating sharp corners and junctions - difficult to quickly turn and accelerate at same time	Improved control design	√				√	No	No	
	Negotiating curves - perceived as if video game simulation (i.e lack of 3D view feeling of depth)	Clear road markings		√			√	No	No	

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
	Railroad crossings - visual scanning (i.e. looking left/right)	Automatic crossings		√			√	No	No	
	Glare sensitivity - Exiting from tunnels	Lit tunnels		√			√	No	No	
	Phobias - Driving over bridges/ flyovers or through tunnels	Pre-trip information regarding bridges/flyovers and tunnels on route				√		Yes	Yes 127	In-vehicle navigation systems that enable avoidance of bridges/ flyovers and tunnels
Vehicle control - traffic related tasks	Viewing indicators of other vehicles (worse for oncoming vehicles)	Improved conspicuity of vehicle indicators		√			√	No	No	
	Overtaking other vehicles (checking traffic behind/in front, judging distances, seeing indicators)	In-vehicle information regarding movements of surrounding traffic		√		√	√	Yes	Yes? 19 (R&D)	Collision avoidance systems that consider the requirements of E&D people
	Entering/leaving traffic - judging gaps and seeing indicators	Alternative means of obtaining information regarding gaps in traffic		√			√	Yes	Yes 19 (R&D)	Gap acceptance collision-avoidance systems that consider the needs of E&D people
	Seeing hand signals of other drivers/pedestrians			√			√	No	No	
	Glare of oncoming vehicle headlights	Improved headlamp design		√			√	No	No	
	Estimation of speeds/ distances of other traffic			√		√	√	Yes	Yes 47 (R&D)	
Vehicle control - maintenance tasks	Routine care and servicing of vehicle	Assistance from others Improved accessibility of engine	√			√	√	No	No	
	Re-fueling vehicle	Means of alerting filling station staff Alternative means of re-fueling vehicle	√				√	Yes Yes	Yes 131 No	Device for alerting staff tha driver requires assistance Automatic re-fueling systems (similar to those used with planes)

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
	Paying for fuel - requires driver to get out of vehicle	Means of paying for fuel without leaving vehicle	√				√	Yes	Yes 132	Automatic card debiting systems for paying for fuel at the pump
	Checking oil levels	Clearer dipstick levels In-vehicle indication of oil levels	√	√		√	√	No	No	
Trip information - determine whereabouts	Overload on residual mental capacity - less capacity to take in other information (e.g. road signs, street names) when finding way in unfamiliar area	Improved means of navigating	√			√	√	Yes	Yes 127	In-vehicle navigation systems that provide simple well designed step-by-step instructions
	Looking for information to side of road (e.g. road signs, street names, landmarks)	Non-reliance on these forms of navigation information	√	√		√	√	Yes	Yes 127	In-vehicle navigation systems that do not rely on information to side of road
	Using directions from passenger (hearing, following and remembering)	Improved means of navigating			√	√	√	Yes	Yes 127	In-vehicle navigation systems that provide a visual interface to the driver
	Reading roadsigns	Non-reliance on text for road signs Improved means of navigating		√	√	√	√	Yes	Yes 127	In-vehicle navigation systems that do not rely on road sign information
	Remembering routes Developing a cognitive map of an area	Improved means of navigating				√	√	Yes	Yes 127	In-vehicle navigation systems that enable driver to plan and remember routes
Trip information - change in regular travel schedule	Obtaining up-to-date traffic/weather information (e.g. radio)	Non-auditory means of obtaining up-to-date traffic information			√			Yes	Yes 51 (R&D)	In-vehicle traffic and travel information systems are needed that provide a visual interface to drivers
	Finding way if have to change plan mid-route	Improved means of navigating		√		√	√	Yes	Yes 127	In-vehicle navigation systems

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Dealing with weather and environment conditions - weather	Driving in fog, heavy rain or snow, and with windscreen wipers on	Pre-trip information regarding weather Improved vision during journey		√			√	Yes	Yes 51 (R&D)	In-vehicle travel and traffic Navigation systems that provide real-time weather information Vision-enhancement systems
	Driving in adverse weather conditions - problems with circulation	Improved car heating	√				√	No	No	
Dealing with weather and environment conditions - night	Driving at night, particularly looking behind, because road is not illuminated by vehicle lights	All-lit roads		√			√	Yes	Yes 46 (R&D)	Vision-enhancement systems that consider requirements of E&D people
	Finding in-vehicle controls at night	Improved lighting of controls Easily memorable control positions		√			√	No	No	
	Seeing lane markings, particularly at night for unlit roads	All-lit roads Improved lane markings		√			√	Yes	Yes 46 (R&D)	Vision-enhancement systems that consider requirements of E&D people
	Using an in-vehicle display at night	Improved lighting of in-vehicle displays (brightness, contrast, etc.)		√			√	Yes	Yes 49 (R&D)	Head-up displays for relevant information that consider needs of E&D people
Parking	Turning steering wheel whilst reversing/parking	Improved control design	√				√	No	No	
	Using ticket machines at carparks - reaching controls, taking ticket, receiving change, etc.	More accessible ticket machines Alternative means of paying for carparking	√				√	Yes	Yes 69 (R&D)	Smart card systems are required to enable disabled people to pay for parking (preferably without leaving vehicle)

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
	Car parking spaces reserved for disabled drivers are frequently occupied by unauthorised users	Physically preventing unauthorised use Alternative means of reserving/securing a car parking place	√				√	Yes	Yes 22 (R&D)	Pre/en-trip information regarding availability of parking places (e.g. Internet, VMS)
	Looking behind to see through rear window or side mirrors when reversing (problem with turning head/trunk and/or visual acuity)	Improved accessibility of mirrors Alternative means of obtaining information regarding surroundings	√	√			√	Yes	Yes 128	In-vehicle parking aids that provide information either auditorily and/or visually to front of driver
	Maintaining balance when looking over shoulder to reverse car	Improved seat design Alternative means of obtaining information regarding surroundings	√					Yes	Yes 128	In-vehicle parking aids that provide information either auditorily and/or visually to front of driver
	When reversing and turning around to look cannot keep hand firmly on controls	Improved control design	√				√	No	No	
	Estimating gaps	In-vehicle parking information		√			√	Yes	Yes 128	In-vehicle parking aids that consider the needs of E&D people
	Lining up car with kerb when parking	In-vehicle parking information				√	√	Yes	Yes 128	In-vehicle parking aids that consider the needs of E&D people
Handling emergency situations - responding to car emergencies	Controlling vehicle when being towed - brakes of adapted cars do not work properly when engine is off	Improved design of adapted cars	√					No	No	
	Vehicle safety in the event of an accident/sudden braking - controls not subject to regulations	Improved, safer controls for adapted cars and a whole vehicle test procedure	√					No	No	
	Obtaining support from other road users	A mechanism for alerting other road users	√		√	√	√	Yes	Yes 20 (R&D)	

