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DIGITAL TELEVISION FOR ALL

A report on usability and
accessible design

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Digital Television For All

A report on usability and accessible design

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EXECUTIVE SUMMARY

Background

- 1 This report was commissioned as part of the 'human aspects' element of the Digital Television Action Plan (DTAP). Its purpose is to address human issues so as to help encourage and enable the take-up of digital services by viewers with differing needs. It is relevant to OFCOM's duty under the Communications Act 2003 to ensure that 'domestic electronic communications apparatus is developed which is capable of being used with ease, and without modification, by the widest possible range of individuals (including those with disabilities)'.
- 2 The work undertaken in the compilation of this report included:
 - **Consultation:** A series of consultations were held with key stakeholders
 - **Quest:** We undertook a quantitative questionnaire-based survey of over 4000 typical viewers
 - **Focus Groups:** Eight consumer focus groups were held in which usability issues were covered
 - **Usability Audit:** An expert audit of the usability of three typical set top boxes (STBs)
 - **Exclusion Analysis:** Prediction of the exclusionary effect of the three typical STBs
 - **User Trials:** A series of 13 in-depth trials with users of varying capability.

Key Findings On Exclusion And Usability

- 1 Our research has established that, from a usability perspective, currently available digital television (DTV) equipment and services are significantly different from current analogue television equivalents. Whereas analogue televisions are self-contained devices with one remote control handset, DTV is mainly received using a separate set top box with its own, additional, remote control. The greater number of channels, and additional features such as electronic programme guides and interactive services, mean that users of DTV equipment are required to use their remote controls more extensively (in combination with on-screen menus) to choose channels, and navigate through information and options.
- 2 We have assessed the extent to which these differences affect how easy current DTV equipment is to purchase, install, set up and use. Our findings confirm the results of previous studies such as Easy TV that current digital television equipment is generally not as usable as analogue

television, though there is some variation across the types of platform (cable, satellite and terrestrial) and the types and models of equipment in use. Today's set top boxes present greater barriers in use than integrated digital televisions (IDTVs).

- 3 We have also estimated the extent to which people with some level of capability loss would be excluded from using DTV using current equipment. The types of capability loss that give rise to exclusion include reduced dexterity, impaired vision and hearing, and impaired cognitive functioning. These types of capability loss are evident among the disabled and the elderly. Based on today's equipment, an additional two million people (4.4% of those able to access analogue television) could be excluded from simply viewing the new digital services using digital terrestrial television set top boxes at switchover. A further 700,000 people (1.6% of those able to access analogue television) would be excluded from using advanced features such as digital text and interactive services. Conversely, through features such as Audio Description, DTV can also make television more accessible to some people with reduced capability.
- 4 While dexterity, vision and hearing impairment are important sources of exclusion, the greatest source of exclusion is a result of the cognitive challenges of current DTV equipment. There are two main problem areas. The first is that the paradigm for user interaction is drawn from the menu-driven world of personal computers whereas some people – particularly the very elderly - have never used personal computers and are therefore not familiar with menus. The second is poor 'system interaction design' where, even for people who are familiar with new technologies, DTV equipment is non-intuitive and exhibits inconsistencies.
- 5 However, we believe that innovation in DTV products will improve usability and reduce exclusion. DTV set top boxes are still in the early stages of their evolution and some of the usability problems we observed in our trials would not have been difficult to resolve through better design. For comparable, everyday viewing we see no fundamental barriers to eventually achieving almost the same level of accessibility as analogue televisions.
- 6 Manufacturers have an interest in improving usability for the broader viewing population, as evidenced by the co-operation within the Technology and Equipment Group under the Digital Television Action Plan. Many of the problems faced by those with some level of capability loss will be solved once usability is improved for the broader viewing population. We have been able to recommend improvements in both equipment and service design.
- 7 There remain substantial problems in the interaction design of interactive content such as text services and interactive TV: for example, in the navigation principles employed. These problems need to be solved in a

way that is consistent with improved system interaction design. Users will thereby be able to build-up a consistent model of how to interact with the equipment and the services it supports.

- 8 There remain numerous problems associated with the installation and set-up of digital terrestrial television set top boxes which would mean that about 15% of viewers who wanted digital terrestrial television would need technical assistance. This is not as much of an issue for satellite and cable set top boxes because with these platforms the operator is currently responsible for installation.

Recommendations

We have identified a number of areas in which manufacturers, retailers, government, broadcasters and other stakeholders could usefully collaborate to improve the usability and accessibility of DTV. These are listed below in the order they appear in the report.

Improving awareness and understanding of DTV (section 9.2)

- 1 For people to acquire the right products and then use them effectively, they need a baseline understanding of DTV and how it could be used in their homes, and they also need to be 'intelligent customers' for DTV equipment. Government and industry should consider running information campaigns as distinct from the current commercial promotion of DTV. Possibilities include a telephone call centre, roadshows, advice desks in public libraries or shopping centres, Webwise centres, and UK Online Centres.

Improving the purchase process (Section 9.3)

- 2 To help customers select the right DTV equipment for their needs, retailers should consider developing computer-based purchasing support. This could be web-based for customers or PC-based for retail staff in-store. Such support should as far as possible be consistent across retailers.
- 3 Retailers should consider developing a training package for retail staff, perhaps along with accreditation.
- 4 The Digital Television Project should consider ways of helping organisations such as RNIB, the RNID, the Consumers Association or the DTG to identify and then list products that are suitable for use for people with particular disabilities.
- 5 Remote controls could be visible through the product packaging, represented visually on the packaging, made tangible through cardboard dummies or put out on display.

- 6 The Digital Television Project should keep the information on packaging under review, but product evolution and the need for differentiation in an increasingly crowded market should improve the information provided on packaging without the need for intervention.
- 7 As switchover nears, it may be necessary for the Digital Television Project to look again at whether the ways in which consumers purchase DTV equipment is effective in ensuring that they obtain appropriate products for their circumstances.

Improving instructions for installation and use (Section 9.4)

- 8 Manufacturers and retailers should review current instruction manuals and should consider the possibility of including additional supplementary information on a range of home connectivity scenarios. Alternatively, such information might not have to be provided in the manuals if it were available elsewhere (at retailers, or on the web). Video-based instructions (on a DVD/VHS, for example) could also be used.
- 9 Manufacturers should ensure that their instruction manuals address digital switchover specifically. Some people will need to re-tune their equipment but, unlike the initial tuning, this will not happen automatically.

Improving equipment functionality and performance (Section 9.5)

- 10 All stakeholders should recognise that the problem of VCRs and programme recording is a critical one for digital switchover and the ongoing usability of DTV. Continued efforts should be made to find a simple, convenient and affordable solution.

Improving system interaction design (Section 9.6)

- 11 An industry body such as DTG should address system interaction design in an integrated way, aiming for the creation and dissemination of a design checklist or best practice guide. The potential for customising the user interface for impaired users should be investigated within this activity. There is a trade-off between allowing customisation, and confusing the user with too much choice of set-up parameters. The functionality should be there, but "hidden", so that it does not add to the immediate complexity for the average user.

Improving remote control design (Section 9.7)

- 12 The scope of the TEG design checklist should be reviewed in the light of this report and its supporting appendices before being disseminated as an industry reference source.
- 13 To encourage the innovation and commercial development of alternative remote controls suitable for users with impairments, manufacturers should open-up access to their infrared remote control codes.

Improving interaction design for broadcast content (Section 9.8)

- 14 An industry group such as DTG should address interaction design for broadcast non-sound and vision content in an integrated way, aiming for a guidance note or code of practice which can be disseminated as an industry reference source. This activity should be integrated with the analogous activity for system interaction design.

Addressing STB-specific problems (Section 9.9)

- 15 Given that IDTVs do solve a set of problems resulting from the compromise and trade-offs often represented by current STBs, government should investigate ways of accelerating the development of the market for suitable mass market IDTVs and other integrated products.

Providing one-to-one support (Section 9.10)

- 16 The DTAP should establish how the level of one-to-one support necessary for the government to achieve digital switchover is to be funded, bearing in mind the affordability criterion for switchover.

1 INTRODUCTION

This report was commissioned as part of the 'human aspects' element of the Digital Television Action Plan (DTAP). Its purpose is to address human issues so as to help encourage and enable the take-up of digital equipment and services by viewers with differing needs.

Government is concerned that:

- Sections of the population that are currently able to use analogue equipment should not be excluded from using digital equipment. Exclusion could come about through differences in the ways in which users interact with digital television. Digital television provides more features but is correspondingly more complex to use.
- The features of digital television can be used effectively to provide better TV access to people with disabilities of all sorts. Audio description is an example of a feature which is not available in analogue television but which could improve the TV experiences of many people.

Full terms of reference are provided in Appendix A. During the research we have been guided by DTI and DCMS as to where to concentrate our efforts. The contents of this report reflect the way in which the emphasis has evolved over the duration of this part of the project (March 2003 to July 2003).

Subsequent to the commissioning of this study, the Communications Act (2003) has defined the following duty of OFCOM (see Appendix B):

It shall be the duty of OFCOM to take such steps, and to enter into such arrangements, as appear to them calculated to encourage others to secure— (a) that domestic electronic communications apparatus is developed which is capable of being used with ease, and without modification, by the widest possible range of individuals (including those with disabilities); and (b) ... (etc)

2 THE COMMERCIAL CONTEXT

Good usability is not an altruistic goal. If DTV products are perceived to be usable, then the market size will be increased and the products will reach beyond the technology literate early adopters who are perhaps quite tolerant of poor usability, towards groups who are less au fait with technology and groups who may have reduced capability and therefore have difficulties with using more complex products. People with reduced capability include the disabled and some of the elderly.

Usable products result in satisfied customers. There will be fewer returns and fewer complaints. The cost of support for set-top boxes is currently high, with almost 25% of all boxes being returned to retailers¹. By contrast, a positive experience on initial contact will encourage word of mouth recommendation and drive sales.

Usability will become more important as digital television spreads. Early adopters are likely to want the benefits of digital television so much that they will be tolerant of design quirks. Late adopters are less likely to be so keen on getting the benefits and therefore will be less inclined to be tolerant of usability problems (Figure 1).

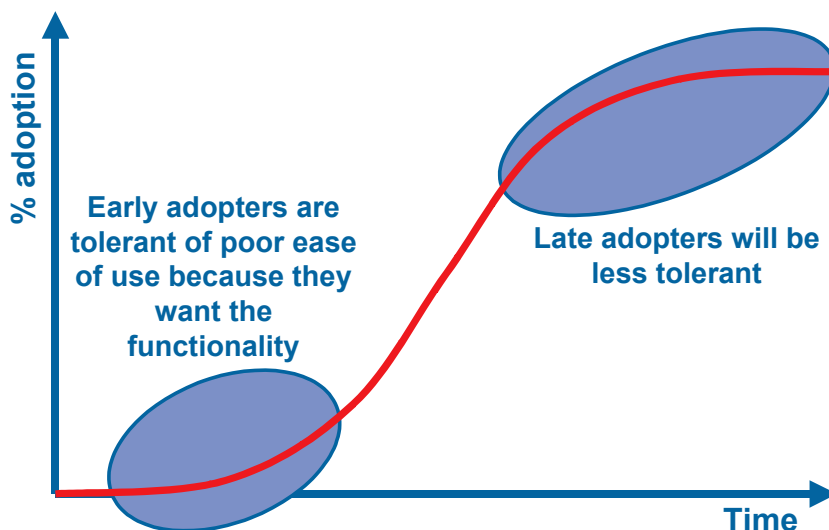


Figure 1. Tolerance of poor usability through the adoption 'S-curve'

¹ Not all such returns are due to product usability, however. Many are due to reception problems which could be mitigated to some extent by better checks being carried out at the point of sale.

In practice, most product categories become more usable over time because of innovation. Manufacturers try out different approaches to the various features of a product, attempting among other things to make their products more usable than competitors' products. The innovations which users like are taken up by the market and eventually form part of everyone's expectation of the design of a particular product. Hence, a dominant design emerges. This is then helpful to users who, through a form of social learning, come to have a shared idea of what a particular category of product does, and how it is used. Eventually, products become to be seen as 'natural' and the skills for their use become second nature.

Improving the usability of DTV will involve both competition and collaboration.

Manufacturers already *compete* on ease of use, as the adverts and brochures for DTV equipment already shows. There are many unsolved problems in respect of DTV – particularly for STBs - so there is an incentive for manufacturers to be innovative. Some manufacturers are aiming to provide a consistent form of user interface across different product categories and using this as a selling point.

There are also good justifications for *collaboration*. Firstly, common approaches simplify the consumer adoption process because it makes it easier for a general understanding to build up in the population of how to use these products (social learning). Common approaches also reduce channel costs such as the training of retail staff. Collaboration is also imperative for tackling system issues that might otherwise fall 'between the cracks' of the different pieces of equipment in a system. An example is the inter-connection of equipment from different manufacturers, and making STBs work seamlessly with televisions, VCRs and audio-visual equipment. Arguably, collaboration should create standards that allow content providers and equipment providers of all sorts to create usable systems that will behave predictably. Such collaborative solutions would be beneficial to consumers regardless of the timing of switchover.

3 EXPLANATION OF DIGITAL TELEVISION PLATFORMS

Digital television covers more than one way of obtaining TV channels, so this chapter has been written to clarify the options and the acronyms. A taxonomy of the options is shown in Figure 2. DTV is transmitted on four platforms – DTT, satellite, cable and DSL. Each platform requires its own sort of reception equipment.

Digital Terrestrial Television (DTT) is a free digital service providing up to 30 digital TV and radio channels plus some interactive services. Known as Freeview, it is broadcast from transmitters and received via an aerial on the rooftop, in the loft, or (in strong signal areas) on the set-top. Freeview is marketed by DTV Services Ltd which is a company run by its three shareholders: the BBC, Crown Castle International and BSkyB.

Because the signals are digital, they cannot be received directly by existing analogue TV receivers. Instead, people need either an adapter (a DTT set top box or PC card) or they must purchase an integrated digital television (IDTV) set with an adapter built-in.

