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DESIGN GUIDELINES FOR USABILITY AND SAFETY OF IN-VEHICLE INFORMATION SYSTEM (IVIS) USER MANUALS

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1 Introduction

1.1 Background

A wide variety of in-vehicle information systems (IVIS) currently exist and many more will become available in the near future. These systems aim to help the driver by providing information, for example, about routes, traffic congestion and accidents. Because these systems can provide drivers with real-time information (and are becoming increasingly sophisticated; and thus more useful) there is a growing concern that they may interfere with the primary driving task and as a result compromise safety.

Drivers may not be aware of the potential hazards relating to secondary tasks involved in interacting with an IVIS whilst driving. Instructions need to communicate critical information (how to use a system in the safest in most effective way) effectively and in a way that can be easily understood, learnt and remembered.

Commonly, in-vehicle information system user manuals are provided to drivers to assist them in using a system and also to warn them of potential hazards and system misuse. Information can also be provided to drivers in the form of on-line help, a quick start leaflet and advertising. The information provided in all of these forms influence how the driver interacts with an IVIS and may therefore impact on driving safety.

Designing effective information to aid drivers in correct, safe and appropriate system use is a complex task. The user manual is one way of informing and supporting the driver. Other methods include on-line help, a quick start leaflet and user training. If the information presented is poorly designed it can be off putting and be misinterpreted, ignored, forgotten or discarded.

The guidelines in this document are intended to alert designers (and manufacturers) of IVIS user manuals to some ergonomic and legal issues relevant to usability and safety of the user manual.

These guidelines can be viewed as a companion document to the ‘IVIS user manual Usability and Safety Checklist’ developed to assess in-vehicle information system (IVIS) user manuals against established ergonomic custom and practice (Brook-Carter, 2003). It is important that IVIS user manuals are assessed to ensure they provide adequate human machine interface safety. It is likely that if the advice provided in these guidelines is followed, any resulting system is more likely to be assessed favourably based on an evaluation by this (or an equivalent) checklist. In addition to issues raised by the checklist, these guidelines include a discussion about writing the guidelines and some legal issues (Section 5).

While this document aims to present objective and measurable solutions to many design concerns, there is likely to remain some element of subjectivity; for example the statement; “Critical information should be repeated in more than one location if required”. The detail of what is ‘critical’ and what is ‘required’ has not been provided and is left to the assessor’s judgement. One assessor may feel that the information is required in more than one location and another may not. Likewise one assessor may feel the information is critical and another may not. Where possible, examples have been given to clarify.

1.2 Scope and objectives

Since there are already relevant guidelines, standards and codes of practice in existence (Section 6 & 7), the objective of these guidelines is to provide manufacturers with a summary of the factors that need to be considered when designing and writing an IVIS user manual, in an easy to use format. The guidelines in this document aim to produce a ‘user friendly’ synthesis of current knowledge, and provide up to date guidance on where to locate more detailed information.
They are not intended as an encyclopaedic collection of all that has been written, or is known, on the subject. However, where necessary appropriate references are provided to supplement the information and advice. A bibliography is also provided for further reading.

The production of information presented to the driver regarding IVIS use should ideally consider:

- Whether an appropriate individual is using the manual
- Appropriateness of the style and method of information presentation
- Limiting factors associated with the user population
- Content of the information presented
- Ease with which the information can be accessed and learned

### 1.3 User Manuals

User manuals are materials that assist users in their interactions with devices or systems. User manuals contain instructions and warnings to assist users. An instruction communicates procedures and critical contextual information; it tells users what to do, how to do it and provides reasons for acting. In addition, warnings are provided which communicate to users that hazards exist, the nature and severity of these hazards and how they can be avoided through correct system use.

User manuals give verbal and visual instructions for the use of a wide range of products and systems. User manuals are ‘how to’ books for the system users and, although often only referred to when initially using the system or when coming across problems or questions, are a critical part of system use.

In the case of consumer products there is rarely any training other than reading the user manual. The user manual can be said, therefore, to take the place of a training course and takes a critical role in system effectiveness. IVIS user manuals therefore need to effectively communicate instructions on operation, installation, maintenance, and repair of the system, efficient use and, in addition, provide safety warnings and details of user responsibilities. It is up to the driver to then act on the information within the manual. This behaviour cannot be guaranteed; however, without having access to this critical information there is even less chance of correct behaviour and the probability of an accident is increased.

### 1.4 Format of document

Although great care has been taken in the compilation and preparation of these guidelines to ensure accuracy, TRL Ltd and the Department for Transport cannot in any circumstances accept responsibility for any errors or omissions.