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
	Getting out of the vehicle in the event of an emergency/breakdown	Easier means of exiting vehicle	√					No	No	
	Getting to and using phone box in the event of an emergency/breakdown	More accessible phone boxes Use of mobile phone In-vehicle communications	√				√	Yes	Yes 126	Emergency alerting system that enables contact to be made with emergency services
	Pushing own car in the event of breakdown	Assistance from others	√				√	No	No	
	Orientation following an accident/breakdown	Improved means of navigating		√		√	√	Yes	Yes 127	In-vehicle navigation systems are needed that enable driver to quickly establish current location
	Using emergency phone, particularly on motorway	Non-auditory means of signalling need for assistance to emergency services	√		√			Yes	Yes 126	Emergency alerting system that enables contact to be made with emergency services
	Warnings of other driver's emergencies	In-vehicle co-operative information			√			Yes	Yes 25 (R&D)	In-vehicle co-operative driving system
	Reacting to hazards, particularly when driving at speed	Advanced warning of hazards				√	√	Yes	Yes 25 (R&D)	In-vehicle co-operative driving system
	Fear of breaking down, particularly at night and during winter - danger of hypothemia	Car heating, even when engine is off In-vehicle communications	√				√	Yes	Yes 126	Emergency alerting system that enables contact to be made with emergency services
Using advanced technology - general	Using system for first time and learning to use system	Training for use of advanced technology				√	√	NA	NA	NA
Using advanced technology - visual displays	Overload on residual abilities, making use of a secondary visual display more problematic.	Simple, well-designed systems	√	√		√	√	NA	NA	NA
	Identifying symbols and reading text on any display	Well-designed visual information		√		√	√	NA	NA	NA

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
	Viewing in-vehicle displays to side of natural line of gaze	Careful positioning of displays		√				NA	NA	NA
	Alternating vision between in-vehicle displays and road environment	Use of HUDS where appropriate		√			√	NA	NA	NA
	Glare sensitivity - Glare on any in-vehicle displays during sunlight	Glare resistant displays		√			√	NA	NA	NA
	Understanding colour coding systems for displayed information	Non-reliance on colour for coding of information		√				NA	NA	NA
	Reading any text on an in-vehicle display	Use of symbols as alternatives Minimum use of text		√	√	√	√	NA	NA	NA
	Driving and using a complex visual-based ITS (e.g. a map only route guidance system)	Non complex visual information Greater use of auditory channel		√		√	√	NA	NA	NA
Using advanced technology - sound output	Overload on residual abilities, making use of secondary sound output more problematic.	Simple, well-designed systems			√		√	NA	NA	NA
	Hearing and/or understanding auditory/ tonal output from an in-vehicle system	Non-auditory means of displaying information			√	√	√	NA	NA	NA
	Following voice directions given by route guidance system	Non-auditory means of displaying information			√	√	√	NA	NA	NA
	Coping with the timing of route guidance instructions	Advanced warning Omni-present information	√			√	√	NA	NA	NA
	Remembering voice instructions, e.g. route guidance	Repeat button Omni-present information				√	√	NA	NA	NA

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I. Driver: Car/van

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
	Paying attention to voice instructions from system	Repeat button Omni-present information			√	√	√	NA	NA	NA
Using advanced technology - tactile input	Overload on residual abilities, making use of a secondary tactile display more problematic.	Simple, well-designed systems	√				√	NA	NA	NA
	Use of system controls that require tactile response, e.g. 'repeat last message' button	Speech input Improved control design (e.g. within easy reach)	√				√	NA	NA	NA
Using advanced technology - sound input	Overload on residual abilities, making use of secondary sound input more problematic.	Simple, well-designed systems			√	√	√	NA	NA	NA
	Use of voice input (e.g. entering destination)	Non-voice input mechanisms			√	√		NA	NA	NA

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip planning - general	Obtaining and giving information, either person to person or over the telephone.	Non-verbal methods of obtaining and giving information.			√	√		Yes	Yes eg 75 or 118	Consider use of portable, visual devices, Internet use, e-mail, video text, video phones and multimedia computers.
Trip planning - find information	Difficulty in accessing information, particularly when interchanges are required, e.g. bus routes, bus stop, departure times, interchange points, etc. Difficulty in memorising a given travel scheme.	A detailed, easy to read and easy to follow schedule containing all necessary information in step-by-step instructions, and available in visual and auditory forms. The ability to compare different travel schemes for the same destination. The ability to define the choice criteria. The ability to make a decision among the proposed trip schemes.		√	√	√	√	Yes	Yes eg 77 and 5,33A (R&D)	Multi-modal information system (see suggested modifications in Appendix 3C, Observation) To minimise the decision-making load on the user, the system should be able to offer a solution w.r.t the choice of transport mode, etc. Clear instructions should be provided which can be printed if needed. Characters should be of an adequate size.
Trip planning - find information	Difficulty in finding the most suitable information to meet specific travelling needs	Specific information requirements need to be included in information systems.	√	√	√	√	√	Yes	Yes eg 77 5 (R&D)	Multi-modal information system (see suggested modifications in Appendix 3C, Observation)
Trip planning - find information	Reading bus stop information, locating correct stop and incoming bus	Improved sources of locating information (simple, concise info., use of symbols/pictograms/ voice output, etc.). Improved localisation methods		√		√	√	Yes	Yes 33D (R&D)	Navigation systems that guide an individual to the correct bus stop

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip planning - find information	Written timetables impossible/difficult to see/read. Information placed high up is also difficult to see.	Non-visual methods for giving information.	√	√	√	√	√	Yes	Yes eg 120 Yes 89	Braille timetables had never been encountered, and would only be useful to a small number of visually impaired travellers. Possible to telephone for information but only for planned journeys. A speech input/output interface at bus stops could be considered.
Trip planning - general	Making travel-related decisions (e.g. departure time, any changes, using maps/bus stop info.)	Improved sources of planning information (simple, concise info., use of symbols/pictograms, etc.). Human assistance. Alternative means of planning a bus journey.				√	√	Yes	Yes 33A (R&D)	Computer-based trip planning systems that are accessible to all potential users
Trip planning - finding destination	Difficulty in identifying and/or memorising the stop according to the user' needs. Difficulty in finding destination from the transportation network. Difficulty in reading and understanding written information	Facilities for a clear & easy identification, understanding & memorising the location of the trip goal. Easy to enter the destination.		√	√	√	√	Yes	Yes 33A (R&D)	Instructions on how to find destination (printed when desired) must be clear. A good contrast and size of characters is recommended. The instructions, the corresponding output & the final output should be presented within boxes using contrasting & differentiated colours. The use of adequate symbols when possible is recommended.