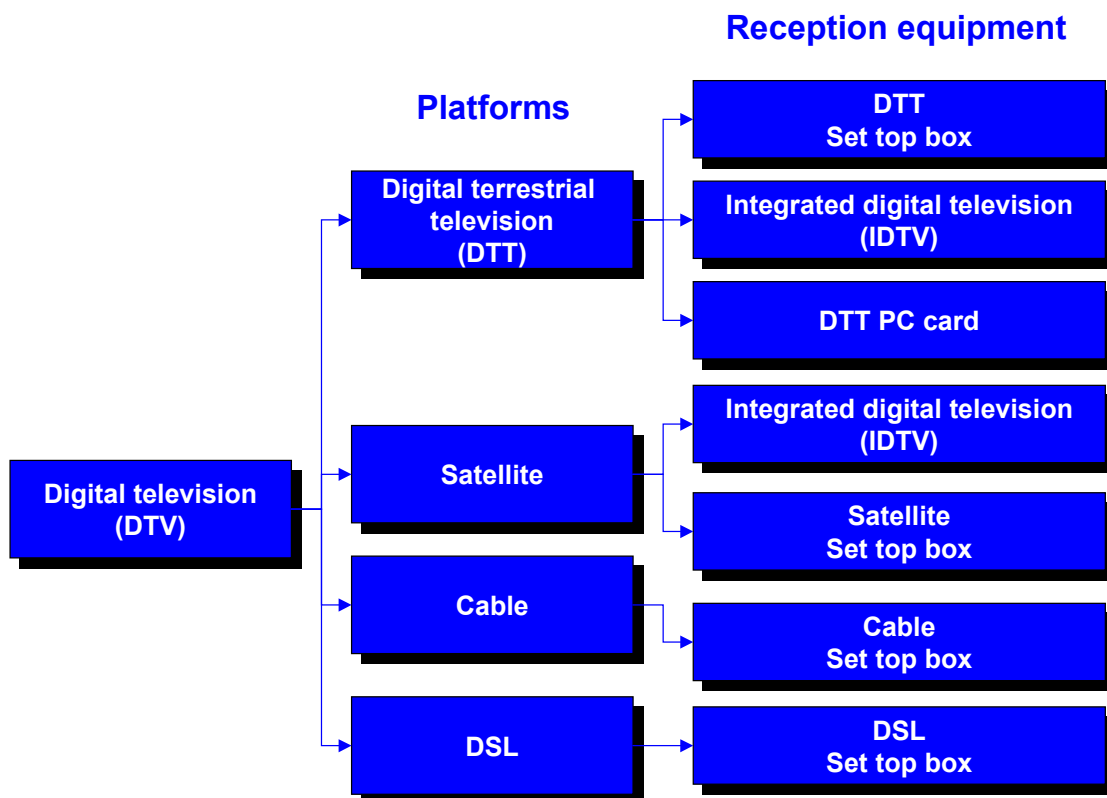
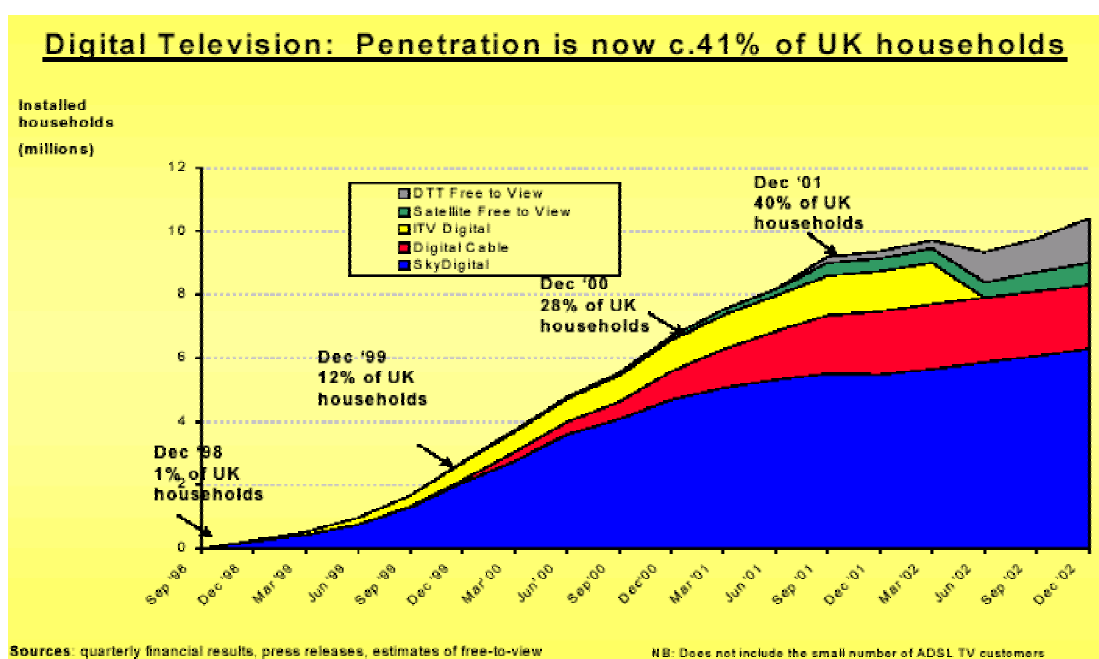


Figure 2. Taxonomy of digital television platforms in the UK

Alternatively, digital television can be received by cable (NTL or Telewest) or satellite (BSkyB). Cable TV requires that special infrastructure – a cable to the home – is present. Cable is generally only available in urban areas. Satellite TV needs a dish. Both cable and satellite also require a set top box, which is typically installed by the operator such as NTL, Telewest or BSkyB along with the cable or dish. Cable and satellite services typically involve a monthly subscription, though it is possible to receive some free channels by satellite without a subscription. DSL is an alternative subscription service like cable or satellite. DSL has a user base of just a few thousand homes which, unlike the other platforms, is declining. The breakdown of the installed base of platforms is approximately as shown in Figure 3.



Source: A Report On Progress Towards Digital Switchover, ITC & BBC, April 2003²

Figure 3. DTV penetration by platform

In March 2003, 10.8 million UK households had installed access to DTV³. Of these, the two DTT platforms (IDTVs and STBs) accounted for 1.6 million households, some 14.8% of the total with access to DTV. The majority of DTT reception is through STBs rather than through IDTVs.

² http://www.digitaltelevision.gov.uk/pdfs/ITC_BBC_switchover_report.pdf

³ ITC Multichannel Quarterly, Q1 2003

The installed base of IDTVs sits at only 352,000 (just 3.2% of all households with digital TV). While integrated digital receivers had only available as high-end, expensive sets, smaller screen low-end IDTVs are expected to be introduced soon. This could give IDTVs a greater future role in the market.

It is clear from the joint BBC and ITC report that growth in DTV to 2007 will need to come predominantly from DTT. It is expected that this will predominantly be through the installation of DTT STBs. Accordingly, this report concentrates on DTT STBs, though other platforms are discussed as appropriate.

4 TYPES OF IMPAIRMENT

A primary purpose of this report is to evaluate and understand the particular demands imposed on people with impairments during their interaction with DTV equipment and content. There are many types of impairment including loss or reduction in sight, loss of hearing, loss of dexterity and reduced cognitive (intellectual) functioning. There are also many variations and orders of magnitude within each impairment. For example, sight impairment ranges from short sightedness to complete blindness. This level of variation causes complexity when investigating accessibility. Furthermore, many people with impairment have multiple disabilities. The types of impairment that are most affected by interaction with DTV equipment are covered in this report. These are:

- Visual impairment (sensory)
- Hearing impairment (sensory)
- Dexterity impairment (motion)
- Intellectual functioning impairment (cognitive).

These impairments are described and rated within the Office for National Statistics (ONS) 1996/7 Disability Follow-up Survey. This survey was undertaken to determine the level and type of disabilities present within the UK. (See Appendix E). Table 1 summarises the number of adults in Great Britain with impairments, as defined by the ONS.

Table 1. Summary of ONS statistics on impairments

Age Bands	Motion		Sensory		Cognitive		Total	
	,000s	%	,000s	%	,000s	%	,000s	%
16-49	1484	5.4	617	2.3	862	3.2	1975	7.2
50-64	1940	20.9	968	10.4	752	8.1	2234	24.0
65-74	1317	27.0	792	16.2	393	8.0	1475	30.2
75+	1970	47.2	1603	38.4	615	14.7	2442	58.5
Total 16+	6710	14.7	3979	8.7	2622	5.7	8126	17.8

5 PREVIOUS AND RELATED WORK

The potential exclusion associated with digital television was addressed in the scoping study on the human aspects of adoption published in March 2002⁴. The conclusions of the study are included in Appendix C. While the scoping study was able to make the case that DTV could have exclusionary effects, no detailed or empirical work was done to determine the exact nature of exclusion, nor details of specific interventions in relation to the sorts of DTV products on the market.

Exclusion is related to the more general issue of usability. Previous work on the usability of digital television has included:

- The ITC study (ITC-UsE: Ease of Use and Knowledge of Digital and Interactive Television: Results⁵)
- The Easy TV 2002 Research Report⁶
- The Go Digital trial⁷.

These programmes have helped lay the basis for work being conducted under the umbrella of the Technology & Equipment Group (TEG) under the DTAP to promote good practice in respect of usability. The working group has developed standard equipment specifications, checklists and guidelines. For example, the guide for remote controls includes suggestions for nomenclature and button size/positioning. It is intended that the material produced by TEG will be incorporated into the appropriate industry reference source.

There have been several initiatives relating to the use of digital television by blind and partially sighted people, and people who are hard of hearing, and many of the organisations representing the elderly and people with disabilities have commissioned or been closely involved with this work.

Royal National Institute of the Blind (RNIB) is focused on two main areas of DTV:

- The first concerns potential problems for people who are blind or partially sighted. For these people, DTV presents additional difficulties compared to analogue TV due to its greater reliance on menu-based navigation. The choice of menu format, font type and size, contrast and customisation are all areas that RNIB are following closely.

⁴ http://www.digitaltelevision.gov.uk/pdfs/scoping_study.pdf

⁵ http://www.itc.org.uk/uploads/UsE_report.pdf

⁶ http://www.itc.org.uk/uploads/Easy_TV_2002_Research1.doc

⁷ http://www.itc.org.uk/uploads/GO_DIGITAL_KEY_FINDINGS.pdf

- The second concerns benefits. RNIB also sees DTV as an opportunity to revolutionise television for those with sight impairments. It has put effort behind the initiative for audio description and are extremely keen to help make audio description a reality.

Like RNIB, the Royal National Institute for Deaf People (RNID) and the Deaf Broadcasting Council (DBC) also expect both problems and benefits from DTV. In respect of subtitling, the DBC is aware of numerous problems of implementation which mean that accessing subtitles is sometimes less easy than it could be on DTV. The main areas in which the two organisations are working are listed below.

- **EPG notification of subtitles.** The RNID and DBC are both concerned that some platforms and equipment do not indicate the availability of subtitles in the electronic programme guide (EPG) listings. This makes it very difficult for users with hearing impairments to use the features offered by DTV to full effect. There are promising signs of progress reported.
- **Closed Signing.** Although the use of signing is still in its infancy on DTV, and is only relevant to a small proportion of the population (around 50,000 people), the RNID and DBC consider this to be a very important area. The RNID has been working with the BBC Research Laboratories to develop technology which will allow the broadcast of closed signing over DTV. This is based on avatar technology.
- **Recording.** DTV does allow for the recording of subtitles on VHS players. In contrast VHS players currently available do not adequately record subtitles from analogue television. However, subtitles can only be recorded in open format on DTV. RNID would like to see recording to be further enhanced to allow subtitles to be recorded in both open and closed format. Once the technology is available for closed signing it should also be possible to record signing in both open and closed format.

Other organisations representing potentially affected groups - such as Age Concern – are keeping a watch on the progress of DTV but are not involved in major initiatives.

In summary, since the publication of the scoping study on human aspects, work has continued on usability but less so on inclusive design as envisaged in the study. However, as we shall see later, the majority of the exclusionary aspects of DTV would be addressed by good design practice. Thus, the work already started by TEG would itself contribute to inclusive design.

6 WORK UNDERTAKEN

6.1 Overview

Our work programme consisted of six elements of research, designed to build upon previous studies through in-depth qualitative approaches:

- 1 **Consultation:** A series of consultations were held with key stakeholders
- 2 **Quest:** A survey of 4000 typical viewers
- 3 **Focus Groups:** Eight consumer focus groups were held in which usability issues were covered
- 4 **Usability Audit:** An expert audit of the usability of three typical mass-market set top boxes (STBs)
- 5 **Exclusion Analysis:** Prediction of the exclusionary effect of the three typical mass-market STBs
- 6 **User Trials:** A series of 13 in-depth trials with users of varying capability.

The consultation, Quest survey and focus groups are described in detail in Appendix D. The usability audit, exclusion analysis and user trials are described in detail in Appendix E. The three most important elements for this study, namely the usability audit, exclusion analysis and user trials are also described briefly below.

6.2 Usability Audit

An expert usability audit of three STBs was conducted by Dr John Clarkson⁸ and Dr Simeon Keates⁹ of the Engineering Design Centre at the University of Cambridge. The Engineering Design Centre is a research centre for the development, validation and dissemination of advanced design methods for technical systems. Both Dr Clarkson and Dr Keates have researched and published in the field of inclusive design.

The three STBs were selected on the basis of their marketing claims and their position in the market at the time of the audit (June 2003). Checks were also carried out to ensure (a) that the chosen STBs were sufficiently different from one another, and (b) that together they comprised a representative cross-section of the STBs on the market at that time.

⁸ Reader in Engineering Design and Director of the Engineering Design Centre at the University of Cambridge

⁹ Senior Research Associate at the Engineering Design Centre at the University of Cambridge

The audit began with a basic analysis of the product design features before any operation of the product was attempted. Each STB was then taken through a seven-stage usage scenario which encompassed the lifecycle of the product and its basic functions, namely:

- Choosing and purchasing the STB
- Installing the STB
- Tuning the STB
- Setting the TV so that the DTV channel is convenient to access
- Finding out what is on and selecting the desired channel, either by using the interactive on-screen guide, or by random surfing
- Using subtitles, accessing additional settings, navigating the menu structure
- Accessing interactive content (e.g. Teletext, BBCi).

For each of these seven stages, the level of exclusion was assessed for people with each of four types of impairment, namely visual impairment, hearing impairment, dexterity impairment and cognitive impairment.

6.3 Exclusion Analysis

Leading on from this usability audit, a complete exclusion analysis was undertaken. The approach taken was to use the ONS data set to extrapolate the results of the usability audit to derive estimates of the levels of exclusion for the population as a whole. This data set is based on 7,500 people recruited to reflect the make-up of the population. However, there are several inescapable factors at work which would lead the estimated exclusion levels to be lower than the actual levels. These are as follows:

- the assessment of capability loss was carried out by the members of the data set themselves, which means that the levels of impairment may be under-estimated;
- people with impairments which have yet to be diagnosed, perhaps because their capability loss is mild, will almost definitely not be included;
- the data set comprises people in private households only, and does not include those in care who are likely to possess higher levels of impairment;
- specifically for cognitive impairment, the data will only take account of those with learning *disabilities* rather than those with learning *difficulties*

or, for our purposes, those with little or no experience of using other consumer electronic products similar to DTV. Our research has indicated that prior experience of, and hence confidence to interact with, such products has a fundamental effect on a person's inclination and ability to use DTV.

The exclusion analysis went through the same seven-stage usage scenario as the usability audit, determining the level of exclusion at each stage.

6.4 User Trials

To verify the results of the earlier assessments, a series of observational user sessions were carried out, again by Dr John Clarkson and Dr Simeon Keates of the Engineering Design Centre at the University of Cambridge.

This phase of the research was composed of a series of in-depth trials in which 13 respondents of varied capabilities were observed interacting with equipment. Each session lasted for two to three hours, during which time respondents were asked to perform defined tasks using both an analogue TV and two different digital STBs.

The respondents included five males and eight females of between 24 and 85 years old. In terms of their impairments, they were selected to represent the range of capability loss defined in Section 4 of this report, namely:

- Visual impairment (sensory)
- Hearing impairment (sensory)
- Dexterity impairment (motion)
- Intellectual functioning impairment (cognitive).

In order to ensure that the most useful data were collected, the users were selected to represent 'edge-cases'. These were defined as those users who are on the borderline of being able to use the products, and those who would commonly be accepted as being able to use the product.

The trials themselves were organised to cover a subset of the usage scenarios used in the previous assessments. In addition to practical exercises, the users were asked to take part in two discussion sessions. These were carried out in order to calibrate their level of capability and understand their views on the equipment and services following the practical trial.

7 USABILITY AND ACCESSIBILITY OVER THREE STAGES OF USE

7.1 Introduction

This chapter concentrates on DTT STBs for the reasons first laid out in chapter 3: in the medium term, the majority of new DTV installations are likely to be DTT and of these installations, the majority are likely to be STBs rather than IDTVs.

This chapter presents our findings on the ease of use and overall accessibility of digital television in respect of the three stages of use shown in Figure 4. 'Getting Started' identifies the things a user must do even to get to the stage of starting to watch digital TV. From then on, the level of difficulty experienced will depend largely on the level of functionality being sought.