This document provides a systematic review of the many factors that need to be considered in the design of an IVIS user manual.

Section 2 describes the logistics of writing a user manual. It discusses who should write the manual and when the manual should be assessed.

Section 3 covers ergonomic issues of usability of the user manual, how the driver interacts with the system with respect to controls, visual displays and the use of auditory information.

Section 4 considers the safety related aspects of IVIS user manuals, including safety instructions and warnings.

Section 5 considers the legal situation and issues of liability and responsibility.

Sections 6 and 7 provide References and a Bibliography respectively. The Bibliography includes references that are further reading, but are not specifically referred to within these guidelines.

A list of Abbreviations and a Glossary of Terms are provided in Section 8.
2 Production of the User Manual

2.1 Writing the User Manual

One person should lead the process of writing the user manual. A technical writer should be involved to ensure consistency and adequate consideration of the users’ limited knowledge of the system. This will help the manual flow by avoiding the use of a number of different writing styles and will help the user to understand. However, people who are technically knowledgeable on each aspect of the IVIS system should also be involved to ensure that all information is correct.

The user manual production process would benefit from the involvement of an Ergonomist or a human computer interaction (HCI) expert who would consider systems and manuals from the point of view of the user, to ensure that they are easy to use. Engineers, technicians and graphic designers should also be involved in the production.

2.2 When to Assess

It is advisable to assess the user manual’s usability and safety early in the design process and again when it is complete. It is important to write the manual so that it is suitable for all users including the elderly, partially illiterate, technically naive and colour blind users. In all cases it is advisable to plan and undertake assessment trials before the manual is finally printed. Ideally, the user manual should be assessed by users who have no experience of using the IVIS.

2.3 How to Assess

In order to assess the IVIS user manual, it is recommended that initially a Checklist assessment be carried out to ensure that the guidelines in this document are being followed. The in-vehicle information systems (IVIS) user manual usability and safety checklist is a useful tool to refer to for this type of assessment (Brook-Carter, 2003).

In addition, the manual should be assessed by conducting a user study. General guidance on how to do this is provided below:

1. The user study should be conducted in-situ, with access to both the IVIS user manual and the IVIS itself.
2. It should involve a number of participants (at least 10) who do not have previous experience with the IVIS (or similar).
3. The participants should be asked to carry out all IVIS tasks using only the instructions provided in the user manual for assistance.
4. Feedback on the usability of the instructions provided in the user manual from the participants can then be obtained by the combining any number of the following methods:
   • Observation: an observer notes down any difficulties the participants have in understanding the user manual and completing the IVIS tasks
   • Verbal protocol: the participants are asked to verbalise any difficulties they are experiencing in understanding the instructions in the user manual as they attempt to complete tasks
   • Usability questionnaires: the participants complete a usability questionnaire after attempting each task in which they can self-report any difficulties they experienced
5. Any problems highlighted during user testing should be addressed and a further set of user testing carried out. This form of testing is an iterative process.
3 Usability

3.1 User Manual Quality

The IVIS system should be provided with a user manual which is separate from the system packaging. Instructions which are only present on packaging material are more likely to be discarded rather than being passed on to subsequent users. Therefore all information on the packaging should be repeated in the user manual.

3.1.1 Physical design of user manual

The user manual should be of good quality and suitably designed for its use. The manual should be in the form of a printed hardcopy. The manual should be of a size small enough so as to fit in the car glove box, so that it is likely to accompany the system and large enough so that it can be easily located and contain text and diagrams of a legible size (Section 3.1.2). The user manual bindings, paper and covers should be sturdy and hard wearing, so that the user manual will last as long as the expected life of the vehicle. The print within the manual should not appear smudged or blurred. Printed material should be on paper (or other material) providing a reasonable durability and the printing should be permanent on that material. Porous paper should be avoided as it picks up dirt and allows ink to bleed.

3.1.2 Size and quality of text/diagrams

Any written text in the user manual should be of a font size of no smaller than 8-point and preferably 10-point or 12-point. The font style within the text should be simple such as ‘Arial font’. If these guidelines are followed, the text will be easy to read and will not be too small so that it could be missed or difficult to see. The text should be consistent (style, size colour) throughout the manual so that the user does not see too many different font styles presented. Text should be spaced and not too cluttered and spacing should be kept consistent. This means that paragraphs should have spaces between them and should not be too long (i.e. no longer than half a page). Regular use of upper case text should be avoided as it reduces recognition and hence increases reading time.