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip planning - choosing type of transport	Difficulty in identifying the adequate type of transport according to the destination.	Relevant information according to the trip destination. Easy to choose the type of transport and to enter the choice.	√	√	√	√	√	Yes	Yes 33A (R&D)	The system should only enable selection of those transport modes which are relevant to the current destination and the users' requirements.
Trip planning - consult map or travel scheme	Difficulty in identifying places within a map. Difficulty in building spatial representations from a map. Difficulty in reading and understanding written information.	Clear & easy identification of the destination and/or a route within a map.		√	√	√	√	Yes	Yes 33A (R&D)	The information provided by means of maps should use accurate survey maps instead of network maps. Destination and/or route should be emphasised. Landmarks should be used to ease the identification of the place. Printed maps should be provided.
Ticketing - general	Difficulty with understanding instructions (e.g. from ticket machine), coping with new tasks, memory.	Improved sources of ticketing information (simple, concise info., use of symbols/pictograms, etc.). Automatic means of paying for ticket			√	√	√	Yes	Yes 86 1 (R&D) 33B (R&D)	Computer based intelligent ticket machine. Automatic debiting via a smart card

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Ticketing - buying and stamping ticket	Difficulty in identifying the ticket/stamping machine. Difficulty in understanding how to use the machine and in performing the task, eg calculating cost, etc. Difficulty in reading.	Information on travel cost and ticketing procedure, using simple displays with suitably sized letters and/or symbols. Clear & easy identification of the ticket/stamping machines as well as information via other modes on the requirement for stamping. Automatic means of paying for ticket.				√	√	Yes	Yes 86 1 (R&D) 33B (R&D)	Computer based intelligent ticket machine. Automatic debiting via a smart card
Ticketing - buying and stamping ticket	Physical interaction in using ticket machines, pressing buttons, handling electronic cards, etc.	Easy to use and explicit controls. Providing help for using the ticket/stamping machine when required. Automatic means of paying for ticket	√	√			√		33B (R&D)	Ticket machine using free-hand card.
Ticketing - buying and stamping ticket	Communication with ticket staff.	Non-verbal communication (one way or two-way), e.g. sign language or other visual method. Automatic means of paying for ticket			√	√	√	Yes	Yes 33B (R&D)	Computerised ticketing with visual display (but may cause delays or be a problem for visual imp.). Language must be easily understandable. Automatic debiting via a smart card

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Ticketing - driver/ticket vendor approach	Difficulty in inter-individual communications (speech, hearing & understanding)	Easy communication between user and driver, e.g. by providing special seats for disabled person which are close to driver			√	√	√	Yes	Yes 33B (R&D)	A free-hand card and adequate trip planning could avoid the users needs for communication with the driver. A system for communication with the driver from the seats for disabled people should be implemented.
Access - travel to and from bus stop	Long walking distances, uneven pavements, high kerbs, snow and slippery surfaces.	Short and safe walking distances. Walking distance max. 200m. Even surface, kerb max. 150mm. High level of maintenance.	√	√			√	No	N/A	Physical modifications to road environment.
Access - waiting at bus stop	Long waiting times (and not predictable), inadequate wind and rain protection, lack of proper seating facilities.	Comfortable seating and weather protection facilities. Dynamic information on waiting time.	√				√	Yes	Yes 89	Information system that shows the waiting time for the bus.
Access - bus arrival	Identifying that a bus has arrived (as opposed to any other similar-sounding vehicle).	Non-visual information of the arrival of a bus, its number and destination.		√				Yes	Yes (partly) 89	Some systems do give auditory announcement triggered by a transmitter on the bus. This should be more widely implemented.
Access - bus arrival	Identifying correct bus, its number and destination.	Dynamic information on departure time, waiting time, destination of next bus. Display with suitable letter size. Destination sign on the bus.		√		√	√	Yes	Yes 89	Information system at the bus stop and on the bus, showing the relevant information.

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Access - entering / exiting bus	High steps and inadequate hand rails, etc.	Low-floor entrances/exits. Easy and comfortable boarding/alighting. Step height max. 230mm. Handrails at a height of 900mm.	√	√			√	No	N/A	Physical modifications to buses.
Access - entering / exiting bus	Not hearing auditory warning that automatic doors are closing	Visual warning			√		√	Yes	No	Visual warning system
Access - changing buses	Identify correct bus stop, gate, bus, departure time.	Information on bus routes, stops, gates, departure time. Sign with map of the terminal. Display with departure times. destination signs on bus stops. Correct order of information and suitable size of letters.		√		√	√	Yes	Yes 89	Information system on bus routes, stops, gates, departure times etc.
Access - locating stop	Difficulty in identifying stops, or asking other travellers for help. Difficulty in reading and spatial representations	Clear & easy identification of the stops (e.g adequate panels & signs).		√	√	√	√	Yes	Yes 33D (R&D)	Information systems for public transport should be located everywhere and provide information about networks & stops.
Travelling on bus - movement	Inadequate hand grips, inadequate seating	Comfortable and safe ride. Proper seats with sufficient strength. Air suspension system.	√				√	No	No	Physical changes to bus design.
Travelling on bus - communication	Communication with other passengers	Inform others of communication difficulty and be able to use non-verbal methods - sign language, written text or other visual method.			√	√		Yes	No	Hand held communication device.

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip information - determining whereabouts	Seeing/identifying/ recognisng correct stop (sensory aspects). Drivers often forget to let them know when they have arrived	Visual and auditory announcement of arrival at each stop (just prior to stopping). Clear and easy identification of the stops (eg audio or adequate panels and signs)		√			√	Yes	Yes 89	Many buses announcing next bus stop and each stop as it is approached. This should be extended through information systems for all buses and other public transport. An alternative is a personal, portable device which detects the travellers location (e.g. via GPS)
Trip information - determining whereabouts	Difficulty in discriminating and selecting the relevant information (cognitive aspects). Difficulty in reading and spatial representations. Difficulty in memorising the trip planning & paying attention to the route. Difficulty in recovering the trip planning when forgotten (stressful situation).	Visual and auditory announcement of arrival at each stop (and just prior to stopping). Clear and easy identification of the stops (eg audio or adequate panels and signs)			√	√	√	Yes	Yes 89, 33A (R&D)	Many buses announcing next bus stop and each stop as it is approached. This should be extended through information systems for all buses and other public transport. An alternative is a personal, portable device which detects the travellers location (e.g. via GPS). Trip planning information should be capable of being printed, and should provide information on stops. Visual & vocal interfaces should be used for this kind of information.
Trip information - hear and comprehend announcements	Hearing and comprehending instructions.	Visual presentation of the same information, and / or better auditory announcements.			√	√	√	Yes	Yes (partly) eg 123	Visual display - on bus or hand-held. Enhancements of auditory information e.g. loop systems.