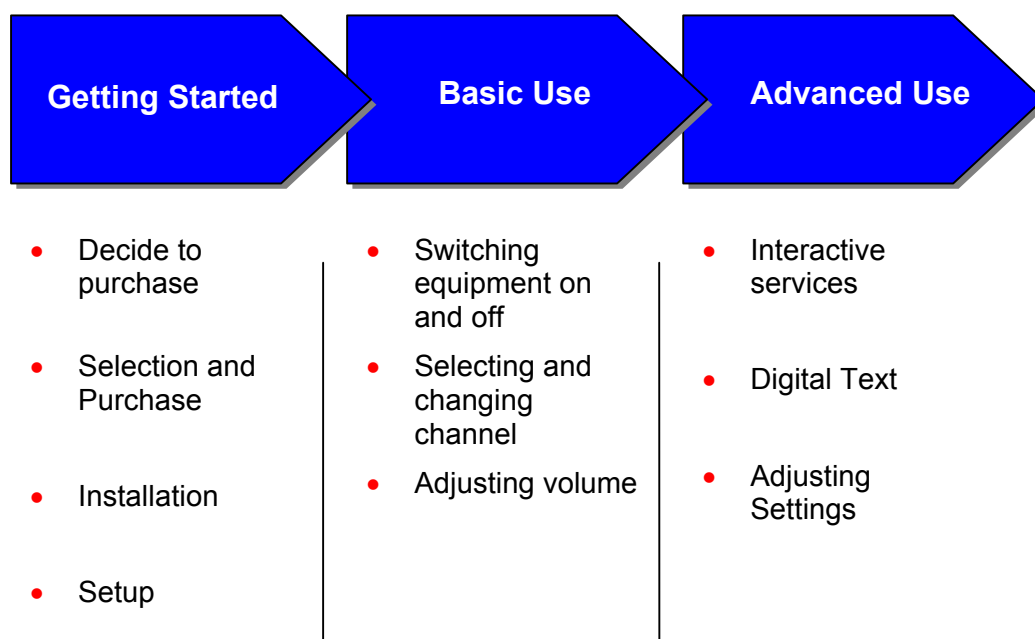


Figure 4. The three stages of use

Basic use refers to straightforward TV watching, similar to the use of analogue TV. Advanced use refers to the use of interactive services which are not available on analogue TV.

The demarcation with respect to teletext and its equivalents is not straightforward. **Analogue teletext**: is broadcast in as part of analogue television transmissions and provides easily accessible text-based information. Typically reached using the 'Text' button on the TV remote control, teletext is a basic text service for people without PCs and internet connections. On digital platforms, text can also be broadcast as part of the transmission but the mechanism is a lot more flexible, and a range of services have been developed in the UK. These include text-only channels such as Teletext¹⁰ and Four Text, and text-based content such as BBCi which is accessed from within a TV channel. Thus, digital teletext cannot be treated in isolation from interactive and advanced services on digital. We have therefore classed digital text under advanced use. A fuller explanation of this potentially confusing field is given in section 7.4.

7.2 Getting Started

The first phase of use considered includes all aspects of consumer actions needed to get to the point at which the user is able to view digital television services, as shown in Figure 5.

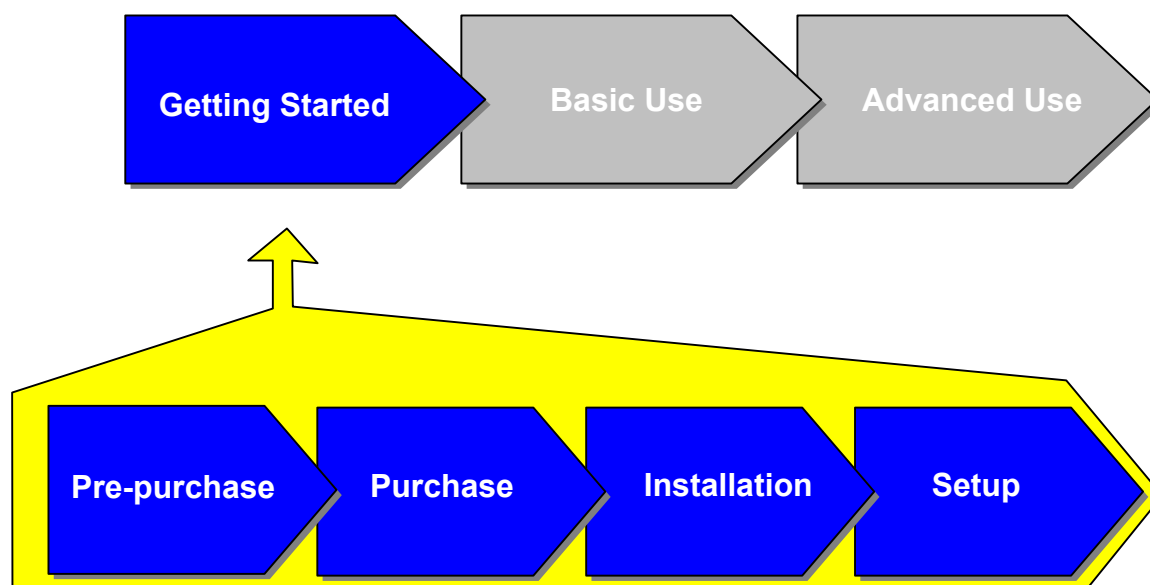


Figure 5. The three stages of 'Getting Started'

¹⁰ In UK DTV, "Teletext" is the name of a service provided by Teletext Ltd, a company. It is not a generic standard

7.2.1 Usability Findings

The evidence to date is that many people who choose, purchase and try to install DTT STBs have difficulties. The clearest statistic is the high proportion of STBs being returned to retailers. Table 2 presents support and returns statistics for DTT STBs bought from a leading high street retailer. Currently, one in four STBs are returned, and at least half of these have no discernible fault. These statistics point clearly to the need for ongoing support and the user must be made aware of where such support is available.

Table 2. High street support and returns statistics for DTT STBs

Support Required	Percentage of STB Sales
Contact retailer customer support for help	46%
Problems solved through support lines	36.8%
STBs replaced / refunded	25%
Percentage replaced / refunded with No Fault Found	12.5%

Source: Dixons, Intellect Usability Seminar, 2003

It is undoubtedly difficult for consumers to make educated purchasing decisions. Our observational trials confirmed the tendency for people to look at the packaging and try to decode from the packaging of products whether a particular product is going to be appropriate for them. Quite subtle differences in packaging can be shown to make a significant difference to a particular consumer's final product selection. For example, one of the STBs presented to our respondents had a number of channel logos on the packaging but these excluded the BBC's channels. From this, one respondent concluded that the equipment could not receive BBC channels. Should a consumer select a product that is inappropriate for them, then the likelihood of ongoing usability problems is greatly increased.

The issues we identified with regard to the purchase phase are:

- Consumer education regarding what DTV has to offer
- The role of the retailer as educator

- Retail staff training to provide information on the relative merits of each product on a platform-neutral basis
- Product packaging and the visibility of key components such as remote controls
- Ensuring that the user is aware of the effect of purchasing each product on the implications of each the purchasing decision on their digital TV viewing experience.

When setting-up an STB, people are required to interpret a set of general instructions into their specific circumstances. In the majority of cases, this must be done against a baseline of only a limited understanding of the system and its behaviour. Not everyone is well-equipped to make that translation. By way of example, there are numerous issues around the labelling of connections that must be considered and addressed by the user. One of the set-top boxes we examined had the words "RF input" on the back whereas the others had the word "aerial". It is clear which would be more meaningful to most people. To compound this, in many cases the sections of the instructions designed to help users with these issues (often called troubleshooting) are unclear and insufficiently detailed to be of much use.

Through the Quest research, we asked the panel of respondents about a range of potential usability problems. The results relating to installation and set-up are shown in Figure 6. The x-axis shows the percentage of respondents that agreed that each potential problem was actually a problem. The top bar in each case looks at the people who have not yet got digital television of any description but have reported that they are likely to get it in the near future. The bottom bar in each case looks at current users of digital TV. The difference between them shows how, when people get digital TV, their perceptions of problems change. For example, running wiring through the home is found to be more of a problem for current users than people who are expecting to get digital television; so the problem is worse than people expect. But needing to install a new aerial and problems with receiving a digital signal are perceived to be more problematic than they actually are.

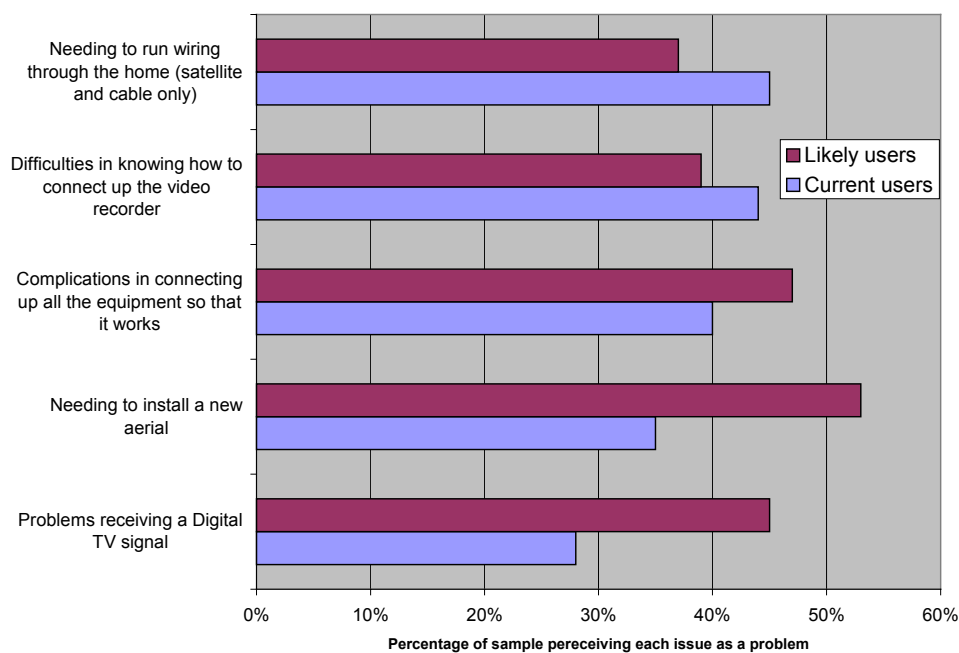


Figure 6. Quest results – installation and set-up problems

Taken together, these results indicate quite a high number of problems relating to set-up. Although purchase and set-up cause a lot of problems, many of these problems are potentially soluble because they happen infrequently. They are 'one off' problems.

7.2.2 Accessibility Findings

Overall Exclusion

Figure 7 shows the overall exclusion of installation for a DTT STB as compared to an analogue TV. A few points should be noted when reading this (and subsequent) graphs. Each bar shows the number of people within the UK population (in millions) who would not be able to perform a given task as a result of their level of capability. The percentages alongside each bar show the percentage of the population within that age band that this exclusion represents. For example, in Figure 7, we can see that two million people over the age of 75 would not be able to install an STB and that this relates to 48.1% of those over 75.

As shown in Figure 7, 15.1% of the population above 16 years of age will be excluded from getting started, compared to 14% for analogue.

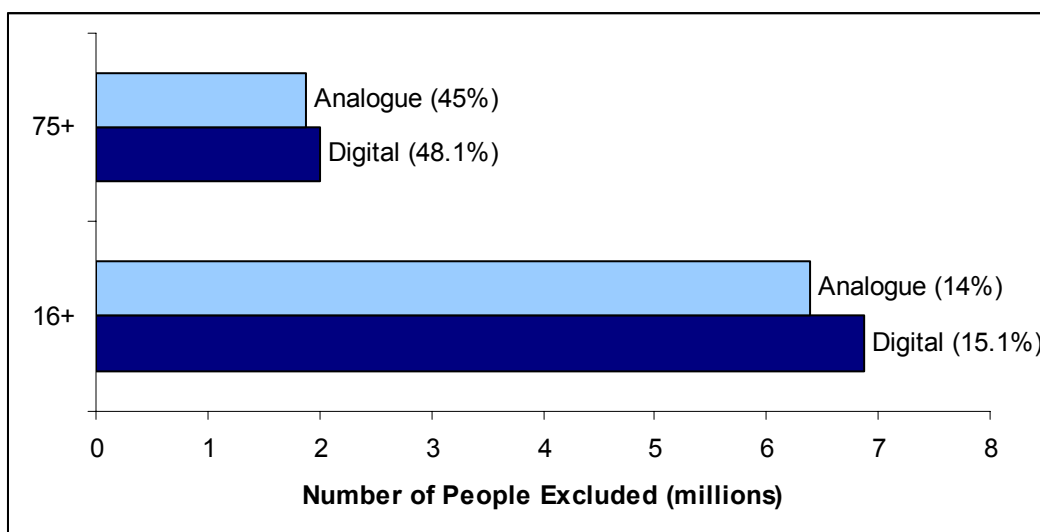


Figure 7. Comparative exclusion of analogue TV and DTT STB for 'Getting Started' stage¹¹

Purchase

6.1% of the population above 16 years of age will be excluded from identifying and purchasing an STB, rising to 23.7% for those over 75.

The purchase of an STB from a shop will require the user being able to complete all of the steps summarised in Table 3. However, for the purposes of the exclusion analysis carried out in this study, it has been assumed that the consumer is already in the shop and that the STBs are within easy reach.

Estimating the level of exclusion from these steps takes into account whether a person has the visual capability to read small print on packaging and whether they have sufficient levels of communication skills and hearing to discuss their needs with a shop assistant and understand the technical information involved. However, these exclusion estimates cannot include the issues of how much the shop assistant knows about the differences between the STBs, what information is available to aid the purchasing decision, what level of understanding the consumer has of their system at home and this type of equipment. These issues suggest that even purchasing an STB is difficult and will affect a greater percentage of the population than estimated here.

¹¹ Data from Clarkson & Keates covered exclusion due to installation only. Percentages relative to total UK population falling within specified age range

Table 3. Nature of exclusion for purchase

Task	Frequency	Level of Importance	Mass Population	Sight	Hearing	Dexterity	Cognitive
Identify stockist and go to shop	Low	High	✗	●	○	◐	◑
Obtain advice from shop assistant	Low	Med	✓	◐	◑	◒	◓
Choose and make purchase	Low	High	✓	◑	◒	◓	●
Transport home	Low	High	✗	◑	○	◐	◑
Overall	Low	High	✗	◐	◑	◒	◓

Key:

Task – individual tasks that are required to complete the purchase properly.

Frequency – how often one has to do each task. Most users will only purchase a set-top box once, so there is a low level of frequency.

Level of importance – how important it is to be able to do each task. If you can't choose a product and get it home, then that has quite a fundamental effect on your ability to watch DTV.

Mass population – how much each task is also a usability challenge for the mass population, rather than just the impaired user.

Sight, hearing, dexterity, cognitive – how much each task affects people with each category of capability loss. The more sectors that are shaded, the more impact.

A secondary concern from the purchasing stage is the impact of an incorrect decision or the lack of understanding of the next steps they will need to consider and undertake. This lack of understanding or purchasing an STB that is not suitable for the user could lead to complaints and returns, potentially with no replacement purchase being made.

Installation

15.1% of the population above 16 years of age will be physically excluded from installing an STB, rising to 48.1% for those over 75.

These levels of exclusion are based on the user being able to complete the steps summarised in Table 4.

Table 4. Nature of exclusion for installation

Task	Frequency	Level of Importance	Mass Population	Sight	Hearing	Dexterity	Cognitive
Unpack STB	Low	High	✘	◐	○	●	◑
Follow instructions	Med	Med	✓	●	○	◑	●
Plan connections	Low	High	✓	●	○	◑	●
Complete connecting up	Low	High	✓	◐	○	●	◑
Overall	Low	High	✓	●	○	◑	◑

Key:

See Table 3

Although installation is a critical phase of use for DTT STBs, it is usually only necessary once. However, despite the low frequency of occurrence, the successful completion of these actions is critical for the user to be able to view the new digital services.

Installation is one of the first interactions the consumer will have with the product and is likely to set the initial impression and 'bond' that they form with the equipment. However, of all the phases of use the consumer is required to face, this is possibly one of the most confusing and challenging. Should the user incorrectly install the box, or should the process appear too complex or unintuitive, there is the danger that it could potentially lead to returns even though there is no technical fault with the STB itself.

Table 4 shows that the main capability difficulties relating to the installation stage of use occur for those with sight and cognitive impairments. Whilst dexterity impairment is also an issue, it is not likely to cause the same level of problems as the other types of impairment.

Installation For The Visually Impaired

Television is primarily a visual medium. As such, it is to be expected that those with visual impairments will experience some level of difficulty during normal viewing. However, for the equipment examined during this study, the installation process did not cater for the needs of such users. Critical

actions, such as reading the instructions, distinguishing between cables and locating the correct ports offered no support for those with visual impairments. These issues are not new, nor are they unique to digital television. Techniques from other products could be implemented here such as: the option of Braille instructions, colour-coding of the cables and respective ports, and instructions provided in different sized fonts.