Diagrams should be large (at least 50 mm), clear, without clutter and should be consistent with one another. To make a diagram clear, text within the diagram should be at least 8-point and there should be contrast between any colours used in the diagram so that people with poor vision can see the diagram easily. Diagrams should be annotated using a numbering system if there are a lot of labels so that text does not take over the diagram and appear cluttered. To reduce clutter and increase clarity, a diagram should not be used to explain several different features of a system. A series of similar diagrams can be used.

Example of a cluttered diagram:
Example of an uncluttered diagram:

![Diagram with clear labels for each element]

Example of a diagram with poor contrast that is difficult to read:

![Poorly contrasted diagram]

3.2 User Manual Information

Organisation of the content of the user manual is an important aspect of design. The user manual needs to inform the user effectively of system operations and functionality, including: basic use, operation and adjustment, maintenance and system limitations.

The manual should provide:

- Effective warnings for misuse of the system
  - e.g. To avoid endangering yourself and other road users you should only input your destination when the car is at a standstill

- A reminder of the drivers responsibilities
  - The use of the Navigation system by no means relieves the drivers of their responsibilities. The Highway Code must always be observed

- Information on the scope of the system
- A system description
- Design detail
- Limits of operation
  - e.g. Destination input by map is only possible when the car does not exceed 30 mph
- Information on setting up and turning on the system
- Normal operation
- Turning off the system
- Abnormal operation and errors
  - e.g. In the event of malfunctions contact your nearest manufacturer service station
  - Include ‘Trouble shooting’ (Section 3.3.3)
- Preventative maintenance
  - e.g. Never use household detergents or chemical cleaning agents to clean the device
• Storage
  o e.g. Never leave the disk or the box exposed to excessive heat or direct sunlight
• Safety
  o See section 4

If necessary, the theory of operation should also be included. It is important to get the level of content right and to avoid including irrelevant information.

### 3.2.1 Extent of Information

Lengthy explanations should be avoided. To help avoid lengthy explanations, there should not be too much information and the information should not be overly complex, but kept simple and concise. Complex explanations should be broken down into short simple sentences. Only useful information that is required by the user in order to operate the system efficiently and safely should be provided.

**Example of a simple sentence:**
The navigation CD provided contains a digitised street map. The street map details highways, national, regional and district roads in different colour. The scale of the map can be decided by the driver.

**Example of a complex sentence:**
The navigation CD provided contains a digitised street map, which details highways, national, regional and district roads in different colours and the scale of the map can be determined by the driver.

**Example of superfluous information:**
“The GPS system is based on the reception of navigation signals from a total of 26 GPS satellites, which orbit the earth at an altitude of 21,000 km in approximately 12 hours”
The user only needs to know how the navigation signals work if it is necessary i.e. it has an effect on how to use the system.

### 3.2.2 Abbreviations and Jargon

Explanations of abbreviations should be provided either every time they first appear in each small section of the user manual or within a glossary at the back of the user manual. It is preferable for both methods of explanation (text and glossary) to be incorporated. Further, numerous abbreviations or jargon words that may be unfamiliar to the novice user should be avoided where possible. It should be assumed that the user is a novice and does not have previous knowledge of the system or any technical information/knowledge associated with the system.

**Example of undefined abbreviations:**
“Once in contact with the RAM Network the letters M, T or W will be displayed…”
This statement does not define RAM.

**Example of Defined abbreviations:**
“The system uses a PIN number; [‘Personal Identification Number’]”

### 3.2.3 Accuracy

The user manual should not contain any misleading or erroneous information. Additionally, the user manual should not contain any discrepancies or conflicting information and all information provided within the user manual should correspond exactly with the IVIS.

The intended use of the system should be described. Reasonably foreseeable misuse should be warned against (if it cannot be designed out). Any restriction on intended use by the manufacturer should be
presented in the user manual. For example, perhaps only some drivers will have access to the full functionality of the system.

3.3 **User Manual Instructions**

IVIS user manual instructions should be factually accurate, unambiguous and easy to understand (see explanation below). The user manual instructions should not be overly technical or complex, even if the system they are describing is.

3.3.1 **Function explanation**

A control operation diagram should illustrate the functions of the IVIS system. In addition to diagrams of system functions operation there should be text (alongside the diagram) that clearly explains the diagrams and the use of system functions. If the user manual describes each button by a diagram with text beside it (as shown below) then each button in the system should be shown on a diagram and referenced. There should be a reference to where the system diagram can be located. The text should explain exactly how to operate the various controls. The use of all functions which are provided on the system should be explained within the user manual. The explanation should include a description of what the function should be used to do and an explanation of how to operate each control (e.g. push/pull/turn). Even the simplest control functionality should be described.