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip information - Identifying visual display (stops)	Difficulty in consulting visual displays.	Clear & easy identification of different visual displays (via adequate location and use of symbols). Auditory information. Detailed plans of each stop and interchange terminal should be provided by the transport operator.		√			√	Yes	Yes 33A (R&D)	The information system should provide plans of each stop and interchange terminal. Symbols should be used as far as possible. Information should be printed, and also available in auditory form.
Trip information - notify driver of desire to stop	Difficulty in identifying/finding the control to notify the driver to stop.	Easy & explicit controls to ask the driver to stop. Easy communication between the user and the driver.		√		√	√	Yes	No	Communication system between user and driver. Easy to identify stop button, using symbols, colour.
Trip information - notify driver of desire to stop	Difficulty in physically using the button or control to notify the driver to stop.	Easy & explicit controls to ask the driver to stop.	√				√	No	No	Stop buttons, accessible from the seats for disabled people, should be provided.
Trip information - change in regular travel schedule	Obtaining the right sort of information to meet particular needs.	Up-to-date simple information relevant to the traveller. Solutions & facilities for waiting.	√	√	√	√	√	Yes	Yes 89, 90 33A (R&D)	Information system should include the specific information requirements of different impairment groups.

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip information - change in regular travel schedule	Obtaining information on route changes and solutions can be difficult because of reduced sensory abilities. Difficulty in dealing with changes in trip planning (stressful situation). Difficulty in identifying & understanding announcements regarding trip planning.	Information presented in visual and auditory modes. Clear & accurate information on schedule deviations.		√	√	√	√	Yes	Yes 89, 90 33A (R&D)	Visual & vocal information on schedule deviations should be used. Visual displays providing clear, updated & accurate information on travel schedules should be provided - at bus stop (VMS), on bus or hand-held. Enhancements of auditory information e.g. loop systems.
Dealing with weather and environmental conditions	Hearing and comprehending announcements in noisy conditions, e.g. heavy rain, high winds.	Visual presentation of the same information, and / or better auditory announcements.			√		√	Yes	Yes 72 (R&D)	Visual display of information. Enhancements of auditory information e.g. loop systems.
Handling emergency situations	Dealing with stress/logistics of evacuation during an emergency situation.	Human assistance, physical and moral support where needed.	√	√	√	√	√	Yes	No	Smart card identifying persons with particular requirements in case of emergency.
Handling during rush hours	Increased communication difficulties if there is a need to ask for information.	Non-reliance on (busy) staff for obtaining information.			√	√	√	Yes	Yes 1 (R&D)	Portable, visual device with the up-to-date information required.
Using advanced technology - visual displays	Difficulties in interpreting complex information, particularly spatial information	Simple, well-designed systems (that do not rely on spatial forms of information or solely visual output)		√		√	√	NA	NA	Alternative forms of output
Using advanced technology - tactile input	Identifying correct key/ button	Simple, well-designed systems (few keys/buttons with clear layout)		√		√	√	NA	NA	Alternative forms of input

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III. Passenger (Public Transport): Bus / Tram

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Using advanced technology - sound output	Not being able to hear tones or speech, clearly or at all	Non-auditory method of information presentation			√		√	NA	NA	Alternative forms of output
Using advanced technology - sound input	Inability to input due to no speech, quiet speech or unclear speech.	Non-speech input.			√			NA	NA	Alternative forms of input

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip planning - general	Some travellers are not able to use the train without assistance (before, during or after travelling), and thus are dependent on knowing that help will be available	Dependent on disability - planning assistance with wheelchair, embarking/disembarking, way-finding, asking directions, transfer to other modes (e.g. taxi).	√	√	√	√	√	Yes	No	In the UK the Disabled Passenger Reservation System (DPRS) which informs staff of E&D passengers could be made more 'intelligent' to meet the needs of travellers more closely.
Trip planning - general	Elderly people often need help, but wish to retain independence. Also, their requirements and motivations are different to that of a younger person with the same functional disability	Support where needed without accentuating 'disabilities'.					√	No	N/A	The Supervisor (for Disabled Travel) did not feel that ATT could take the place of human assistance and awareness to meet this need.
Trip planning - general	Making travel-related decisions (e.g. departure time, any changes, using maps/train stop info.)	Improved sources of planning information (simple, concise info., use of symbols/pictograms, etc.). Human assistance. Alternative means of planning a train journey.				√	√	Yes	Yes 33A (R&D)	Computer-based trip planning systems that are accessible to all potential users
Trip planning - general	Obtaining and giving verbal information, either person to person or over the telephone.	Non-verbal methods of obtaining and giving information.			√	√		Yes	Yes 118	Consider use of portable, visual devices, Internet use, e-mail, video text, video phones and multimedia computers.

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip planning - find information	Lack of awareness of support systems, e.g. the Disabled Passenger Reservation System (DPRS) in the UK, which aims to make staff aware of the needs of travellers in advance of their journey, in order that assistance can be available.	Travellers need to know where to go for assistance and what is available. Some E&D people may find it difficult to express their needs or that the service is not meant for them (e.g. elderly travellers who do not consider themselves disabled may feel that DPRS is not for them, but still need assistance)	√	√	√	√	√	Yes	Yes 3 (R&D) 5 (R&D)	The train staff feel that the system is sufficient (although anecdotal evidence suggests that it is susceptible to human error and not designed for 'last-minute' use). User groups need to verify this and propose possible solutions/modifications. Increased publicity and easier day-to-day access to systems should be promoted
Trip planning - find information	Unreliability of certain computerised systems already provided e.g. the Disabled Passenger Reservation System (DPRS) in the UK. Visually impaired travellers have arrived to find no assistance. Their current solution is to 'mis-use' the system and call at the last minute (rather than the recommended 48 hours) - the urgency helps to ensure that assistance is provided.	A more reliable system.	√	√	√	√	√	Yes	No	An evaluation of the system should point out the source of problems which can then be rectified. A potential use of smart cards or 'smart tickets' to flag the presence of a travellers who may require assistance (and the nature of it)