The Cognitive Demands Of Installation

The greatest difficulties during installation are cognitive, extending beyond those with impairment to people with little experience of, or confidence with, this type of equipment. The difficulties arise in a number of ways:

- The number, type, brand and age of equipment in every home varies, making the set-up more complicated for the user and preventing the manufacturer from being able to supply exact step-by-step instructions for each installation.
- Current instructions that accompany the STBs are not written for the least technical consumers. For example, many instruction sheets make the assumption that most users can correctly interpret a wiring diagram.
- Physically having to connect up equipment round the back of the TV causes difficulties for those with stretch and reach impairments.
- There are a vast number of people in the population with limited technical experience and who are even scared of this level of technology. This leads to a section of the population who will not even attempt the installation themselves whether they are physically capable or not.

These difficulties do not only affect people with diagnosable or age-related cognitive impairments. The less technically literate and confident people in the broader population face the same challenges.

Issues For Those With Dexterity Impairments

During our research, even though people had access to the back of the TV, it was apparent that some respondents had serious difficulties in connecting some of the leads (notably the SCART connector). Given the inaccessibility of the back of the TV in many homes, there would be more problems in a true home environment.

The issues relating to installation, presented above are all cause for concern. However, as will be shown to be the case throughout this study, it is not any one single issue that causes the main problems. It is more the interaction of multiple impairments that have a cumulative impact on the ability of the user to correctly install their STB. Combining all these issues





















leads to a potentially substantial problem above and beyond the estimated 15.1% that are excluded from installing an STB.

7.2.3 Set-up

7.4% of the population above 16 years of age will be excluded from setting-up an STB, rising to 24.8% for those over 75.

These levels of exclusion are based on the user being able to complete the steps summarised in Table 5.

Table 5. Nature of exclusion for set-up

Task	Frequency	Level of Importance	Mass Population	Sight	Hearing	Dexterity	Cognitive
Switch on STB	High	High	✘				
Switch on TV	High	High	✘				
Follow on-screen Instructions	Low	High	✓				
Press "OK" Button	Low	High	✓				
Overall	Med	High	✓				

Key:

See Table 3

The details of the set-up process can vary greatly depending on the STB being installed. Nonetheless generally all the STBs are self installing (i.e. launch a 'wizard' when power is applied for the first time). This has clearly been implemented in order to simplify the process as far as possible, and for this reason has become an industry norm. However, the research carried out in this study has highlighted that even with this simplification, significant proportions of the user base will experience difficulties.

Note that the 'wizard' only launches at first switch-on. The re-scanning at switchover will have to be invoked manually. The instruction books make no mention of this eventuality, however.

Installation For Those With Visual, Dexterity And Hearing Impairments

Once again, we can see from Table 5 that sight is an important requirement for the successful set-up of the STBs examined. Crucial demands include the need to follow the on-screen instructions and to press the 'OK' button to accept the result of the tuning. Through both the expert assessment and user trial phases of the research, these functions have been highlighted as sources of difficulty for a sizeable proportion of society. In addition to causing problems individually, there is a compound effect caused by having to frequently adjust focus between the remote control and the TV screen. In order to correctly complete these tasks, a sufficient level of sight and literacy is required. The visual acuity demanded is affected by numerous aspects of the user interface, including: contrast, font type and size and colour choice.

In addition to visual capability, literacy is crucial to the successful set-up of a typical STB as all on-screen instructions are primarily text based. Whilst this does not in itself impact those users with hearing loss, there is a statistically higher level of illiteracy amongst those users for whom British Sign Language is their first language.

Consequently, this group of viewers may suffer from problems with installation.

Setup As A Cognitive Challenge

The research demonstrates that the primary cause of difficulties is cognitive. Our qualitative research has demonstrated that almost all respondents were unable to recognise when they were required to use the 'OK' button. The concept of confirming a selection to initiate a response was unintuitive to many users who either were not familiar with this type of interaction or just did not relate it to a television. We call this the 'one click or two?' problem. This is a problem that should reduce as a new user becomes more familiar with a system.

7.3 Basic Use

Once the STB has been selected, purchased, installed and set-up, the user is ready to begin viewing the variety of channels, information and features offered through digital television. However, the primary interest will initially be in achieving the same level of functionality from the new equipment as the user has come to expect from analogue TV. For the purposes of this research programme, these have been defined as shown in Figure 8 and have been collectively defined as 'Basic use'.

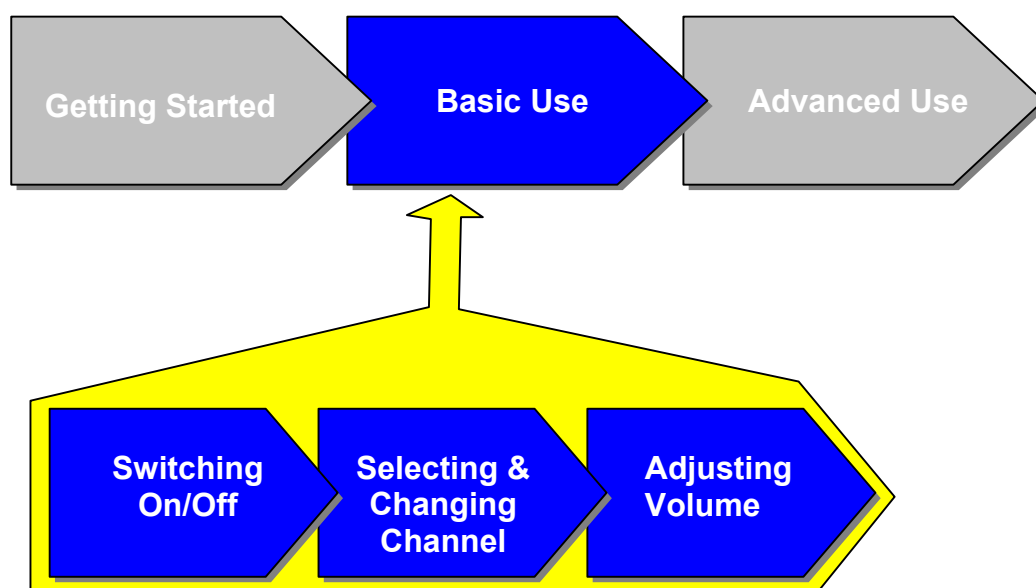


Figure 8: The constituent tasks of 'Basic Use'

7.3.1 Usability Findings

The ITC-sponsored survey into the usability of interactive and digital television conducted by the Department of Psychology at Goldsmiths College, University of London (ITC-UsE: Ease of Use and Knowledge of Digital and Interactive Television: Results¹²) concluded that

Digital and interactive TV received lower perceived ease of use ratings than did the majority of the other 17 products for which ratings of perceived ease of use were obtained; both were in the hardest third of products rated.

The Easy TV 2002 Research Report¹³, also conducted by the Department of Psychology at Goldsmiths College, conducted user trials with the then currently available domestic digital TV receiver equipment. The report identified key ease of use issues associated with the remote control, the on-screen display, the user manual and the services available.

The level of difficulty experienced in using DTV equipment depends partly on the level of functionality being sought. Whilst interactive tasks are, by their

¹² http://www.itc.org.uk/uploads/UsE_report.pdf

¹³ http://www.itc.org.uk/uploads/Easy_TV_2002_Research1.doc

nature, complex, simpler TV viewing may not present so many difficulties. In our Quest survey we attempted to distinguish between simple and more complex functionalities.

The problems experienced in use are shown in Figure 9.

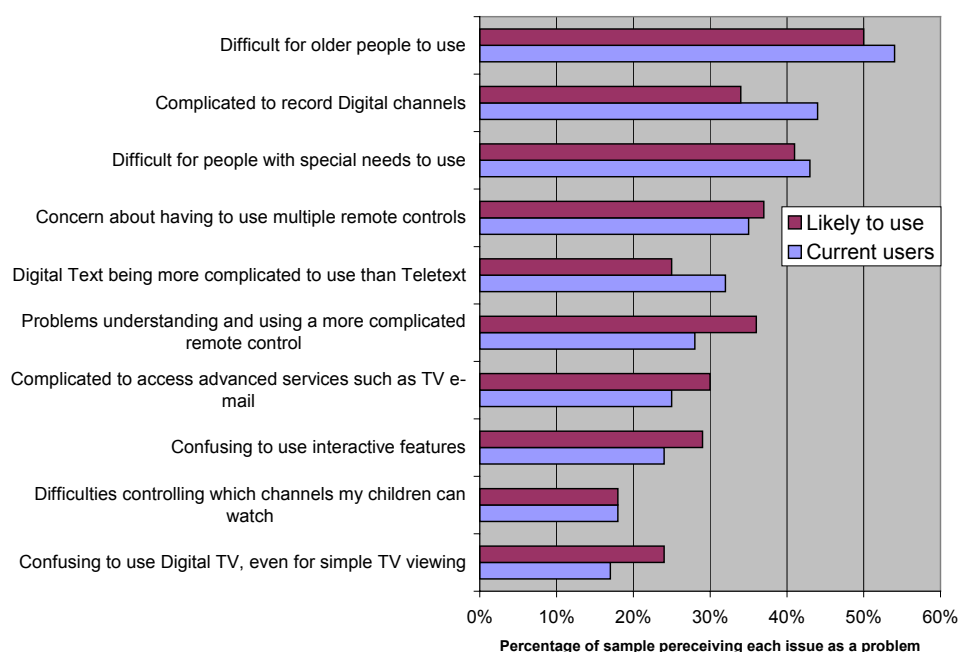


Figure 9. Quest results – problems in-use

We asked whether people found it confusing to use digital TV for simple TV viewing and we found that by and large people found it easier in practice than they thought it would be. Just 18% of respondents reported that digital TV was confusing for simple TV viewing. This result confirms that it is the additional features of digital TV that present the most usability problems and is reassuring that digital TV is not generally believed to be difficult to use on a like-for-like basis with analogue TV.

The problems observed in the observational trials and their implications are represented in Figure 10.

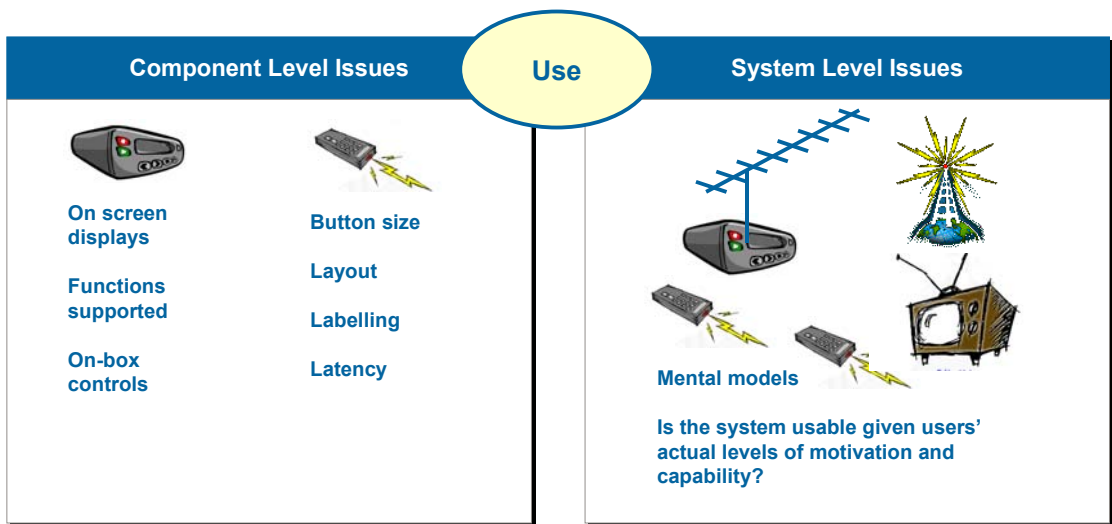


Figure 10. Usability issues in-use

It is apparent from this diagram that there are two categories of problem. The first category of problem is at the component level. At this level, the problems result solely from the operation of one part of the DTV system (e.g. the STB itself, the remote control, the TV). For example, one can look at the set-top box and its attributes, such as on-screen displays, the functions supported, and what controls are (or are not) on the box itself. Similarly, one can look at remote controls, and address issues like the size of the buttons, the feel of the buttons, the layout, the labelling and so on. These are important determinants of usability and there is already quite a lot of work being undertaken within the industry to look at these component level issues.

The system level issues are perhaps more important, but they are more difficult to deal with. These are issues which occur as a result of the interaction between the distinct components of the system. When viewers use a set-top box and a TV, they have to build up a mental model of how that system is operating and how to interact with it. Assessing the products currently on the market, the model of interaction implied seems not to take sufficient account of the level of motivation and capability that people are likely to have. If people think of television as relaxation, they are unlikely to be particularly motivated to get involved in interaction scenarios that they perceive as an uphill struggle.

Two main issues come through from a discussion of mental models. Firstly, users are unable to determine where the hub of the system is. This then leads to functional ambiguities such as where the volume control should live. (Should it be an attribute of the TV receiver or of the set-top box?) As more

complex functionality is put through the system, people have even more difficulty understanding what it is they are trying to interact with and how.

Secondly, there is the interaction process: the 'one click or two?' problem. Current systems occupy a no-man's land between the television paradigm of interaction and the PC paradigm of interaction. In the user trials we found that people would scroll down menus and would get to the option they wanted but that they would not realise intuitively that they had to press OK to make that menu choice actionable. Using a PC, people are quite used to selecting something and clicking on a button; this form of interaction is second nature. But to those people who have not had any experience using PCs, they are trying to interact with digital television using the familiar language of interaction that derives from analogue TV.

A lot can be done to make menus more intuitive to people. There are numerous issues around inconsistency of style, layout and terminology in the set-top box and between the STB and the remote control. By way of example, in one case the menus would highlight with blue on white, then in another menu, the highlight would be white on blue. It is this sort of inconsistency that causes disproportionate levels of confusion. Additionally, digital TV relies far more on the use of coloured ('fasttext') buttons than does analogue TV. This need, along with the visual correlation between the on screen instructions and the remote control must be made clear to the user.

Then there is the issue of people's levels of motivation. This seems to come down to the question of what functions need to be readily available within digital television. There is not much clarity over users' actual hierarchy of needs. Some products will provide a button to execute a particular function, whereas on other products one might have to go through two or three levels of menu to get to the same point. The underlying question for digital television is to what extent is it going to be used in a highly interactive way. One scenario has digital television as a 'lean-back experience': like analogue TV only with more channels and better quality. Another scenario has digital TV as a 'lean-forward experience' in which viewers are interacting with programme content and using the TV to access the internet, interact with government and service providers, and so on. While there are technological possibilities, how the technology will actually be used is still not known.

7.3.2 Accessibility Findings

Figure 11 shows the overall exclusion of a DTT STB for basic use as compared to an analogue TV. 7.1% of the population above 16 years of age will be excluded from basic use of an STB, compared to 2.7 % for analogue.

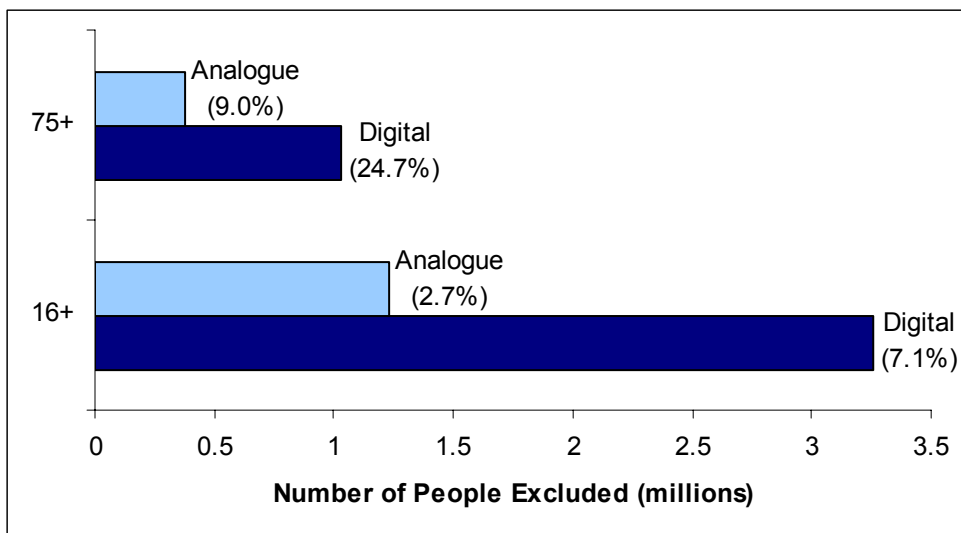


Figure 11. Comparative exclusion of analogue TV and DTT STB for basic use stage¹⁴

'Basic use' includes the simple everyday functions involved in watching television for the average person. For the user to be satisfied with their choice to convert to digital, digital must offer more functionality. However, it is vital that the level of functionality already expected from analogue television is not lost.