**Example of an unclear explanation:**

“Use the VIEW control to switch between different display modes”

This explanation does not describe the actions required to switch between modes e.g. push, pull or turn. However it does explain what the function can be used for.

**Example of a clear instruction:**

“Press and hold the view control to switch between display modes”

Additionally, if a control has more than one function, the operation of all these functions should be described. For example:

“Turn the dial to move the cursor and push the dial to select the desired option, or push the control once to select and twice to return to the main menu”.

**Example of diagram to explain function:**

![MENU](image)

This is the button for calling up the menu display. The position of the button (1) can be seen on the system diagram on page 4.

3.3.2 **Clear and easy to follow**

Information should be clear and easy to follow so that it is unlikely to be misinterpreted. Information that is complex and not broken down is more likely to be misinterpreted by the user (see examples below). To make the instructions clear and easy to follow, all necessary information should be provided, so that the user can operate the system effectively and knows how the system will respond. Additionally, information that is not required in order to operate the system safely and efficiently should not be included and information should not be overly complex or contain lots of jargon or unfamiliar words.

Instructions should be presented as simple command statements, for example ‘turn the knob’ as opposed to ‘the knob should be turned’. They should begin with an action verb which describes the required user behaviour, followed by the object which is to be acted upon and a qualifier of the action such as how fast or how much, finishing with an explanation of why the action needs to be done.

**Example of overly complex instructions:**

“If the menu button is pressed the menu will appear on the display”
Better wording:
"Press the menu button to display the menu"

Example of a clear and easy to follow instruction:
"To select GPS navigation:
1. Press the MENU button (1) to display the menu
2. Turn the rotary control (10) until ‘on road navigation’ is highlighted
3. Press ‘OK’ (6) to start the navigation system.

The reason this is clear and simple is because it is broken down into single steps, which are separated. Additionally the buttons (1, 6, and 10) are numbered so the user can refer to the system diagram to find the location of the relevant button that is needed.

Example of an uncleared instruction that could be misinterpreted:
"In order to select the GPS navigation system the menu button should be pressed, but only if the menu is not already displayed. Then turn the rotary control button until the text ‘on road navigation’ is highlighted in the top left corner of the screen, then ‘OK’ to begin the navigation system.

The reason the above example is difficult to follow because it is not broken down into steps which could lead to the user accidentally missing out a stage. The instruction contains information that is not required such as the location of the text on the screen and the words ‘the text’. This additionally requires the user to spend more time reading.

Information in the user manual should instruct the user what to do rather than what not to do. The language used in the user manual should be aimed at a low level of literacy to increase the readability of the text. The language and grammar used should consist of short simple sentences and short, simple, common words. However, the vocabulary should match that displayed on the system. If the language that is displayed on the system is not simple, it should be explained in the user manual text and glossary.

The system should do what is expected after following the instructions step by step. No steps should be missed out and each step must be in the correct order.

3.3.3 Troubleshooting/help

A troubleshooting/help section should be provided within the user manual. This section should explain how to overcome all common problems which may be experienced when using the IVIS. It should also answer common questions often asked relating to IVIS use. Information to be included in the troubleshooting can be gained from the testing phase.

This section of the user manual might include what the user should do when, for example, a navigation system fails to find a requested destination or what to do in the event of power failure to the IVIS.

The help section should be included in the contents/index of the user manual to make it easy to locate. Each potential problem should be clearly listed within the troubleshooting section. Troubleshooting instructions should be easy to follow, detailing common options for solving a problem with the IVIS. Both the problem and the explanation should be clear (Section 3.3.2).

Example of clear trouble shooting:
“What if the battery becomes disconnected?
"The system will be fully functional 15 minutes after the battery has been re-connected."

NB – The bold text makes the information easier to locate.
Example of poor trouble shooting:
“Once the battery has lost its connection, about 15 minutes must elapse after the battery has been re-connected, before the system will be fully functional.”

In addition to the manufacturers’ knowledge, the questions answered in this section should be developed by testing phase. Several novice users should be asked to regularly use the system after reading the manual. Any queries which arise should be included.

3.4 Diagrams

Diagrams should be used within the user manual to help explain use of the IVIS. The design and presentation of illustrations should be consistent throughout the user manual. However unnecessary illustrations should be avoided.

3.4.1 Important information

The user manual should present important information in diagrammatic form as well as in the text to aid the user with limited literacy. Diagrams should be big (50 mm or more), clear and simple (Section 3.1.2).

Diagrams should contain enough information to be useful and represent controls and functionality effectively. Diagrams should correspond exactly to how the system both looks and operates to avoid confusion.