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip planning - identify facilities	People with hearing impairments may not be able to locate a 'Minicom™' device	Accessible information on the availability and location of such devices in the station and/or on the train			√			Yes	No	The Supervisor (for Disabled Travel) claimed that locating Minicom™ in the station was not a problem, but this has not been confirmed by users. Ensure that location of Minicom™ is made known to users, both in the station and on the train.
Trip planning - identify facilities and accessibility en route	For routes not previously travelled, travellers may be unaware of physical features such as number of steps, location of doors, length of carriages etc.)	Information before or during trip which supports independent negotiation around the station.	√	√		√	√	Yes	Yes 59 (R&D)	An in-home device for planning, or a portable device during the journey (possibly a device that could be hired for journeys where required - e.g. for unfamiliar routes). Basic architectural design solutions should be considered in the first instance.

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip planning - finding destination	Difficulty in identifying and/or memorising the station according to the user' needs. Difficulty in finding destination from the transportation network. Difficulty in reading and understanding written information	Facilities for a clear & easy identification, understanding & memorising the location of the trip goal. Easy to enter the destination.		√	√	√	√	Yes	Yes 33A (R&D)	Instructions on how to find destination (printed when desired) must be clear. A good contrast and size of characters is recommended. The instructions, the corresponding output & the final output should be presented within boxes using contrasting & differentiated colours. The use of adequate symbols when possible is recommended.
Trip planning - choosing type of transport	Difficulty in identifying the adequate type of transport according to the destination.	Relevant information according to the trip destination. Easy to choose the type of transport and to enter the choice.	√	√	√	√	√	Yes	Yes 33A (R&D)	The system should only enable selection of those transport modes which are relevant to the current destination and the users' requirements.
Trip planning - consult map or travel scheme	Difficulty in identifying places within a map. Difficulty in building spatial representations from a map. Difficulty in reading and understanding written information.	Clear & easy identification of the destination and/or a route within a map.		√	√	√	√	Yes	Yes 33A (R&D)	The information provided by means of maps should use accurate survey maps instead of network maps. Destination and/or route should be emphasised. Landmarks should be used to ease the identification of the place. Printed maps should be provided.

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Ticketing - general	Difficulty with understanding instructions (e.g. from ticket machine), coping with new tasks, memory.	Improved sources of ticketing information (simple, concise info., use of symbols/pictograms, etc.). Automatic means of paying for ticket			√	√	√	Yes	Yes 86 1 (R&D) 33B (R&D)	Computer based intelligent ticket machine. Automatic debiting via a smart card
Ticketing - buying and stamping ticket	Finding the ticket window or ticket desk within the station (perceptual aspects). Automatic ticket machines do not take visually impaired users into account. All instructions and controls are visual.	Alternative means of buying ticket or locating window. Alternative methods of user input and system output to enable use of system.		√				Yes	Yes 11 (R&D)	Pre-booking of tickets via travel agents or a home / office based system would eliminate the problems at the station. For unplanned journeys a solution needs to be found. Braille input, speech input (recognition system would need to be robust in noisy stations). Card slots should not be too small and should have tactile markings. Speech output, large print.

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Ticketing - using ticket machine / stamping ticket	Difficulty in identifying the ticket machine (cognitive aspects). Difficulty in performing the task. Difficulty in reading.	Easy and explicit controls. Providing help for using the ticket machine when required. Clear & easy identification of the ticket/stamping machines via adequate signs, etc., as well as information via other modes on the requirement for stamping. Easy communication between users and operators (eg specific desks for people with disabilities)			√	√	√	Yes	Yes 33B (R&D)	A free-hand card is the best solution to avoid the difficulties in buying & stamping tickets. Good interfaces (e.g. touch screens), easy control & small size are recommended.
Ticketing - buying ticket	Queuing in the rush hour can be a problem.	Alternative means of buying ticket.	√	√		√	√	Yes	Yes 11 and 69 (R&D)	Pre-booking of tickets via travel agents or a home / office based system would eliminate the problems at the station. For unplanned journeys a solution needs to be found.
Ticketing - buying and stamping ticket	Physically interacting with ticket machines, pressing buttons, handling electronic cards, etc.	Automatic means of paying for ticket	√	√			√	Yes	Yes 33B (R&D)	Automatic debiting via a smart card, and especially a free-hand card.
Ticketing - buying and stamping ticket	Communication with ticket staff. Difficulty in inter-individual communications (speech & understanding)	Non-verbal communication (one way or two-way), e.g. sign language or other visual method. Automatic means of paying for ticket			√	√	√	Yes	Yes 69 (R&D) 33B (R&D)	Computerised ticketing with visual display (but may cause delays or be a problem for visual imp.). Language must be easily understandable. Automatic debiting via a smart card

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Access - transfer wheelchair	A regular traveller was given a new wheelchair (by local authority?) which would not fit through the internal access door to the wheelchair space. Hence the person could not travel.	Standardisation of wheelchair/access sizes	√					No	N/A	Train staff are investigating. User groups should be surveyed to find any repetitions of this. Standardisation of wheelchair/access sizes
Access - finding train station/ platform	Maps for indicating the location of station/platforms can be difficult to interpret	Improved localisation methods				√	√	Yes	Yes 33D (R&D)	Navigation systems that guide an individual to the correct location
Access - entering/ exiting train	Opening access doors (handles, weight of doors)	Means of informing staff of need for assistance	√				√	Yes	No	
Access - entering / exiting train	Inconsistency in length of carriages/platforms, train-platform gap and lack of information as to such.	Method to enable easier identification of platform or carriage location / heights / gaps for transfer between the two.	√	√			√	Yes	No	Physical standardisation would be the most helpful solution. ATT solutions are hard to envisage - possibly an 'intelligent' system which knows the station and the relative position of carriage / platform which is conveyed via an auditory message.
Access - entering / exiting train	Difficulty in opening manual doors, especially when hands are occupied with guide dog and luggage. And particularly older doors requiring opening from the outside via the window.	Easier door opening system	√	√			√	No	N/A	Automatic doors and/or easier opening device.