Table 6 shows three ways of selecting a channel: using the channel up/down buttons, typing-in a number, and using the EPG. Once again, it is those with visual and cognitive impairments that are most likely to experience problems using DTV for tasks comparable to those familiar from the world of analogue TV. However, here we see a greater emphasis placed on the need for dexterity, primarily due to the increased use of the remote control to navigate through more channels.

¹⁴ Data from Clarkson analysis of exclusion due to channel hopping. Percentages relative to total UK population falling within specified age range

Table 6. Nature of exclusion for basic use. Chart shows comparable functions on both analogue and digital TV

Task	Frequency	Level of Importance	Mass Population	Sight	Hearing	Dexterity	Cognitive
1 Using channel +/- buttons	High	High	✗	◐	○	◐	○
2 Typing in specific channel number	High	High	✗	◐	○	◐	○
3 Entering the EPG	Med	High	✓	◐	○	◐	◐
Understanding navigation method	Med	High	✓	●	○	○	●
Pressing [^] /v buttons to access desired channel	Med	High	✓	◐	○	◐	◐
Pressing "OK" button	Med	High	✓	◐	○	◐	●
Overall	High	High	(✓)	◐	○	◐	◐

Key:

See Table 3

- 1- Changing channel using the channel up/down buttons to access a specific channel
- 2- Changing channel by typing-in a specific channel number
- 3- Changing channel using the EPG to access a specific channel

Adjusting the volume

3.9% of those over 16 years old will have severe difficulty adjusting the volume.

Adjusting volume creates distinct problems for STBs. Some remote controls do include buttons to control the volume. Sometimes, these control a volume function within the STB. Other times they control the TV, but normally only a TV from the same manufacturer. In many cases the remote control for the STB does not offer a practical mechanism by which the user can control the volume of the channel they are watching¹⁵. As a result, the

¹⁵ In some cases, a volume control on a remote can adjust the recording volume, causing consumer confusion and messing-up recordings.

original remote control for the analogue television is required to adjust the volume.

This reliance on the use of two distinct remote controls presents a number of issues:

- It confuses users
- It generates a reliance on the user remembering which remote control to use for which function
- It requires increased visual, cognitive and dextrous capability to correctly use two remotes.

In addition to the effect this will have on those with a variety of capability impairments, it causes irritation and difficulty for the mass population.

Channel Selection

6.5% of the population above 16 years of age will be excluded from simple channel selecting, rising to 23.6% for those over 75.

Selecting a desired channel on digital TV can be done in three ways: by typing in the channel number, by using the arrow up and down keys or by using the Electronic Programme Guide (EPG). However, even in the most basic modes of use, there are differences between analogue TV and digital TV which can be a source of exclusion. This is then further compounded by the introduction of the EPG which has no analogue equivalent.

Visual, Dexterity And Other Physical Impairments

One of the core advantages of Digital TV to the user is the increased number of channels on offer. However, even this most basic of advantages can lead to potential usability problems. With the introduction of more channels comes a greater reliance on use of the remote control. Whilst this may not be cause for concern for many users, for those with dexterity impairments this increased use of the remote will raise a significant barrier to the comfortable use of DTV which may be further heightened by the necessity to enter two or even three digit numbers. If this problem is then combined with the likelihood of the system timing out (i.e. not waiting long enough for the user to press the next button), this can cause serious problems.

Poor remote control design can increase these problems for impaired users even further. In the trials we observed the effects of small or poorly laid out buttons, unintuitive button clustering, inadequate button sensitivity, too

many or too few buttons available, poor colour contrasts, inappropriately small fonts, inconsistent or confusing terminology, and unintuitive icons.

For those with sight loss, the primary problem is one of reading both the screen for on-screen instructions and the remote control to action their desired function. Although these are much the same issues as encountered with analogue TV, the impact is much higher with a Digital system due to the increased frequency of use of the remote control.

The Mental Model and Associated Cognitive Concerns

For those with some level of cognitive impairment, the primary problem is understanding how to navigate the system. This is also the area that is the most conservatively estimated in our analysis because people *without* cognitive impairment are also affected.

For example, with one of our set top boxes it had both an 'STB mode' button and a 'TV mode' button, but without the functionality to control the TV we were using. Therefore if the TV mode button were pressed it would toggle the remote control away from being able to control the STB. However, from the user's point of view, and without a TV to control, the remote control appeared not to function at all from that point on until the 'STB mode' button was pressed. There was no indication of which state the remote control was in to help the user make sense of what was happening.

Another category of problem stemmed from the system behaving unpredictably from a user's standpoint. When users press a button, they expect to complete a certain function or be taken to a certain destination in the menu structure. If they find themselves in an unexpected and perhaps unfamiliar location, then they become confused. Older users expressed concern that their button presses could break the equipment. The combination of confusion and fear of damaging the equipment led on some occasions to self-doubt and hesitancy in using the functionality available.

Once the EPG is selected (which in itself can cause problems), the user is faced with an on screen menu that he or she has to interpret. If successfully interpreted, they have to understand how to scroll through the system and comprehend how to select the channel they desire. On some STBs the mechanism by which the user scrolls through the list of channels can be different, with some offering the option of a 'page up' and 'page down' function to jump a number of channels at a time. This can cause further confusion for the unfamiliar user.

On-screen menus in general are not familiar to all of the population, with many problems being seen at the most basic level of entering and exiting these parts of the system. Having been derived from the PC world, this

interface may be so unfamiliar for some that they would not even attempt to understand and use this part of the service.

These primary usability issues are further compounded by the fact that, for a number of users, there is a lack of understanding of how a remote control operates. Traditionally consumers are used to pointing the remote control at the screen of the television and the television then responding to their commands. However, in the case of an STB, the remote control must be directed towards the box that drives the television. In this case the direction in which the remote control is pointed will depend upon the relative positioning of the STB and the TV.

As mentioned previously, the issue of the system timing-out before the user has completed their interaction is a very real one. However, this is not just due to dexterity issues. It also relies upon an understanding of how the system operates. For example, if channel 40 is desired, the user presses '4', however before they have time to input the '0' the channel has changed to channel 4. Conversely for an able bodied user, if they input 40 and it takes an unexpected amount of time to register and change the channel they may attempt to input the number again and also end up on channel 4. Therefore, in setting the length of this delay, manufacturers must take account not only of the dexterity of the user, but of their level of understanding and expectations of the system.

7.4 Advanced Use

'Advanced Use' is defined as those functions and features of digital television that are either unique to the new system or in the analogue equipment can be considered to be infrequently used (or used by relatively few people). These include:

- Digital Text (BBCi Text, FourText, Teletext etc)
- Interactive TV (BBC1 Sport, Interactive game shows etc)
- Subtitles
- Favourites
- Re-scanning etc.

Some aspects of these advanced features are complicated and can be the cause of confusion in the mind of not only the novice user, but also the expert user to whom the particular service is familiar. One such aspect is the difference between analogue teletext, digital Teletext, digital text, and interactive services. Because they cause some confusion, we have explained the different services below:

- **Analogue teletext.** Since the mid-70s, text-based information has been broadcast as part of analogue television transmissions according to the international teletext standard. The teletext pages are broadcast in a hidden part of the television signal and decoded by the television. The pages are accessed using the 'Text' button on the TV remote control and navigated by keying-in a 3-digit number.

The teletext service on the BBC channels is provided by Ceefax, part of BBC News and Current Affairs. The service broadcast on analogue ITV, Channel 4 and Five is branded as 'Teletext'. The service is operated by a separate company, Teletext Ltd¹⁶.

- **Digital teletext.** While from a viewer's perspective, the digital platform also provides "teletext", the mechanism is entirely different. On DTV in the UK, "Teletext" is a service provided by Teletext Ltd, not a generic standard for presentation of information as it is on analogue TV. "Teletext" as it exists on UK DTV is a discrete channel that broadcasts text-based information. There are at least one other separate channel - FourText - that also broadcasts solely text-based information on UK DTV.
- **Digital text.** In addition to text-only channels described above, DTV channels can broadcast text alongside vision and audio¹⁷. One example of this is the BBCi service. Although the nature of this service may vary by platform, the norm is for the services to be accessed by pressing either the red button or the 'text' button on the remote control. The service that is activated with the red button varies according to channel being viewed at the time. There is no fixed navigation structure or layout as with the analogue teletext standard. Currently, Freeview allows access to channels offering a multitude of these services in different combinations (TV channels with text services, TV channels without text services, radio stations and text-only channels).
- **Interactive services.** One of the advanced features of digital television is the interactive programming capability offered by the technology. The level (or even existence) of interactivity depends not only upon the channel being viewed, but the programme being watched. Examples of interactive services would be the ability of the user to choose which court to watch at *Wimbledon*, or to play the game *Who Wants to be a Millionaire?* as the show progresses. When a programme is being broadcast with interactive content, pressing the red button will bring up this content in preference to any digital text service also broadcast by that channel (e.g. BBCi).

¹⁶ www.teletext.co.uk

¹⁷ The digital teletext services described above are in fact just a special case of the general ability to transmit text alongside vision and audio in which the vision and audio are absent. The DTV radio channels have the vision and text absent.

This sort of interactive service does not use a return path from the viewer to the broadcaster. A further, and more truly interactive, form of service can be provided if a return path is present. Such a return path can be provided over the telephone or cable network. At present, DTT does not support this sort of truly interactive television.

7.4.1 Usability Findings

The problems surveyed in the Quest survey are shown in Figure 9. As would be expected, the more advanced features such as digital text are perceived as more difficult than the basic ones.

There are two particular areas of concern when evaluated on a like-for-like basis.

- The first is Digital Text. Digital Text services are found to be more complicated to use in practice than their analogue equivalent (based on the teletext standard).
- The second is recording. The chart shows that recording digital channels is found to be more difficult in practice than people think. Taken together with the finding in Figure 6 that connecting up the VCR is considered to be a problem, it is clear that recording programmes presents as yet unsolved problems.

7.4.2 Accessibility Findings

8.7% of the population above 16 years of age will be excluded from using advanced services, rising to 27.9% for those over 75.

Figure 12 shows the overall exclusion of advanced use of a DTT STB as compared to an analogue TV. 8.7% of the population above 16 years of age will be excluded from advanced use, compared to 5.1% for analogue.

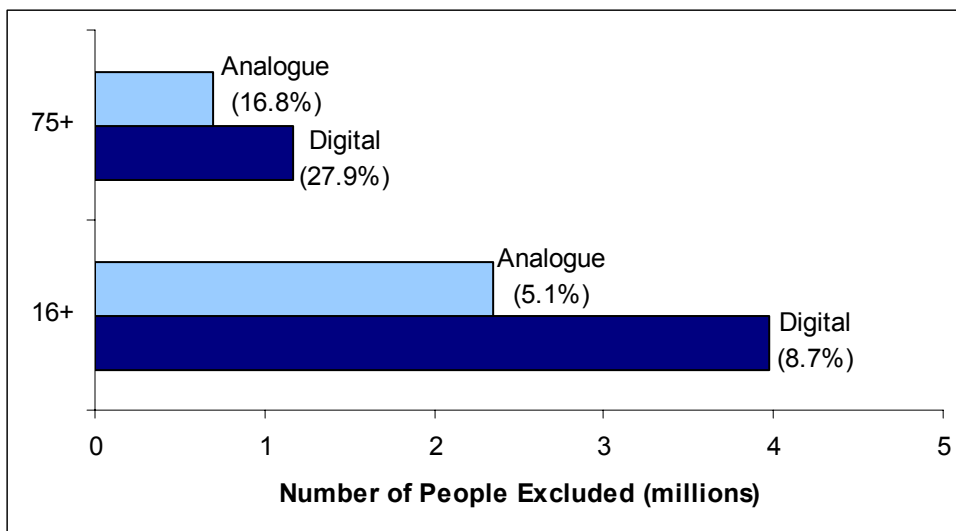


Figure 12. Comparative exclusion of analogue TV and DTT STB for advanced use¹⁸

Interactive services are an extra benefit of DTV above and beyond the increased number of channels and the improved sound and vision. However, these high functionality features and services also require greater levels of capability to achieve. Typical advanced functions and their exclusion are shown in Table 7.

¹⁸ Data from Clarkson & Keates covered exclusion due to use to analogue teletext and novice use of digital interactive TV services. Percentages relative to total UK population falling within specified age range

Table 7. Nature of exclusion for advanced use. Chart shows typical functions on digital TV

Task	Frequency	Level of Importance	Mass Population	Sight	Hearing	Dexterity	Cognitive
Altering Set-up	Low	High	✓	●	○	◐	●
Using the RED Button	Med	High	✓	◐	○	◐	◐
Reading / Interpreting the Interactive Content	Med	Med	✓	●	○	○	●
Navigating	Med	Med	✓	●	○	◐	●
Using the "OK" Button	Med	Med	✓	◐	○	◐	●
Exiting Interactive Services	Med	High	✓	●	○	◐	●
Overall	Med	High	✓	●	○	◐	●

Key:

See Table 3

Although the resultant demands and hence capability requirements are higher, it has been found that the underlying cause of these demands on users are the same challenges and issues as those faced with more basic use of the system.

Examples of the services and their demands include:

- Teletext. For people who are used to the analogue implementation of teletext, the DTV equivalents are unfamiliar and confusing.
- Subtitles. Access to subtitles varies widely amongst STBs. On some systems subtitling has a dedicated button on the remote control. On others the user is required to navigate numerous levels of menu and submenu. This access mechanism then defines how easy it is for the user to toggle subtitles on and off at will. On certain systems subtitles need to be activated whenever the channel is changed, or they can even conflict with the EPG. (Currently, subtitles cannot be run simultaneously with any other MHEG function.) This functionality therefore also presents

the typical cognitive and dexterity issues encountered throughout interaction with the rest of the system.

Whilst we have found that these advanced services in themselves do not present new issues, if advanced services are going to play a major part in the future of Digital TV, then these levels of exclusion are not only conservative, but will also be increasing as the complexity of the content being provided over this medium increases. In certain circumstances this increased complexity and thus capability demand may be justified in terms of the benefits provided. This is the case for accessibility services such as audio description or closed caption signing¹⁹.

¹⁹ Closed captioning is optional subtitling; open captioning is always on

8 USABILITY AND ACCESSIBILITY FOR THOSE WITH IMPAIRMENTS

8.1 Introduction

The usability problems identified by our research will affect all users across the population to varying extents. For those with sensory, motor and cognitive impairments, the effect will simply be more significant. Each usability problem will also affect people with different types of impairment to different degrees. During product selection and purchasing it is therefore vital that consumers with any type of impairment can be informed as to which piece of equipment is designed most appropriately for their specific range of needs. Each capability type has different needs and each STB manufacturer has taken a different design approach to the functionality that their STB provides. If the STB is not well matched to a user's particular needs, there will be a high likelihood of usability and accessibility problems.

Work is being carried out by the Digital Television Group (DTG) on access technologies for deaf, hard of hearing, blind and visually impaired people. Access technologies include audio description, subtitling and signing. We have not therefore covered access technologies in any depth in this report.

During the three stages of use, namely getting started, basic use and advanced use, there are a number of issues that specifically affect the different impairments. These are described in the sections below.