Example of a superfluous diagram:

![Superfluous Diagram]

3.4.2 Positioning

User manual diagrams should be positioned as closely as possible to their accompanying text. Ideally the diagram should be next to or opposite the paragraph in which it is discussed in the text. The user should not have to turn a page to see a diagram that the text refers to, unless it is a common diagram which is on an introductory page. If a common diagram is used, it should be clearly cross-referenced (see Section 3.5.3) every time it is referred to. If the above guidelines are followed then it will be clear to the user which piece of text belongs to which diagram. The order in which text and diagrams are presented should be kept consistent, i.e. text is either always presented before the diagram or always presented after the diagram. Text and diagrams which are linked should be cross-referenced, so that the user can find all the relevant information quickly and easily. All diagrams, figures and tables should have a caption to explain to the user what they are supposed to see. Finally, diagrams should be presented in the correct order, i.e. - the same order as the textual descriptions.
3.4.3 Control operation and system functionality

Control operation diagrams should be provided within the user manual and should be positioned in a prominent position at the beginning of the user manual. The control operation diagram should mirror how the system looks and labels of each control should be provided. The system should react in the manner that is suggested by the control operation diagram.

The control operation diagram should correspond exactly to how the system operates so that it is clear how to use the system controls and there should be no other way around the menu structure than that described. The information should not be overly complex but should provide enough information so that the user understands exactly how each control is operated.

Example of a clear control operation diagram:

The user manual should also contain diagrams for use of system functionality. System functionality diagrams should illustrate the operation of various functions in an appropriate form (such as step by step illustrations of system status after each control action).

3.4.4 System Menu Structure

The IVIS menu structure should be clearly presented within the user manual. The user manual should refer to the order in which menus and submenus are presented within the system and how to navigate (forward and backwards) through the system menu. The manual should also detail how operations and functions can be accessed from the menu system.

A model of the system menu structure should be provided within the user manual, preferably in the form of a flow diagram or series of diagrams. This menu structure model should make it clear how to navigate menus so that the user will not get lost within the menu structure and knows where desired menus and submenus can be found. The user should be able to easily see where they are in the menu structure and how to move around the menu.
Example of a system menu structure diagram:

3.5 Navigation of User Manuals

3.5.1 Ease of navigation

An effective method for navigating through the user manual should be provided, such as a contents page and index unless the user manual is very small and therefore easy to navigate. It would be preferable for the user manual to contain both forms of navigation aid (contents and index). The contents page should be at the beginning of the user manual and the index at the back of the user manual.

The contents page should be clear and easy to use. To make the contents clear and easy to use, ideally it should contain all chapter headings and sub-headings. Both chapter numbers and page numbers should be indicated. The organizational level of the headings should also be indicated in the contents by indents, varied font size or numbering. The contents should not be more than two pages, so it may be necessary to exclude the lower level sub-headings.

The index should ideally be positioned on the last page of the user manual and listed in the contents page to make it easy to find. The index should contain all keywords, be presented in alphabetical order and clearly provide the appropriate page number/s for ease of use. Keywords should include important and frequently required/used words. The navigation aids should be easy to find.

The user manual text should be separated into headings and subheadings. These headings should stand out from the rest of the text by using a different font size and by bolding the text. No more than three levels of text should be used as this can be confusing to the reader. Headings should be useful, indicating clearly to the user the contents of the section to which they refer.

Text highlighting techniques should be used appropriately to draw the readers’ attention to important information (see Section 3.5.2). The use of highlighting techniques should be consistent; bolding and underlining are recommended. No more than two highlighting techniques should be used.

All instructions should be provided in a logical order, for example, the user manual should not tell the user how to adjust the volume before telling the user how to switch the system on.

In the case of user manuals that apply to a number of products it should be explicitly clear which product the instructions refer to. For example “Operating instructions for Navigation System” in font size 20 together with a picture of the system.
3.5.2 Important information

Important information should be presented in different ways in order to make it stand out. For example, important information such as warnings, safety advice, section headings, keywords and control operations might be bolded, in a different colour or in capitals. Section 4.1.1 provides information on warning/hazards.

Each piece of information should be provided in a chunk rather than providing the user with cluttered lengthy text.

3.5.3 Cross referencing

Related information should be cross-referenced within the user manual. For example, information on inputting data into the IVIS should be cross-referenced to the input control functionality diagram, the controls operation diagram and to safety related information on inputting data whilst driving. Critical information which is required to accompany instructions should be presented within the manual more than once if required; i.e. if cross-referencing is complicated and frustrating for the user to ‘flick between pages’.