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Access - entering / exiting train	Not hearing auditory warning that automatic doors are closing	Visual warning			√		√	Yes	No	Visual warning system
Access - obtaining seating position	Identifying an unoccupied seat, avoiding luggage left on seats or in the aisles.	Automatic detection of such.		√				Yes	No	Auditory guidance system to unoccupied seats, and obstacle detection?
Access - toilets	Difficulty in locating toilet, opening door, getting in, finding tap, having sufficient room for guide dog.	More obvious location, larger space.	√	√				Yes	No	Location could be given auditorily, but could cause embarrassment. Space and layout is outside the scope of ATT.
Travelling on train - communication	Communication with other passengers	Inform others of communication difficulty and be able to use non-verbal methods - sign language, written text or other visual method.			√	√		Yes	No	Hand held communication device.
Trip information - determine whereabouts	Seeing, hearing and comprehending announcements (sensory aspects). Auditory announcements are common on mainline trains but not always on local routes and are often difficult to hear.	Both visual and audio presentation of the same information, and / or better auditory announcements.		√	√	√	√	Yes	Yes (partly) eg 123	Visual display - on train or hand-held. Enhancements of auditory information e.g. loop systems.
Trip information - determining whereabouts	Identifying/ recognising correct stop/stations. Difficulty in identifying the lines and directions inside the station. Difficulty in reading and spatial representations	Accurate information on one's own stop. Clear & easy identification of the station (eg adequate panels & signs).		√	√	√	√	Yes	Yes 33D (R&D)	Clear announcements at all stations or a personal, portable device which knows the stop required and informs the traveller when it is reached (e.g. via GPS or station specific transmitters).

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip information - hear and comprehend announcements	People with hearing impairments cannot hear departure or other messages, or cannot hear them clearly	Auditory information should be as clear as possible and complemented by visual display of the same information (both in the station and on the train)			√		√	Yes	No	Departure information is often provided visually and station staff do not perceive any problems. This needs to be verified with the relevant user groups. Other announcements should be presented visually (both in the station and on the train).
Trip information - change in regular travel schedule	Obtaining the right sort of information to meet particular needs.	Up-to-date simple information relevant to the traveller and presented visually and/or non-verbally.	√	√	√	√	√	Yes	Yes 94	Information system should include the specific information requirements of different impairment groups.
Trip information - change in regular travel schedule	Obtaining information on route changes and solutions can be difficult because of reduced sensory abilities.	Up-to-date simple information relevant to the traveller and presented in both visual and auditory modes.		√	√		√	Yes	Yes 94	Visual display - in station, on train or hand-held. Enhancements of auditory information e.g. loop systems.
Trip information - Identifying visual display (stations)	Difficulty in consulting visual displays due to their difficulties with reading and understanding. Difficulty in discriminating and selecting the relevant information.	Clear & easy identification of the different visual displays (via adequate location/use of symbols/alternative output modes). Detailed plans of each station and interchange terminal should be provided by the transport operator.		√		√	√	Yes	Yes 33A (R&D)	The information system should provide plans of each station and interchange terminals. Symbols should be used as far as possible. Information should be printed and provided in alternative forms.

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Trip information - detect arrival point	Difficulty in memorising the trip planning & paying attention to the route. Difficulty in spatial representations. Difficulty in recovering the trip planning when forgotten (stressful situation).	Information on the station before & at arrival in different modes of output.		√		√	√	Yes	Yes 33A (R&D)	Trip planning information should be capable of being printed, and should provide information on station. Visual & vocal interfaces should both be used for this kind of information.
Trip information - change in regular travel schedule	Difficulty in dealing with changes of the trip planning (stressful situation). Difficulty in identifying & understanding announcements regarding his or her trip planning.	Travel according to the trip planning. Clear & accurate information on schedule deviations. Solutions & facilities for waiting.		√	√	√	√	Yes	Yes 33A (R&D)	Visual displays (VMS) providing clear, updated & accurate information on travel schedules should be provided. Visual & vocal information on schedule deviations should be used.
Dealing with weather and environmental conditions	Hearing and comprehending announcements in noisy conditions, e.g. heavy rain, high winds.	Visual presentation of the same information, and / or better auditory announcements.			√		√	Yes	Yes (partly) 123	Visual display of information. Enhancements of auditory information e.g. loop systems.
Handling emergency situations - station announcements	People with hearing impairments may not be aware of the need to evacuate the station. Station staff are trained to be aware of this	Visual indication of the nature of the emergency and the action to be taken, would give control to the traveller without reliance on station staff.			√		√	Yes	Yes 11 (R&D)	"Old technology", e.g. warning lights in all locations (including toilets). Would this initiate the appropriate, quick reaction? Would such a system be vandalised? Consider possible ATT applications for visual warning/information systems.

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant?	ATT available?	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly	Yes/no	Yes/no	
Handling emergency situations - evacuation of train	Being able to leave the train quickly and safely in case of an emergency. Visually impaired travellers are not informed of the location of exits.	People with various impairments may need help to evacuate. The awareness of staff and other passengers is important.	√	√	√	√	√	Yes	Yes 11 (R&D)	The DPRS in the UK flags the presence of E&D travellers for departure/arrival assistance but may not provide support for the traveller whilst on the train. Staff are trained to be aware of E&D travellers for such situations. Critical incidents should be investigated and analysed. User groups would need to verify the problem and propose possible solutions/modifications. The view of focus group interviewees was that there is little that can be done to improve the situation.
Handling during rush hours	Increased communication difficulties if there is a need to ask for information.	Non-reliance on (busy) staff for obtaining information.			√	√	√	Yes	No	Portable, visual device with the up-to-date information required.
Using advanced technology - visual displays	Unable to see visual displays. Difficulties in interpreting complex information, including spatial and text information	Simple, well-designed systems (that do not rely on spatial /textual forms of information or solely on visual output)		√		√	√	NA	NA	Alternative forms of output
Using advanced technology - tactile input	Identifying correct key/ button	Simple, well-designed systems (few keys/buttons with clear layout)		√		√	√	NA	NA	Alternative forms of input

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III. Passenger (Public Transport): Metro / Train

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Using advanced technology - sound output	Not being able to hear tones or speech, clearly or at all	Non-auditory method of information presentation			√		√	NA	NA	Alternative forms of output
Using advanced technology - sound input	Inability to input due to no speech, quiet speech or unclear speech.	Non-speech input.			√			NA	NA	Alternative forms of input

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III. Passenger (Public Transport): Ship

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip planning - general	Making travel-related decisions (e.g. departure time,using maps)	Improved sources of planning information (simple, concise info., use of symbols/pictograms, etc.). Human assistance. Alternative means of planning a ship journey.				√	√	Yes	Yes 33A (R&D)	Computer-based trip planning systems that are accessible to all potential users
Trip planning - general	Obtaining and giving information, either person to person or over the telephone.	Non-verbal methods of obtaining and giving information.			√	√		Yes	Yes 118 2 (R&D) 5 (R&D)	Consider use of portable, visual devices, Internet use, e-mail, video text, video phones and multimedia computers.
Ticketing - general	Difficulty with understanding instructions (e.g. from ticket machine), coping with new tasks, memory.	Improved sources of ticketing information (simple, concise info., use of symbols/pictograms, etc.). Automatic means of paying for ticket			√	√	√	Yes	Yes eg 86 1 (R&D) 33B (R&D)	Computer based intelligent ticket machine. Automatic debiting via a smart card
Ticketing - buying and stamping ticket	Communication with ticket staff.	Non-verbal communication (one way or two-way), e.g. sign language or other visual method.			√	√	√	Yes	No	Computerised ticketing with visual display (but may cause delays). Language must be easily understandable.