8.2 Visual Impairment

Many of the usability issues observed in our research have a significant impact on blind and visually impaired people. When compared with analogue TV, digital TV offers many more channels and many more functions. This means that users have to deal with more on-screen instructions and more buttons on the remote control. Many users will be unable to memorise all the necessary control sequences, which implies a need for more frequent and rapid switching between short-range vision (for the remote control) and medium range vision (for the screen). This may require some people to continually change their glasses, which is inconvenient and time-consuming. This constitutes a serious usability problem for elderly people, or others, who have two sets of glasses.

In addition, many usability problems which affect analogue TV also affect digital TV, but more severely. For example:

- **Printed instructions and user manuals, etc** – Printed instruction materials supplied with analogue TV are very variable in quality and readability. Given the greater functionality and complexity of digital TV, and hence the greater need for clear written instructions, the consequences of any readability deficiencies will be more severe.
- **Recognising and locating buttons on the remote control** - The remote controls for digital TV are similar in size to those for analogue TV, and in each case visually impaired users can encounter problems of readability of the text labels and icons used to indicate the functions of the buttons. However with Digital TV there are potentially more buttons on the remote, more dedicated buttons to use and more operations to remember. Therefore there will be a greater reliance on sight to recognise and locate the appropriate buttons. This implies that the means by which the functionality of the buttons is conveyed to the user is increasingly important.
- **Reading the on-screen display** – Many users of analogue TV are unfamiliar with the use of on-screen displays. With digital TV, their use is often mandatory, so there is a consequent increase in the need to read information on the screen. If a user cannot easily read the information on screen, then the wrong button may be pressed in response, or the user may find him- or herself in an unintended location.

All these factors indicate that visual impairment is more likely to cause usability problems with digital TV than with analogue TV.

8.3 Hearing Impairment

In general, hearing impairment does not affect a user's ability to interact with digital TV and to navigate through the system. However, other accessibility difficulties can arise for those with impaired hearing.

- **Subtitles** - Access to subtitles is particularly important and therefore needs to be easily achieved. The RNID suggests that accessing subtitles should be as easy as adjusting the sound volume, implying that users should be able to toggle the subtitles on and off with one button. In addition, it is also important to have them remain on the screen when the channel is changed. With some STBs, the control of subtitles is buried within complex menu structures, while others have a dedicated subtitle button. It is therefore important for those who need subtitles to know which STBs provide them most easily. The speed of subtitling can also be a problem with current STBs.
- **Volume** - The facility to adjust volume is extremely important to those with hearing difficulties. Some STBs do not support volume control on their remote controls, which makes this facility less accessible.

- **Literacy** – Literacy difficulties face some deaf people for whom English is their second language (typically prelingually deaf people for whom British Sign Language is their first language). Using digital TV to the full, which includes using the EPG and interactive functionality, places an increased demand on the ability to read. Hence people with a low level of literacy are likely to experience accessibility problems.

8.4 Dexterity Impairment

Digital TV generally requires more use of the remote control than analogue TV. Therefore, any dexterity-related problems that people already have with analogue TV will be more exclusionary with DTV. The additional exclusion is one of degree, rather than of kind, just as it was in the case of visual impairment (see Section 8.2 above).

Factors such as button size and height, compactness of button layout, location of specific buttons etc can all affect the usability of the remote control and hence of the DTV system as a whole. A number of specific issues were identified during our user trials:

- **Button sensitivity** – Digital TV places a greater reliance on scrolling through channels or menus. A common difficulty experienced is ‘overshooting’, i.e. the user missing their choice and running past on to a subsequent option. This was due to many aspects including location and size of the button, but predominantly resulted from the sensitivity of the button.
- **Compact layout** – Remote controls for digital TV often include more buttons, and buttons located in clusters for related functions such as scrolling. As a result, a common difficulty was pressing more than one button when only one was intended.
- **Remote Control Complexity** – There is a trade-off between providing a dedicated button for a function and adding more buttons to the remote control, not only in cost but also in the perceived complexity of the remote control from the user’s point of view. Our research showed that a significant proportion of the user’s time could be spent searching for specific dedicated buttons, but also that embedding functions in complex menu structures also has many disadvantages. While different remote controls embody different trade-offs, the trade-offs are not always working to the benefit of people with impairments.

8.5 Cognitive Impairment

Understanding how to interact with digital TV is undoubtedly more complex for the user than with analogue TV. For example, in general more control

steps are needed to achieve the same end result, such as watching a TV programme. This is one of several factors which indicate that a different mental model is involved in interacting with digital TV. The mental model for analogue TV is simple, intuitive and even ingrained in most people, but that for Digital TV has moved from the traditional TV interaction paradigms towards a model much closer to that of the personal computer (PC).

Our research has shown that digital TV makes many specific and challenging demands on the user's cognitive ability. For example -

- Understanding how the STB interacts with existing "legacy" equipment in the home.
- Realising that there can be time delays between cause and effect, which can cause confusion and affect the user's confidence, potentially leading to greater difficulties.
- Understanding the way in which elements of the on-screen display are intended to correspond to the buttons on the remote control. This was a source of confusion for many people. Some picked up on the wrong clues and made incorrect associations between the two interfaces.²⁰
- The need for literacy is also greater for DTV.

The usability problems outlined above are important barriers to those with impairments, but they also affect the broader population. In particular, the cognitive issues associated with the modified mental model which applies to digital TV mean that it is not only those with learning disabilities who may find the type of interaction required with Digital TV difficult. It is likely that people who have limited confidence or who are simply not experienced with technology of this type will also have difficulties in interacting with digital TV.

²⁰ For example, the interaction between on-screen commands and the coloured "Fasttext" buttons on the remote controller caused confusion for users during the user trial. Many users incorrectly inferred a link between the colour of text on the screen and a button of the same colour on the remote control, rather than the button instructed on the screen.

9 IMPROVING USABILITY AND ACCESSIBILITY

9.1 Classification of solutions

This chapter is about solutions.

Because we have looked at usability and accessibility from several perspectives, we have uncovered over 60 problems, potential problems or issues. We have considered the potential solutions to all of these. Rather than produce an unmanageable list of over 60 solutions, we have looked for natural 'clusters' for the solutions. These are:

- 1 Improving awareness of DTV
- 2 Improving the purchase process
- 3 Improving instructions for installation and use
- 4 Improving equipment functionality and performance
- 5 Improving system interaction design
- 6 Improving remote control design
- 7 Improving interaction design for broadcast content
- 8 Addressing STB-specific problems
- 9 Providing one-to-one support.

The full list of problems and their relationship to the solution clusters is shown in Appendix F.

The following sections summarise the problems addressed by each solution cluster and discuss the possible solutions. These are then crystallised into a set of recommendations. The recommendations are brought together in Chapter 10.

9.2 Improving Awareness and Understanding Of DTV

9.2.1 Problems and Issues

The level of awareness and pre-existing knowledge that a user has regarding digital TV lies at the heart of many of the usability problems that this study has identified. To avoid disappointment and problems during use, it is important that users' expectations are set correctly and that they are able to be sure of making the right purchasing decision.

In order for the consumer to make an informed decision, they must understand what the benefits of DTV are for them. At a basic level this is likely to relate to the content and programming, quality and selection. However, there are also more specific benefits that may meet the needs of individual users. For example, clearer subtitles, access to Audio Description services and provision of more text-based factual information.

The components that comprise a home entertainment centre vary markedly for each user. For some this may comprise just a stand alone TV, whilst for others it may include a surround sound DVD home cinema with both DVD and VCR. So that the consumer can be sure of selecting the most appropriate STB, they must be able to understand the level of connectivity and compatibility offered by each box.

The decisions made by the consumer at purchase will have an impact on their viewing experience for the life of the product. It is therefore important that the ongoing implications of the decisions regarding compatibility, functionality and features at the time of purchase are clear.

9.2.2 Potential Solutions

Despite recent increased publicity and general awareness of DTV, it is likely that a continued campaign will be necessary to maintain and further drive public awareness of DTV. To some extent natural market forces will promote DTV through advertising and the release of new products and services. Under normal circumstances this would form the main force driving the market. In order to accelerate market growth it is likely that government or other independent body would have to step in to drive increased awareness of DTV and address the concerns and perceptions that people already have. This may involve information campaigns beyond the current advertising for Freeview and the new BBC channels.

9.2.3 Recommendation

- For people to acquire the right products and then use them effectively, they need a baseline understanding of DTV and how it could be used in their homes, and they also need to be 'intelligent customers' for DTV equipment. Government and industry should consider running information campaigns as distinct from the current commercial promotion of DTV. Possibilities include a telephone call centre, roadshows, advice desks in public libraries or shopping centres, Webwise centres. and UK Online Centres.

9.3 Improving The Purchase Process

9.3.1 Problems and Issues

To prevent any usability difficulties or even accessibility problems during use it is imperative that the user purchases the equipment which is most suited to their requirements. However, a fundamental problem of DTV is that customers are not always able to easily obtain a good understanding of the products and their capabilities before purchase. The consumer needs to understand many factors at the point of purchase. The following are some that were illustrated within our research:

- Knowledge of the benefits of DTV and the differences between the products on the market.
- Compatibility of the available STBs with the home entertainment equipment a consumer already has in their home.
- An appreciation of the ramifications of switching to DTV beyond the pros and cons of each product. These include potential reception difficulties and how these may be solved and the types of functionality that different items of equipment offer and how such equipment should be used.
- Suitability for specific impairments.

Currently these factors are not completely taken into account by consumers, leading to detrimental consequences such as the high level of returns.

The retailing process does not help:

- Where STBs are displayed in the shop the remote control is normally not on display. This means that an important determinant of usability is not apparent to customers.
- Customers may not know much about the equipment they already have (eg model numbers) and sales staff are unlikely to be able to offer much expertise in helping customers to make good purchasing decisions.

9.3.2 Potential Solutions

There are currently initiatives by retailers to provide more support at the point of purchase; a good example of this is Dixons' computer-aided support. However, this effort is targeting the problems as they happen post-purchase. Ideally, this level of training and expertise should be focused earlier as a preventative measure at the point of purchase.

There are ways in which shoppers could be provided with better pre-purchase information:

- Product packaging could provide clearer indication of the product features and differences – particularly *vis-à-vis* impaired users.
- Remote controls could be visible through the product packaging, represented visually on the packaging, made tangible through cardboard dummies or put out on display.
- Retail staff could be better trained to ask the right questions of customers and direct them to appropriate products.

9.3.3 Recommendations

- To help customers select the right DTV equipment for their needs, retailers should consider developing computer-based purchasing support. This could be web-based for customers or PC-based for retail staff in-store. Such support should as far as possible be consistent across retailers.
- Retailers should consider developing a training package for retail staff, perhaps along with accreditation.
- The Digital Television Project should consider ways of helping organisations such as RNIB, the RNID, the Consumers Association or the DTG to identify and then list products that are suitable for use for people with particular disabilities.
- Remote controls could be visible through the product packaging, represented visually on the packaging, made tangible through cardboard dummies or even put out on display.
- The Digital Television Project should keep the information on packaging under review, but product evolution and the need for differentiation in an increasingly crowded market should improve the information provided on packaging without the need for intervention.
- As switchover nears, it may be necessary for the Digital Television Project to look again at whether the ways in which consumers purchase DTV equipment is effective in ensuring that they obtain appropriate products for their circumstances

9.4 Improving Instructions For Installation And Use

9.4.1 Problems and Issues

The instructions supplied with STBs provide two sorts of information: information on installation and information on the use of DTV. Due to the complexity of DTV interaction comprehensive and legible instructions are important. The format and clarity of instructions is crucially important for impaired users.

The need for instructions on installation only applies to DTT STBs and IDTVs, as satellite and cable equipment is professionally installed. Self installation of STBs (and IDTVs to a lesser extent) causes difficulty for a sizeable number of consumers. This leads to a considerable reliance on the instructions in the first instance. Clarity of the instructions is critical, as well as the need to supply the information required by the consumer, i.e. how the STB may interact with the equipment options in the home.

Most instruction booklets do not address the need to re-scan at digital switchover.

9.4.2 Potential Solutions

There are many incremental solutions that manufacturers are likely to develop to improve the legibility and clarity of instructions. These improvements are likely to be driven through product evolution and an increasing understanding of the consumer difficulties, i.e. the choice of text based or diagrammatic instructions, more complete troubleshooting information, etc.

However the higher level issue of the types, age, and configurations of equipment people have in their home and how the STB interfaces with them is a more significant challenge that is unlikely to be addressed through natural market forces alone.

It may be necessary to provide additional instruction manuals to supplement the information already provided. These could better describe how to cope with different home installation scenarios.

9.4.3 Recommendations

- Manufacturers and retailers should review current instruction manuals and should consider the possibility of including additional supplementary information on a range of home connectivity scenarios. Alternatively, such information might not have to be provided in the manuals if it were available elsewhere (at retailers, or on the web). Video-based instructions (on a DVD/VHS, for example) could also be used²¹.
- Manufacturers should ensure that their instruction manuals address digital switchover specifically. Some people will need to re-tune their equipment but, unlike the initial tuning, this will not happen automatically.

9.5 Improving Equipment Functionality & Performance

9.5.1 Problems and Issues

Variations in functionality

Whilst the majority of STBs available enable access to the full range of services available on that platform, the level of functionality not directly related to content can vary widely between boxes. These variations in functionality would typically include:

- Limitations in the way the STB interacts with other equipment in the home
- Cables included with the STB at purchase
- Advanced accessibility services
- The way in which the box responds to input from the user.

If home entertainment equipment is to operate as the user expects, suitable levels of interaction between an STB and the associated items of equipment already in the home must be provided for. Achieving this is largely dependent on the connections available on the STB: the number of SCART sockets, availability of audio out sockets and RF loop through).

²¹ Task 5.1.8 in the DTAP will produce new interconnection guidelines

Recording

The subject of recording of digital TV is a problem that has attracted much attention in the industry and among consumers. So far, no clear and easy solution has been identified. Fundamentally, two tuners are required, such as in one newly launched Personal Video Recorder (PVR).

However, these are new products and it is expected to take some time before they become practical, mass-market solutions. Currently, if the user wishes to record one channel whilst watching another, they would need two STBs (one controlling the TV and one for the VCR). Even if the user is willing to be limited to being able to record only the channel being watched, there are complications should they wish to use the timer functionality on their VCR (as the VCR is not able to control which channel the STB decodes). Ideally, the EPG needs to be able to drive the VCR. Of the STBs investigated for this study, many attempted to address this by providing a timer function in the STB itself. This function allows the user to set the STB to change to the relevant channel at the relevant time for the VCR. Although this does work, it means that the user now has to set two timers to coincide. With approximately 88.1% of UK households owning a VCR²², the limitations of recording from DTV presented by today's equipment are severe and must be addressed.

Subtitling

Despite some of the functional limitations presented by DTV STBs today, the move to digital is able to provide new functionality to those users that have traditionally experienced problems viewing analogue TV. Of these, the most notable are subtitles, audio description and the potential for closed caption signing. Subtitles are an established part of television. DTV is able to enhance the subtitling services available to the user, but consideration must be made of crucial aspects of how to access and control the service. Whilst audio description is still in its infancy, the nature of the product has been defined and content is broadcast with existing programmes. However, to access audio description services, the user must currently use an adaptor module plugged in to a Common Interface port on an STB. This requires the user to own an STB suitably equipped with Common Interface, of which there are few currently on the market, and the audio description modules themselves are not yet commercially available²³.

²² Mintel, Audio Visual Retailing, Retail Intelligence, Feb 2002

²³ Only one STB currently has a Common Interface port for an audio description module. Other STBs and some IDTVs have CI ports but do not have the right software configuration to support the audio description module

Remote controls

With only a few exceptions, the use of an STB to deliver digital TV services to the user requires the use of the normal TV remote control to be supplemented with an additional STB remote. Whilst this adds functionality to the system, it also adds confusion for the user. Many manufacturers attempt to resolve this by offering TV control (power and volume) from their STB remotes. Unfortunately, these buttons sometimes only work with that manufacturer's TVs.