Example of Cross Referencing:
“The position of traffic congestion is shown by a symbol on the map view. See page 15 for a list of symbols and definitions”

If a page is frequently referred to (cross-referenced), the page should be made as easy as possible to find. For example by colouring the end of the page, using thicker paper than the rest of the manual or using a page which folds out beyond the rest of the pages.

3.6 The User

One critical step in the development of user manuals is identifying the user population and determining which characteristics might affect a user’s ability to take in and understand information. User manuals need to be produced with the range of potential users in mind. For example, the user manual writer needs to consider the age range, literacy, technical ability and nationality of potential users.

3.6.1 Language

The driver population should be considered in relation to the likely and intended use of the system as well as the native languages and other languages spoken and read. Published statistics on language proficiency by country could be used as a reference. As a minimum, instructions should be provided in the majority language of the country in which the system is being sold. Official and minority languages should ideally also be considered. The language used in the manual should also be the naturally spoken, everyday language of the user population i.e. it should be colloquial to the country in which it is used. If more than one language is used, then each language should be completely separate with their individual contents and index etc.

When using diagrams and warnings, accepted stereotypes and conventions for the intended population should also be considered.

3.6.2 Literacy

Illiteracy and declining literacy should be considered when designing the manual. If the system is complex, unusual, or hazardous then reliance on visuals or pictures is essential, particularly with respect to safety warnings.
In addition to illiteracy, the users’ reading ability should be considered. Although no specified level of reading ability is recommended in the production of user manuals, the basic underlying idea behind readability is that the longer the sentences and the more complex the vocabulary (or abbreviations), the more difficult the text will be to read. Therefore, long sentences with complex vocabulary or unfamiliar abbreviations should be avoided in order to make the text readable for the majority of the user population.

### 3.6.3 Technical sophistication

As members of the general public, IVIS users may be technically sophisticated or naïve. The manual should be directed at the naïve user, hence should be written avoiding jargon and unfamiliar words and abbreviations. The manual instructions should be kept simple, clear and non-technical.

### 3.6.4 Age

The general population in Britain is aging and so is the driver population. Older drivers have differing sensory, physical and psychomotor abilities, which will affect how they use both IVIS user manuals and the IVIS themselves.

For example, ageing affects the short-term memory and information processing capacity. The time it takes an individual to retrieve information from memory increases with age and the elderly require increased ‘thinking time’ to interpret complex information and to work out the next step when using a system or a system user manual. This might be addressed in user manual design, by ensuring that all required information to carry out a function is presented together, as opposed to requiring the user to remember information from previous sections in the user manual.

Older people also suffer reduced attention. The user manual should therefore be kept relatively simple to ensure that high levels of attention and vigilance are not required to understand the user manual instructions.

Finally, the elderly are less able to select information efficiently when it is needed. The user manual should not, therefore, require the user to select the appropriate information out of a large amount of information. Instead, only the required information should be presented and irrelevant information should not be included (Section 3.2.1).

### 3.6.5 Training requirement

The need for training should be specified in the user manual. If any initial training is required, then all product information should make this clear, by stating it prominently in the user manual. If the IVIS requires a special skill or is unsuitable for a particular group, this information should be written in the user manual.

### 3.7 Other

It may be useful to have a notes section at the back of the user manual for information to be written in by the user.
4 Safety

4.1 Safe use of system

Instructions should make the driver fully aware of the use of the system intended by the manufacturer. Any restriction on intended use should be provided in the user manual as a warning. The warning should be clear and explained in full (Section 4.1.1).

Certain functions may require lengthy interaction time and significantly increase workload while driving, therefore compromising safety. These functions should preferably be disabled whilst the vehicle is in motion. The manual should clearly state that they are not to be used while the vehicle is in motion. Clear warnings should be provided against unintended use (Section 4.1.1).

After becoming aware of the instructions, drivers should be in no doubt about which aspects of the system are designed for use while driving and which have not been designed for use while driving.

Example of clear ‘use’ guidelines
“Destination input should be completed before the start of the journey. Under no circumstances should the destination be entered when the vehicle is in motion”

Regardless of any information received from the system, the driver retains absolute responsibility for safe operation of the vehicle, and compliance with presiding traffic regulations. These points should be made clear within the user manual.