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III. Passenger (Public Transport): Ship

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Travelling on ship - way finding	Open plan nature of many ships makes orientation and way finding difficult, unless with a companion. For this reason, visually impaired travellers tend to favour air travel to ships (although generally more expensive).	Less open plan design or system providing more guidance as to location and way finding.		√		√	√	Yes	No	Portable guidance devices are being developed for land based use (using GPS). However, their application for navigation around a ship would seem impossible (as the vehicle is in motion). Alternative solutions need to be found (one interviewee had heard of a ship designed for the visually impaired).
Travelling on ship - safety	Fear of falling overboard, especially if travelling alone.	More secure (and obvious) perimeters to ship's deck.		√		√	√	No	No	Structural design issue.
Travelling on ship - communication	Communication with other passengers	Inform others of communication difficulty and be able to use non-verbal methods - sign language, written text or other visual method.			√	√		Yes	No	Hand held communication device.
Trip information - determine whereabouts	Hearing and comprehending announcements.	Visual presentation of the same information, and / or better auditory announcements.			√	√	√	Yes	Yes (partly) 118	Visual display - on ship or hand-held. Enhancements of auditory information e.g. loop systems.
Trip information - change in regular travel schedule	Obtaining information on route changes and solutions can be difficult because of reduced sensory abilities.	Up-to-date information relevant to the traveller and presented in both visual and auditory modes.		√	√		√	Yes	No	Visual display - in port, on ship or hand-held. Enhancements of auditory information e.g. loop systems.
Dealing with weather and environmental conditions	Hearing and comprehending announcements in noisy conditions, e.g. heavy rain, high winds.	Visual presentation of the same information, and / or better auditory announcements.			√		√	Yes	Yes eg 72 (R&D)	Visual display of information. Enhancements of auditory information e.g. loop systems.

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III. Passenger (Public Transport): Ship

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Handling emergency situations	Dealing with stress/logistics of evacuation during an emergency situation.	Human assistance, physical and moral support where needed.	√	√	√	√	√	Yes	No	Smart card identifying persons with particular requirements in case of emergency.
Handling during rush hours	Increased communication difficulties if there is a need to ask for information.	Non-reliance on (busy) staff for obtaining information.			√	√	√	Yes	No	Portable, visual device with the up-to-date information required.
Using advanced technology - sound output	Not being able to hear tones or speech, clearly or at all	Non-auditory method of information presentation			√		√	NA	NA	Alternative forms of output
Using advanced technology - sound input	Inability to input due to no speech, quiet speech or unclear speech.	Non-speech input.			√			NA	NA	Alternative forms of input

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III. Passenger (Public Transport): Airplane

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip planning - general	Making travel-related decisions (e.g. departure time, any changes, using maps)	Improved sources of planning information (simple, concise info., use of symbols/pictograms, etc.). Human assistance. Alternative means of planning a plane journey.				√	√	Yes	Yes 33A (R&D)	Computer-based trip planning systems that are accessible to all potential users
Trip planning - general	Obtaining and giving information, either person to person or over the telephone.	Non-verbal methods of obtaining and giving information.			√	√		Yes	Yes 118	Consider use of portable, visual devices, Internet use, e-mail, video text, video phones and multimedia computers.
Trip planning - identify facilities / accessibility	Some travellers like to be sure of procedures at the airport prior to travel. Currently this involves phoning or writing to the airport and often performing a 'dry run' prior to the actual day.	Detailed and clear information on procedures e.g., where the disabled parking spaced are, costs of parking, how to transfer luggage from car to terminal.	√				√	Yes	Yes 3 (R&D) 5 (R&D)	Information system at home/travel agent to provide the most commonly requested information. With regard to 'dry runs', a video or computer simulation of the airport could be helpful. An ideal candidate for the application of Virtual Reality.
Trip planning - reservation	Elderly travellers with long winter breaks will book a return taxi 3 months in advance. This is often not in line with the shorter term operations of taxi companies and there is no transport waiting for them on their return.	The ability to book reliable return transport from airport to home.					√	Yes	No	A longer term booking system or an easy to use, short-term booking system from abroad

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III. Passenger (Public Transport): Airplane

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip planning - reservation	Often, the special needs of E&D travellers are only identified on arrival at the airport. This does not allow the staff to organise the most efficient assistance.	To assist airport staff and travellers, the former should be identified of specific needs as much in advance as possible.	√	√	√	√	√	Yes	No	More 'intelligent' booking systems which would prompt the travel agent or traveller to give all relevant information (via a smart card for speed of entry?). The system should ensure that the need is genuine (e.g. that an aisle seat is a necessity, rather than a luxury) This should also allow the relevant information to be transmitted to the appropriate bodies: handling agent, tour operator, airlines, transfer transport (taxis etc.) to enable seamless travel through the system. NOTE: potential user acceptance problem re. privacy issues.
Ticketing - general	Difficulty with understanding instructions (e.g. from ticket machine), coping with new tasks, memory.	Improved sources of ticketing information (simple, concise info., use of symbols/pictograms, etc.). Automatic means of paying for ticket			√	√	√	Yes	Yes 86 1 (R&D) 33B (R&D)	Computer based intelligent ticket machine. Automatic debiting via a smart card

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III. Passenger (Public Transport): Airplane

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Ticketing - buying and stamping ticket	Communication with ticket staff.	Non-verbal communication (one way or two-way), e.g. sign language or other visual method.			√	√	√	Yes	No	Computerised ticketing with visual display (but may cause delays, or be a problem for people with visual imp.). Language must be easily understandable.
Access - general	Few problems were mentioned although this was due to reliance on airport staff (travellers call the airport beforehand) or travelling with friends.	Currently none, although satisfaction depends on reliance on others.	√	√	√	√	√	Yes	No	ATT could increase independence, e.g. portable guidance devices to find way around the airport.
Access - parking	(For airport staff) mis-use of disabled parking bays by those without permits. Also, identifying 'legitimate' use by those travellers 'temporarily disabled' (e.g. broken leg).	Method to prevent mis-use. Method to allow use by those 'temporarily disabled.	√				√	Yes	Yes 69 (R&D)	Smart card system for access to parking area? Temporary smart card for those with e.g. broken leg? NOTE: potential user acceptance problem re. privacy issues.
Access - finding way	Lack of direction information.	Direction assistance through both visual and non-visual means		√			√	Yes	No	Portable auditory guidance device provided on entry to the airport. Would this be acceptable to elderly travellers? Other non-telematic solutions e.g. Braille on low level signs, tactile flooring.