The way in which the STB responds to inputs from the user is also an area of concern. Whilst it is necessary for the system to wait for input sequences (i.e. entering a two digit channel number) to be completed, the length of this delay cannot be optimised for all users.

Performance

While most of these issues are related to the functionality of the boxes, there may also be some problems related to the performance of the STBs currently in the marketplace. As interactive content and digital text become more complex, the demands placed on the box in terms of processing capability, speed of response and memory will vastly increase. While technological advances should ensure that new boxes become ever more capable, it is important not to lose sight of the fact that services must always be backwards compatible if sales today are to prepare the population for full switchover by 2010.

Inherent functionality of an STB is therefore about more than just the reception and display of the core digital TV services. It is crucial that the consumer understands both the functionality that they need in order for the system to meet their demand and the relative functionalities of the boxes from which they choose.

9.5.2 Potential Solutions

Many of the functionality and performance problems described here can be expected to be addressed through competition and normal market dynamics. The majority of these problems stem from one component in the system (the STB) and we can expect the drive to differentiate and successfully compete will lead manufacturers to address the usability issues that are important to the consumer. However, some issues (particularly recording) are both critical for switchover and complex enough to require co-operation by many stakeholders. In these cases it is likely that some level of guidance and co-ordination will be necessary to find a timely solution.

9.5.3 Recommendation

- All stakeholders should recognise that the problem of VCRs and programme recording is a critical one for digital switchover and the ongoing usability of DTV. Continued efforts should be made to find a simple, convenient and affordable solution.

9.6 Improving System Interaction Design

9.6.1 Problems and Issues

These problems concern the way in which users are expected to interact with DTV equipment. All of the equipment examined as part of this study uses a combination of remote controls and on screen displays to provide user interaction. However, users were observed having difficulties understanding how to scroll and navigate, recognising when an item is highlighted and knowing that it is necessary to press 'OK' to access one's highlighted chosen item. ('One click or two?') Because the grammar of this type of interaction is based on that of personal computers and is similar to that of mobile phones, people who have never used these products are at a disadvantage in being able to understand how to interact.

The result is that some users without experience of personal computers are confused by, or even unable to use, almost every aspect of digital TV.

Several design flaws compounded this basic problem in our trials. Inconsistent terminology between remote controls and on screen displays was commonplace, leading to further confusion. Users needed to study both the screen and the remote control to continue.

Of the more common interactions, some could only be accessed through the menus, requiring a disproportionate level of effort relative to their likely frequency of use. On some boxes, this was particularly the case for interactions such as accessing subtitles. Generally, there appears to be no accepted hierarchy of use for the different functions, nor does there appear to be a recognised hierarchy of needs for the user.

The lack of immediate feedback after a key press caused confusion, as all of the boxes examined exhibited a delay between the user's action and the system's reaction (or recognition of the input). This causes problems in two dimensions. For those users who have dexterity impairments or are not familiar with the system, the delay can be too short. This would result in the system responding before the input is complete. For those who are

familiar with the system, the delay may prove to be annoying or (worse) may lead to the conclusion that the input has not been recognised.

The Electronic Programme Guide (EPG) presented numerous problems to users. Whilst the navigation problems already described clearly also apply to this part of the interface, many users were confused by the inclusion of a 'page up / down' function to allow faster scrolling. Many users in the trials experienced difficulty in entering and exiting the guide as well as in understanding what to do once the EPG was active.

More advanced functionalities (such as using interactive or digital text services) merely exacerbated these types of problem. The function of the 'Red button' was poorly understood in the context of user interaction.

9.6.2 Potential Solutions

The work currently being undertaken by the Technology and Equipment Group on remote controls and on-screen displays can act as a starting point for dealing with these types of issue. But whereas TEG has been successful to date in creating guidance for these aspects *separately*, there is a need for a similar initiative looking at improving interaction design across the components of the system in a more *integrated* way.

Due to the range of impairments that these systems are required to cater for, there is unlikely to be a single set of ideal solutions. Therefore, the potential for customisation of the STB should be considered.

9.6.3 Recommendations

- TEG, or a similar industry group such as DTG, should address system interaction design in an integrated way, aiming for the creation and dissemination of a design checklist or best practice guide
- The potential for customising the user interface for impaired users should be investigated within this activity. There is a trade-off between allowing customisation, and confusing the user with too much choice of set-up parameters. The functionality should be there, but "hidden", so that it does not add to the immediate complexity for the average user.

9.7 Remote Control Design Problems

9.7.1 Problems and Issues

The problems of remote controls include ergonomics, nomenclature and the size and colour of buttons. These are problems that are inherent for all remote controls regardless of the equipment they are interfacing with. These issues have also been explored specifically for DTV within previous studies completed by the ITC and Goldsmiths College. However one issue that was observed in our research, that has not been mentioned previously, is the difficulty with opening the battery cover on one model. This is not an insignificant problem as most remote controls require the battery to be inserted by the user before first use.

9.7.2 Potential Solutions

TEG is addressing the field of remote control design as part of the DTAP. The scope of this work may want to be reviewed in light of the findings from this study. However, the extent to which the design checklist is followed in practice depends on the commercial realities of remote control design. There is a need for greater incentives here.

One direction in which this could progress would be through the availability of suitable additional remote controls for purchase at the point of sale. Industry should co-operate to make this possible. Industry could share remote codes, and reintroduce a remote code database, which should be held by a neutral third party organisation such as the DTG.

9.7.3 Recommendations

- The scope of the TEG design checklist should be reviewed in the light of this report and its supporting appendices before being disseminated as an industry reference source.
- To encourage the innovation and commercial development of alternative remote controls suitable for users with impairments, manufacturers should work to enable greater access to their infrared remote control codes.

9.8 Improving Interaction Design For Broadcast Content

9.8.1 Problems and Issues

The problems highlighted here are analogous to those of system interaction design (section 9.6). Whereas Section 9.6 concerned the interactions that are governed by the equipment, this section concerns interactions that are governed by the content provider or broadcaster. For example, in the case of digital text, the content provider or broadcaster and not the STB manufacturer controls the interface with the user.

Interactive programming and digital text services are major step changes in the move from analogue to digital TV. Whilst users may be familiar with analogue teletext, there is often confusion regarding their digital equivalents. Users do not find it intuitive to have to view a specific channel to access some digital text services (i.e. channel 9 for Teletext). Even once there, many users have exhibited problems in using these services. These difficulties have primarily arisen due to the reliance by these services on a PC-like navigation and operational model. The concept of 'select and click' operations, reliance on the red button and even menu structures is unfamiliar to many.

As with many analogue teletext services, digital text relies on the use of four coloured buttons on the remote control. Unfortunately, there is no standardisation across channels and content providers as to the basic operations and terminology that should be applied to these. There has, however, been some progress already made within the scope of the DTAP.

The design of the user interface is in the domain of the content provider. However, it is a crucial factor in the user's experience of these interactive services. As such, every effort must be made to ensure consistency of terminology, labelling and location of both physical buttons and on screen commands.

9.8.2 Potential Solutions

The successful development of digital text and interactive services relies on the provision of well-designed applications and consistent STB controls. Only if the two are aligned can the confusion being experienced by the user be solved. However, this would rely upon consistent development practices by content providers and similarly consistent development by STB manufacturers. These efforts must also be transparent along the value chain to ensure complete adoption. It is not likely that this level of co-operation

will occur in the short term through natural market dynamics. Therefore, it is thought likely that the process must be driven by an industry group such as DTG.

9.8.3 Recommendations

- TEG, or a similar industry group such as DTG, should address interaction design for broadcast non-sound and vision content in an integrated way, aiming for a guidance note or code of practice which can be disseminated as an industry reference source.
- This activity should be integrated with the analogous activity for system interaction design.

9.9 Addressing STB-specific Problems

9.9.1 Problems and Issues

Set top boxes are a low-cost solution to aid the timely transition from analogue to digital TV. However, the use of an STB to convert existing analogue sets brings its own complexities and usability problems.

The necessity to manually connect the STB to the TV and other equipment in the home raises installation issues for many users. Not least of these is the need for the consumer to take account of all of the equipment that they wish to use with the STB and the likely equipment configuration when initially choosing the box.

Furthermore, as the STB is simply an adapter, it is limited in its ability to communicate with and control other components of the system (i.e. the TV). Some attempts have been made to address this issue through the introduction of Pin 8 functionality on the SCART cable etc, but these solutions can, in themselves, cause problems.

The STB has been a low cost device. In order to achieve the price points at which they can be accessible to the mass market, the development costs and levels of functionality have been kept low. An example of this is the very limited control over the box that is possible should the remote control be lost.

In general, the use of an STB type solution causes many users to become confused as to the location of the 'hub of the system'. In the analogue TV usage scenario the user is clear that the TV forms the heart of their home

entertainment centre, with an STB in the system this is no longer the case. In time, it may be that a different model emerges in which television equipment is more like hi-fi in being composed of separate elements which may be replaced individually according to different time-scales.

9.9.2 Potential Solutions

STBs are likely to form the main means of digital TV reception for the foreseeable future.

Some the problems caused by STBs will be addressed as IDTVs become more accepted and their penetration increases. The use of an IDTV will clearly address many of the connectivity and control problems, as well as providing a clearer mental model of system. However, IDTVs are currently only available for DTT. Whilst there are limited integrated products supporting other products (i.e. IDTVs with satellite receivers and CAM slots) these are few and far between and are not expected to soon become mainstream.

9.9.3 Recommendation

- Given that IDTVs do solve a set of problems resulting from the compromise and trade-offs often represented by current STBs, government should investigate ways of accelerating the development of the market for suitable mass market IDTVs and other integrated products.

9.10 Providing One-to-one Support

9.10.1 Problems and Issues

Installation

DTT STBs are currently sold through retail channels for self-installation, whilst equipment for other platforms are normally professionally installed. For many people, self installation of a DTT STB is a feasible option, and they are able to successfully connect their equipment and set up for viewing. However, this is not always the case and there may be unforeseen problems. This is particularly so if the TV is old and has no SCART socket, or if the

STB is to be connected to a VCR or DVD player as part of a home entertainment centre.

Our research suggests that self-installation and set-up will not be possible for approximately 15% of the population, rising to almost 50% of all over 75s. Understanding which lead should be connected to which box is an obvious problem, as are physical challenges such as reaching behind the TV or routing leads behind shelves.

One problem that might render the above figures for exclusion conservative is the lack of motivation on the part of otherwise capable users to even attempt self-installation. On occasion, this can even be characterised as fear. This fear is often rooted in a lack of understanding of the equipment and concern that the user may 'break' it or that it may in some way harm them (i.e. 'blow up' or give them an electric shock) if they do not install it correctly.

Use

For many people, both DTV and STBs are unfamiliar. For some people, the nature of interaction, being based on PC-like menus and click sequences and completely unlike any TV they have ever had before. While instruction manuals will be sufficient in many cases, our research suggests that some people will need one-to-one instruction. This is so to the extent that without provision of such support, a certain proportion of the population may be unable to use the new digital services at switchover.

9.10.2 Potential Solutions

For people having difficulties, support could be provided by family and friends, by telephone to a call centre, and/or by technicians visiting the home.

As relatively low-priced items, STBs are usually sold without the expectation of extended periods of significant support. In practice, almost 50% of users are contacting help lines for assistance. The full cost of support represents a potential barrier to meeting the affordability criterion in the conditions for switchover.

In the longer term, the increasing penetration of IDTVs would be expected to solve many of the connectivity problems challenging users today. As high end devices, these products could be priced to include an allowance to cover the costs of support where required.

9.10.3 Recommendation

- The DTAP should establish how the level of one-to-one support necessary for the government to achieve digital switchover could be funded, bearing in mind the affordability criterion for switchover.

10 RECOMMENDATIONS

We have identified a number of areas in which manufacturers, retailers, government, broadcasters and other stakeholders could usefully collaborate to improve the usability and accessibility of DTV. These are listed below in the order they appear in the report.

Improving awareness and understanding of DTV (section 9.2)

- 1 For people to acquire the right products and then use them effectively, they need a baseline understanding of DTV and how it could be used in their homes, and they also need to be 'intelligent customers' for DTV equipment. Government and industry should consider running information campaigns as distinct from the current commercial promotion of DTV. Possibilities include a telephone call centre, roadshows, advice desks in public libraries or shopping centres, Webwise centres, and UK Online Centres.

Improving the purchase process (Section 9.3)

- 2 To help customers select the right DTV equipment for their needs, retailers should consider developing computer-based purchasing support. This could be web-based for customers or PC-based for retail staff in-store. Such support should as far as possible be consistent across retailers.
- 3 Retailers should consider developing a training package for retail staff, perhaps along with accreditation.
- 4 The Digital Television Project should consider ways of helping organisations such as RNIB, the RNID, the Consumers Association or the DTG to identify and then list products that are suitable for use for people with particular disabilities.
- 5 Remote controls could be visible through the product packaging, represented visually on the packaging, made tangible through cardboard dummies or put out on display.
- 6 The Digital Television Project should keep the information on packaging under review, but product evolution and the need for differentiation in an increasingly crowded market should improve the information provided on packaging without the need for intervention.
- 7 As switchover nears, it may be necessary for the Digital Television Project to look again at whether the ways in which consumers purchase DTV equipment is effective in ensuring that they obtain appropriate products for their circumstances.

Improving instructions for installation and use (Section 9.4)

- 8 Manufacturers and retailers should review current instruction manuals and should consider the possibility of including additional supplementary information on a range of home connectivity scenarios. Alternatively, such information might not have to be provided in the manuals if it were available elsewhere (at retailers, or on the web). Video-based instructions (on a DVD/VHS, for example) could also be used.
- 9 Manufacturers should ensure that their instruction manuals address digital switchover specifically. Some people will need to re-tune their equipment but, unlike the initial tuning, this will not happen automatically.

Improving equipment functionality and performance (Section 9.5)

- 10 All stakeholders should recognise that the problem of VCRs and programme recording is a critical one for digital switchover and the ongoing usability of DTV. Continued efforts should be made to find a simple, convenient and affordable solution.

Improving system interaction design (Section 9.6)

- 11 TEG (or a similar industry group such as DTG) should address system interaction design in an integrated way, aiming for the creation and dissemination of a design checklist or best practice guide. The potential for customising the user interface for impaired users should be investigated within this activity. There is a trade-off between allowing customisation, and confusing the user with too much choice of set-up parameters. The functionality should be there, but "hidden", so that it does not add to the immediate complexity for the average user.

Improving remote control design (Section 9.7)

- 12 The scope of the TEG design checklist should be reviewed in the light of this report and its supporting appendices before being disseminated as an industry reference source.
- 13 To encourage the innovation and commercial development of alternative remote controls suitable for users with impairments, manufacturers should work to enable greater access to their infrared remote control codes.

Improving interaction design for broadcast content (Section 9.8)

- 14 TEG, or a similar industry group such as DTG, should address interaction design for broadcast non-sound and vision content in an integrated way, aiming for a guidance note or code of practice which can be disseminated as an industry reference source. This activity should be integrated with the analogous activity for system interaction design.

Addressing STB-specific problems (Section 9.9)

- 15 Given that IDTVs do solve a set of problems resulting from the compromise and trade-offs often represented by current STBs, government should investigate ways of accelerating the development of the market for suitable mass market IDTVs and other integrated products.

Providing one-to-one support (Section 9.10)

- 16 The DTAP should establish how the level of one-to-one support necessary for the government to achieve digital switchover could be funded, bearing in mind the affordability criterion for switchover.

APPENDIX A TERMS OF REFERENCE

To produce a report which will help the objective to encourage and enable the take-up of digital services by viewers with differing needs. Primarily focusing on the issues of inclusive design and usability, it will also identify how appropriate provision of services for people with disabilities can be made, including identifying ways of minimising re-authoring and other constraints (see item 2.9 of the Action Plan). The report should be completed by end July 2003.

This work should also link with and complement the ITC's Easy TV initiative, which is addressing the issues of inclusive design/usability, and access for deaf and partially sighted people. This was identified in the Technology and Equipment Group report of June 2002 (published on the Digital Television website www.digitaltelevision.gov.uk).