Example of explicit instructions:
“The use of the Navigation system by no means relieves the drivers of their responsibilities. The Highway Code must always be observed”

Representations of system use (e.g. descriptions, photographs and sketches) should neither create unrealistic expectations on the part of the potential user nor encourage unsafe or illegal use. For example, a photograph of a user driving and manually inputting a destination into a navigation system would be seen as encouraging inappropriate use of the system. Rather, the user manual should assist the user in appreciating the functionality, benefits and limitations of the system before (and during) use, and promote road safety and compliance with existing traffic regulations and codes concerning road and vehicle use.

4.1.1 Warnings

The manufacturer has a duty to warn users of dangers present in using the system both in normal and foreseeable misuse. Warnings should therefore be provided in the user manual for all potential hazards or foreseeable misuse connected with the system.

Warnings should follow existing guidelines (ISO/IEC Guide 51, 1997). A good warning might be presented in three parts: a single word and colour to convey the severity of the hazard, a symbol or pictogram showing the nature and consequences of the hazard and words to describe how to avoid the hazard. For example red can be used as a dangerous warning/hazard, orange as a general but less dangerous warning/hazard and green for an environmental warning.

Wording of warnings should be simple, direct and active, clearly communicating the nature of the hazard and how it can be avoided. Warnings should be located in the user manual where they are connected to the text. The warnings should be consistent and should never be mixed with general text in the user manual. Warnings should stand out and be easily readable. Warnings should contain a single word to convey the gravity of the risk, a description of the nature of the hazard, the consequences of the hazard and instructions to reduce or eliminate the hazard.
Warnings should not be grouped together as they may lose their impact. Warnings should instead be placed next to the text to which they are connected, preferably at the beginning of the associated instruction. For extra impact it may be possible to draw a picture with a cross through it to accompany the warning text, this will also help illiterate users.

Example of warnings grouped together:
“Do not leave the panel open when driving. Do not touch the metal contacts on the portable panel or on the radio”

Example of High Impact Warnings:

a) “WARNING – DO NOT leave panel open while driving”

b) “WARNING - DO NOT leave panel open while driving”

c) ! ATTENTION!
   DO NOT leave panel open while driving

d) WARNING: DO NOT leave panel open while driving

e) ![X] ![Checkmark]

Please note the above diagrams provide different examples, but are separate warnings, any of which would be sufficient.

Example of a warning that describes the nature of the hazard and how it can be avoided:
“If the code is input incorrectly 3 times in succession the alarm will sound for 30 seconds. The alarm can be de-activated by disconnecting the battery (see page 57)”

4.2 General Instructions
The user manual should include instruction on installation such as the fitting of systems and sub-systems within the vehicle, including loading software. (Systems that are fully pre-installed do not require these instructions).

The user manual should provide full instructions on the maintenance of the system such as the replacement of sub-systems (e.g. batteries, licences, and software), periodic cleaning and checking and calibration procedures. It should also address the consequences of disregarding maintenance advice.

4.3 Help/advice
The user manual should provide the driver with contact details should they require further help or assistance. For systems which are not very complex further contact details may not be necessary.
5 The legal situation (For United Kingdom)

The current legal situation with regard to IVIS that apply in the United Kingdom (although similar provisions do apply throughout Europe) can be found in the “Design guidelines for safety of In-Vehicle information systems (Stevens et al, 2001). This report can be obtained from TRL Information Centre (see Section 6) or at http://www.trl.co.uk/pdf/IVISGuidelines_finalversion.pdf. The guidelines consider the legal situation concerning new in-vehicle devices including the following:

- Responsibilities – of the IVIS supply chain, employers and vehicle hire companies
- Traffic law – Highway code, control of vehicle
- Licences and contracts – IVIS devices may be subject to the granting of licences
- Type approval – agreed and acceptable levels of performance must be provided in new road vehicles
- Tort liability – “duty of care”/negligence of manufacturer
- Consumer protection liability – defective products/misuse
- Health and Safety at Work Act – correct instruction/training

Further to these, the following issues should be considered:

5.1 Highway Code

Paragraph 127 and 128 of The Highway Code discuss ‘Mobile phones and in-car technology’. The Highway Code states that a hand held mobile or microphone should never be held when driving. The Code highlights that it is always safer to find a safe place to stop and that even hands free equipment is likely to cause distraction when driving. The Highway Code also states that there is a danger of driver distraction caused by in vehicle systems and such systems should not be operated, adjusted or viewed if it will distract attention while driving. The driver must exercise control of the vehicle at all times.