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III. Passenger (Public Transport): Airplane

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Travelling on plane - movement	Access to toilets can cause problems due to positioning at extreme ends of plane and small compartment (particularly if carer is required to assist)	Larger compartment and easier access to it.	√				√	No	N/A	Non-telematic issues of space/physical access.
Travelling on plane - movement	Finding location of toilets and using the facilities within them is a problem (e.g. confusion between the 'flush' button and the emergency call button in one instance)	More information and assistance on location of facilities and controls.		√		√		No	N/A	Better design and more standardisation of layouts would be helpful. Possible use of technology for auditory identification of correct button, for example?
Travelling on plane - communication	Communication with other passengers	Inform others of communication difficulty and be able to use non-verbal methods - sign language, written text or other visual method.			√	√		Yes	No	Hand held communication device.
Trip information - announcements in airport	There is a move to reduce the number of auditory announcements for flight departures (particularly in areas other than the departure lounge). This could cause problems for visually impaired travellers.	Provide enough warning for travellers to have confidence, not feel under time pressure and, ultimately, not miss the departure.		√			√	Yes	No	Maintain current frequency of announcements OR replace with a satisfactory, auditory alternative via the use of telematics.
Trip information - announcements in airport	Auditory announcements are not accessible by people with hearing impairments.	Hearing impaired travellers require visual information/instructions.			√		√	Yes 102 5 (R&D)	Yes	Visual displays and enhancements of auditory information, e.g., loop systems.

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III. Passenger (Public Transport): Airplane

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Trip information - announcements in airport	Visual display screens are too high for some visually impaired travellers to see.	Alternative to visual information, or better visual displays.		√			√	Yes	No	Current auditory announcements were generally found to be good. Maintain these and consider personal information devices for the traveller also.
Trip information - announcements on plane	Majority of information is provided through speakers. Hearing and comprehending instructions impossible or difficult.	Hearing impaired travellers require visual information/instructions and/or better auditory announcements.			√		√	Yes	Yes (partly) 118	More use of visual displays as used in many long-haul aircraft. Alternatively, use of a portable visual device.
Trip information - change in regular travel schedule	Obtaining the right sort of information to meet particular needs.	Up-to-date information relevant to the traveller.	√	√	√	√	√	Yes	Yes 5, 33A (R&D)	Visual and vocal information should be used. Traveller information systems.
Trip information - change in regular travel schedule	Obtaining information can be difficult because of reduced sensory abilities.	Up-to-date information relevant to the traveller and presented in both visual and audio modes.		√	√		√	Yes	Yes 5, 33A (R&D)	Visual display - in airport, on plane or hand-held. Enhancements of auditory information e.g. loop systems.
Handling emergency situations - in the airport	In the first few seconds of an emergency - auditory alarms only.	Hearing impaired travellers would require alternative warning			√		√	Yes	No	Visual warning in airport. Warning on a portable device for the travellers. Easier identification of those requiring assistance (smart card / transmitter / locator). NOTE: potential user acceptance problem re. privacy issues.

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III. Passenger (Public Transport): Airplane

Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Handling emergency situations - in the airport	Unable to see the visual alarm to warn that fire shutters are dropping.	Visually impaired travellers will need auditory or other appropriate warning.		√			√	Yes	No	Auditory warning in airport. Warning on a portable device for the travellers. Easier identification of those requiring assistance (smart card / transmitter / locator). NOTE: potential user acceptance problem re. privacy issues.
Handling emergency situations	Dealing with stress/logistics of evacuation during an emergency situation.	Human assistance, physical and moral support where needed.	√	√	√	√	√	Yes	No	Smart card identifying persons with particular requirements in case of emergency.
Handling emergency situations - on the plane	Travellers seated next to exit doors may have a disability that the airline is unaware of, but which could affect ability to use emergency exits.	For the airline staff - knowledge of relevant disabilities	√	√	√	√	√	Yes	No	Smart card which holds relevant information on travellers and could be used for seat allocation. NOTE: potential user acceptance problem re. privacy issues.
Handling emergency situations - on the plane	Majority of safety / emergency information is provided through speakers.	Hearing impaired travellers require visual information/instructions			√		√	Yes	No	More use of visual displays as used in many long-haul aircraft. Alternatively, use of a portable visual / tactile device.

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Task	Problem	User Needs	User groups					ATT relevant? Yes/no	ATT available? Yes/no	Possible solutions / modifications
			Skeletal - lower limbs	Vision	Hearing, Language/ Speech	Intell/ Psych/ Cognitive	Elderly			
Handling emergency situations - on the plane	The 'illuminated strip' used along the aisles to locate emergency exits serves no purpose for visually impaired travellers.	Alternative location method for visually impaired travellers.		√			√	Yes	No	Easier location of visually impaired traveller by airline staff (possible telematics solution/smart card) Non-telematic solution of tactile strip.
Handling emergency situations - on the plane	Visually impaired travellers are told what to do in an emergency and positioned where visible by staff. Those interviewed were unaware of the illuminated strips directing towards the nearest exit and also mentioned that they could not read the safety instructions provided.	Ability to be aware of safety instructions (more independently?)		√			√	Yes	No	Braille or auditory instructions to replace the traditional 'card'.
Handling during rush hours	Increased communication difficulties if there is a need to ask for information.	Non-reliance on (busy) staff for obtaining information.			√	√	√	Yes	No	Portable, visual device with the up-to-date information required.
Using advanced technology - sound output	Not being able to hear tones or speech, clearly or at all	Non-auditory method of information presentation			√		√	NA	NA	Alternative forms of output
Using advanced technology - sound input	Inability to input due to no speech, quiet speech or unclear speech.	Non-speech input.			√			NA	NA	Alternative forms of output

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