5.2 Construction and Use Regulations

Part 7-1018.1 of the Construction and Use Regulation on Television sets clearly states that vehicle drivers must not be able to see (either directly or by reflection) a television, a television receiving appliance or other cinematographic apparatus used to display anything other than the following types of information:

- “about the state of the vehicle or its equipment”
- “about the location of the vehicle and the road on which it is located”
- “to assist the driver to see the road adjacent to the vehicle”
- “to assist the driver reach his destination”

5.3 Consumer Protection Act 1987

The Consumer Protection Act 1987 has five parts:

- Part I: Product liability
- Part II: Consumer safety
- Part III: Misleading price indications
- Part IV: Enforcement of parts II and III
- Part V: Miscellaneous and supplemental

Part I and II may be particularly useful to refer to when writing a user manual. Part I includes information on: Liability for defective products; the meaning of ‘defect’; defences; damage giving rise to liability; application of certain enactments; prohibitions on exclusions from liability. Part II contains information on: general safety requirements; safety regulations; offences against the safety
regulations; prohibition notices and notices to warn; suspension notices; appeals against suspension notices; fines/penalties; power to obtain information.

Additionally to the Consumer Protection Act, the ANEC (the European Association for the Co-ordination of Consumer Representation in Standardisation) would be an additional useful source of consumer related information and requirements.

5.4 Advertising in the context of road safety

In 1993 a working party of the High-Level Group of EC Government representatives developed a report on “Advertising in the context of road safety”. The report contains recommendations on the following three aspects:

1. subjects to be avoided in advertising
2. target groups
3. Measures to be put in place to inform target groups of proposed regulations and examination of different possible approaches for putting them into practice.

Although this report is not specific to IVIS user manuals it should be taken into account when writing user manuals. Motor and component manufactures are within the target groups for which the report is aimed so they should be fully aware of the report.

None of the content of the user manual should encourage the driver to break the law or infringe the basic rules governing careful driving. The manual should not evoke needs incompatible with safety or suggest exaggerated personal values such as dominance, recklessness or power. Furthermore, the manual should not suggest that particular characteristics (of the vehicle or its accessories) will enable the driver to master every situation, however dangerous it may be, and hence instil a false sense of safety. It should be made clear in the user manual that the IVIS does not give them superior rights over other road users.

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6 References


http://www.trl.co.uk/pdf/IVISGuidelines_finalversion.pdf


7 Bibliography


8 Abbreviations and glossary of terms

ABBREVIATIONS

ANEC European Association for the Co-ordination of Consumer Representation in Standardisation
DfT Department of Transport (UK Government Department)
EC European Commission
EU European Union
HCI Human Computer Interaction
ICT Information and Communications Technology
ISO International Organisation for Standardisation
IVIS In-Vehicle Information System
TRL Transport Research Laboratory

GLOSSARY

Control Operation Diagram An illustration that shows how the controls on an IVIS are operated
Driver responsibility The responsibility of the driver to abide by all traffic and safety laws and conventions
Feedback Response from the IVIS giving information to the user about an input action taken, further action that is required, or a change in system state
Foreseeable Misuse Use of the IVIS in a way that is not intended, but which the suppliers might be expected to have anticipated
Function Operation or activity carried out by the IVIS that is executed on reception of incoming information, and transforms this into an information output
Irrelevant information Information that is not directly applicable to assist the user to use the system or to warn them of potential hazards and system misuse
Manufacturer The person or organisation responsible for system construction. The term includes the designer, component suppliers and system integrator; plus system suppliers who, by putting a name, trade mark or other distinguishing feature on a product presents themselves as its producer.

The responsible organisation will typically be the vehicle manufacturer or the system supplier

Misuse The use of IVIS functions (intended by the supplier for use while driving) that are used by the driver in a manner or way that is not intended, and may lead to negative consequences

Primary Task The most important task that a user is completing. They may complete the primary task in conjunction with a secondary task, but the primary task should always take precedence
<table>
<thead>
<tr>
<th><strong>Secondary Task</strong></th>
<th>A task which is of lesser importance than the primary task but may be completed in conjunction with a primary task</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System functionality</strong></td>
<td>A description of how the system works and the different capabilities available</td>
</tr>
<tr>
<td><strong>System limitations</strong></td>
<td>Any functions or capabilities that the IVIS system does not have</td>
</tr>
<tr>
<td><strong>System operation</strong></td>
<td>A description of how to use the system</td>
</tr>
<tr>
<td><strong>Technically naive</strong></td>
<td>A person who has no or limited experience of using IVIS or computer operated systems</td>
</tr>
<tr>
<td><strong>Usability</strong></td>
<td>Ease with which the IVIS can be used</td>
</tr>
<tr>
<td><strong>User</strong></td>
<td>A driver or passenger who will be making use of an IVIS and referring to the IVIS manual</td>
</tr>
</tbody>
</table>