APPENDIX B EXTRACT FROM COMMUNICATIONS ACT, 2003

10 Duty to encourage availability of easily usable apparatus

(1) It shall be the duty of OFCOM to take such steps, and to enter into such arrangements, as appear to them calculated to encourage others to secure—

(a) that domestic electronic communications apparatus is developed which is capable of being used with ease, and without modification, by the widest possible range of individuals (including those with disabilities); and

(b) that domestic electronic communications apparatus which is capable of being so used is as widely available as possible for acquisition by those wishing to use it.

(2) It shall be the duty of OFCOM from time to time to review whether they need to take further steps, or to enter into further arrangements, for the purpose of performing their duty under this section.

(3) OFCOM must not do anything under this section that would be inconsistent with the Community requirements set out in section 4.

(4) In this section “electronic communications apparatus” means apparatus that is designed or adapted for a use which consists of or includes the sending or receiving of communications or other signals that are transmitted by means of an electronic communications network.

(5) For the purposes of this section electronic communications apparatus is domestic electronic communications apparatus except to the extent that it is designed or adapted for use solely for the purposes of, or in connection with, a business.

(6) In this section “signal” includes—

(a) anything comprising speech, music, sounds, visual images or communications or data of any description; and

(b) signals serving for the impartation of anything between persons, between a person and a thing or between things, or for the actuation or control of apparatus.

APPENDIX C CONCLUSIONS AND RECOMMENDATIONS OF POSITION PAPER 3 – DESIGNING FOR INCLUSION

A consortium led by Professor Leela Damodaran of Loughborough University undertook a scoping study on the human aspects of adoption in March 2002. (http://www.digitaltelevision.gov.uk/pdfs/scoping_study.pdf). Position paper 3 concerned designing for inclusion. The conclusions and recommendations of the are reproduced below.

Promotion of inclusive design of DTV equipment and services depends not just on providing specific information, but on fostering a context and a culture conducive to the concept of inclusion. This begins with creating awareness of inclusive design within society in general and in design, manufacturing and retail communities in particular. Some recommended actions to engender awareness, understanding and uptake of inclusive design principles for DTV products and services are the following:

- 1 Establish one-stop information centres with comprehensive databases of relevant information relevant to inclusive design of DTV products and services. Desirably these will have such features as:
 - exciting and innovative multi-media presentation of material;
- 2 Video footage, photographic storyboards and mood boards (e.g. that describe the end user, their lifestyle and home environment);
 - research papers, statistical references and case studies;
- 3 Internet search facilities;
 - awards for good design practice or output.
- 4 Develop the business case for inclusive design, promulgating awareness of advantages such as:
 - National, European and worldwide market opportunities that derive from leading competitors in inclusive DTV design.
 - Extended market for inclusively designed DTV products and services (as a result of wider diversity of potential users, including the elderly and those with impairments, being able to use the same products as the “average” consumer).
 - Cost savings in the production process arising from HCD and usability engineering.
- 5 Encourage designers and manufacturers to use inclusive design methods specifically for the DTV market through, for example:

- Promotion of national design competitions (for both students and practitioners) – e.g. for the most “elderly friendly” electronic programming guides, remote controls etc.
 - Provision of government incentives (funding, endorsements) for manufacturers to encourage them to re-evaluate their current products and approaches and move to more inclusive design approaches.
- 6 Establish national or regional design assessment centres for testing, analysing and evaluating products. The centre should be staffed by a multidisciplinary team of experts, who respectively, speak the jargon of relevant groups, understand design and manufacturing processes as well as economic constraints and can communicate effectively to designers and others who may not actually know what they are looking for.
 - 7 Mechanisms to be established to encourage greater involvement of the general public in design research activities i) to promote awareness and understanding of the value of design; ii) to inform design specifications, test prototypes and evaluate products.
 - 8 Establish independent advisory bodies – perhaps regionally based – to advise consumer organisations, impairment groups, industry and government with impartial and objective evidence and information in an accessible format.
 - 9 Publicise good practice in inclusive design to those involved in the design and production of DTV products through such mechanisms as:
 - National/regional collections of artefacts that represent sound inclusive design awareness.
 - Museum exhibition of exemplars of leading British/European/international inclusive design.
 - Publication, dissemination and promotion of case studies where inclusive design has been used successfully.

APPENDIX D OUR RESEARCH METHODOLOGIES

D.1 Consultation

We have held discussions with the main representative organisations relevant to usability and inclusivity. In addition, we have spoken with broadcasters, manufacturers and retailers about their approach to usability and inclusivity. The people and organisations we have spoken to are listed in the Acknowledgements (Appendix G)

D.2 Quest

This survey was conducted by means of a self-completion questionnaire which was submitted to Ipsos's QUEST panel, and which was completed between March 17th and 23rd 2003. In total 4,537 respondents aged 16 or over completed the questionnaire, and weighting was implemented to ensure that they were fully representative of the GB population in terms of key demographic variables. The questionnaire covered many aspects of digital television. The two questions that explored issues of usability or exclusion are included below.

Q6a How much do you agree or disagree that the following are problems and difficulties that you think Digital TV presents for households such as yours?
(Please place a cross in one box on each line across)

	Agree strongly	Agree slightly	Neither agree nor disagree	Disagree slightly	Disagree strongly
Problems receiving a Digital TV signal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Needing to install a new aerial	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Needing to run wiring through the home (satellite and cable only)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complications in connecting up all the equipment so that it works	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulties in knowing how to connect up the video recorder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Confusing to use Digital TV, even for simple TV viewing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Confusing to use interactive TV features	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q6 b How much do you agree or disagree that the following are problems and difficulties that you think Digital TV presents for households such as yours?
(Please place a cross in one box on each line across)

	Agree strongly	Agree slightly	Neither agree nor disagree	Disagree slightly	Disagree strongly
Problems understanding and using a more complicated remote control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Concern about having to use multiple remote controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital Text being more complicated to use than Teletext	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complicated to record Digital channels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complicated to access advanced services such as TV e-mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficulties controlling which channels my children can watch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficult for older people to use it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Difficult for people with impairments to use it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In addition to these questions about usability, we cross-referenced the results to data already held on the Quest panel in respect of age, sex and any impairments.

D.3 Focus groups

Eight focus groups were held with eight people in each group. The groups were constructed according to the table below.

	Attitude to adoption	Age	SEG	Location
1	Won't be	25-45	BC1	London
2	Won't be	46-65	C2D	Nottingham
3	Could be	25-45	C2D	Nottingham
4	Could be	46-65	BC1	London
5	Adopter	25-45	BC1	Nottingham
6	Adopter	46-65	C2D	London
7	Could be	65 +	C2D	London
8	Adopter	65 +	BC1	Nottingham

The focus groups included an opportunity for hands-on 'experience' of digital television to see how this impacts on reluctant adopters' perceptions. This gave us the possibility of observing new users and seeing how they coped. Furthermore, we saw how the opportunity to 'experience' digital impacts on reluctant adopters' perceptions and whether this has the potential to overcome concerns and barriers.

D.4 Usability audit, exclusion analysis and user trials

An expert evaluation of three set-top boxes and a programme of observational user trials was undertaken for us by Dr John Clarkson²⁴ and Dr Simeon Keates²⁵ of the Engineering Design Centre at the University of Cambridge. The Centre has one of the leading UK teams in inclusive design.

There were three parts to this study:

- 1 Expert assessment – an analysis of the accessibility of DTV systems by researchers with experience of other such assessments;

²⁴ Reader in Engineering Design and Director of the Engineering Design Centre at the University of Cambridge

²⁵ Senior Research Associate at the Engineering Design Centre at the University of Cambridge

- 2 Exclusion analysis – the estimation of the levels of exclusion to be expected when using DTV;
- 3 User trials – the observation of individual users undertaking a range of specified tasks using DTV.

Further details are presented in Appendix E.

**APPENDIX E INVESTIGATING THE INCLUSIVITY OF
DIGITAL TELEVISION SET-TOP BOX
RECEIVERS**

Report by Dr John Clarkson and Dr Simeon Keates of the Engineering Design
Centre at the University of Cambridge

Published separately – URN 03/1277

APPENDIX F SOLUTION CLUSTERING

Usability problems and issues identified	Improving awareness of DTV	Improving the purchase process	Improving instructions of installation and use	Improving equipment functionality & performance	Improving system interaction design	Improving remote control design	Improving interaction design for broadcast content	Addressing STB-specific problems	Providing one to one support
Knowledge of the benefits of DTV at time of purchase	0	0							
Compatibility of available STBs with equipment already in the home	0	0		0				0	
Clear indication of product features and differences through product packaging		0							
Availability of remote controls for inspection at time of purchase		0							
Limited retail staff knowledge to advise at time of purchase		0							
Appreciation of the ongoing implications of product choice at time of purchase	0	0							
Unclear or unintuitive installation instructions using unfamiliar means of description (i.e. wiring diagrams)			0						
Lack of clear instructions for installation with other typical home equipment in various common configurations			0						
Lack of clear instructions on how to install STB with old equipment (i.e. a TV with no SCART socket)			0						
Inability to easily identify components of the DTV system at installation			0						0
Insufficient cables or connections on the STB to connect typical home entertainment equipment				0					
Lack of confidence by the user with the equipment and lack of motivation to install it themselves									0
Restrictions to the user's ability to reach behind the TV and plug-in cables (caused by vision, stretch & reach and dexterity impairments)									0
Insufficient instructions to aid set-up should the system not respond as the user expects (Troubleshooting)			0						
Delay between the user entering a channel number and the system registering the input (i.e. by showing the number entered)				0	0				
The STB not allowing sufficient time for the user to press a second or subsequent button in a sequence before responding				0	0				
Lack of understanding by the user of how to access the EPG					0	0			
The increased dexterity demands placed on the user by the reliance on using the remote control to use EPG						0			
The necessity for the user to understand the concept of scrolling and menu navigation within the EPG					0				
The need for the user to appreciate the need to press 'OK' to go to a channel selected in the EPG					0				
User confusion caused by the availability of a "page up" and "page down" function in the EPG					0				
Lack of understanding by the user of how to exit the EPG					0				
Confusion caused by the complexities of the mechanism used to access subtitles (dedicated button vs. menu item)					0				

Usability problems and issues identified	Improving awareness of DTV	Improving the purchase process	Improving instructions of installation and use	Improving equipment functionality & performance	Improving system interaction design	Improving remote control design	Improving interaction design for broadcast content	Addressing STB-specific problems	Providing one to one support
The ability of the user to easily activate/deactivate subtitles at will				☐					
Whether subtitles remain active when the user changes the channel being watched				☐					
The behaviour of subtitles (if activated) when the user enters the EPG or another MHEG application				☐					
The provision of text-based information (i.e. teletext) on a dedicated channel rather than across channels as on analogue							☐		
Lack of understanding by the user of how to access digital text information once the correct channel has been selected					☐				
Lack of clear understanding of the function of the red button in interactive / digital text applications							☐		
The delay between the user correctly accessing an interactive / digital text service and the content appearing on the screen							☐		
The user's ability to recognise when an item is selected in an interactive / digital text application							☐		
Lack of understanding by the user of how to navigate through options in interactive / digital text content							☐		
Acceptance by the user that "OK" must be pressed to active a selection in an interactive / digital text application							☐		
Lack of understanding by the user of how to exit from interactive / digital text applications							☐		
Access to Audio Description services				☐					
Access to closed caption signing services				☐					
Insufficient space between buttons on the remote control resulting in accidental button presses						☐			
Intuitive remote control button design and positioning						☐			
Overly sensitive remote control buttons causing the user to select the wrong on-screen item						☐			
Clear and consistent colouring and positioning of common remote control buttons (i.e. standby)						☐			
The trade off between overall complexity of the remote control and providing dedicated buttons for clarity						☐			
Clear and intuitive use of the Prog +/- and up and down arrow buttons on the remote control for navigation and channel selection					☐	☐			
Clear and intuitive positioning of dedicated service buttons on the remote control (i.e. subtitles)						☐			
Use of unclear and unintuitive terminology for labels on the remote control						☐			
The preferential and unclear use of icons or text on remote control buttons						☐			
Use of text for remote control button labels that is not clear to read by users of all capabilities (i.e. font, colour etc)						☐			

Usability problems and issues identified	Improving awareness of DTV	Improving the purchase process	Improving instructions of installation and use	Improving equipment functionality & performance	Improving system interaction design	Improving remote control design	Improving interaction design for broadcast content	Addressing STB-specific problems	Providing one to one support
Difficulty opening the remote control battery compartment						☐			
Ergonomic design of the remote control to allow for comfortable use over prolonged periods						☐			
The necessity for the user to use two remote controls to perform basic TV viewing functions (i.e. volume adjustment)				☐					
Lack of clarity of current operating mode for remote controls where multiple modes are available					☐				
Inconsistency of terminology and representation of buttons and instructions between system components (i.e. on screen menus and remote controls)					☐		☐		
Clear and intuitive labelling of coloured buttons for control of system functions from the remote control					☐		☐		
Provision of an 'off the shelf' remote control that is not specifically designed for use the STB purchased					☐		☐		
Confusion caused by the system response to powering on of components in different orders where the order is detected through the Scart links								☐	
Insufficient controls and feedback provided on the STB itself to control and monitor the system								☐	
Inconsistent use of terminology and content layout in the On-Screen Display across different channels							☐		
Difficulty reading text in various On-Screen Displays					☐		☐		
The requirement that a user be able to read to use an On-Screen Display					☐		☐		
Recording of digital TV programmes, either automatically on a timer or whilst watching another channel				☐					
Confusion caused by a perceived lack of a 'hub' to the system which controls all aspect of the users viewing experience								☐	
Clearly available information informing the user where they can get support									☐
Problems caused by frequent switching between having to look at the remote control and the screen					☐		☐		

APPENDIX G ACKNOWLEDGEMENTS

Our thanks go out to the following for their participation and contribution to this study.

Organisation	Name	Job Title
Age Concern	Gretel Jones	
Amethyst Consulting	Meirion Hughes	Consultant
BBC Strategy & Distribution	Andy Townend	Controller, Distribution
BSkyB	Robin Crossley	Strategic Advisor, Technology
BSkyB	Sheila Cassells	Head of Economic Policy
BSkyB	Kaye Allen	Special Needs Manager
City University	Helen Petrie	School of Informatics
Consumers Association	Michelle Childs	Head of Policy Research and Analysis
Consumers Association	Allan Williams	Senior Communications Policy Adviser
Cambridge University Engineering Department	John Clarkson	Engineering Design Centre, Dept of Engineering
Cambridge University Engineering Department	Simeon Keates	Engineering Design Centre, Dept of Engineering
Department for Culture, Media and Sport (DCMS)	Maureen Collins	Digital TV Project Team Member
DCMS	Catherine Smadja	Co-Director of Digital Television Project Head of Digital Broadcasting at DCMS
Deaf Broadcasting Council	Ruth Myers	Hon. Secretary
Digital TV Group (DTG)	Marcus Coleman	Director General
Digital TV Group (DTG)	Peter Marshall	Technical Director
Digital Television Project	Michael Starks	Project Manager, Digital Television Project
Digital Television Project, Market Preparation Group	Danny Churchill	Chairman - Market Preparation Group
Digital Television Project, Technology & Equipment Group (TEG)	Henry Price	Digital Television Project Team – Chairman, Technology & Equipment Group
Digital Television Project, Stakeholders Group	Barry Cox	Chairman, Digital Television Stakeholders Group

Organisation	Name	Job Title
DTI	Jane Humphreys	Co-Director of Digital Television Project (DTP), Head of Broadcasting at DTI
DTI	Ian Dixon	Digital TV Project Team Member, Head of Broadcasting Technology at DTI
DTI	David Harby	Interactive Television Project Manager, Digital Television Project Team
DTI	David Fuhr	Digital TV Project Team Member, Deputy Project Manager
DTI – Industry Economics & Statistics	Michael Crosse	Economist
DTI – Radiocommunications Agency	Michael Hodson	Chief Economist
Freeview	Matthew Seaman	General Manager
Goldsmiths	Maria Sourbati	
Humax	Dale Heathcote	Commercial Director
I2 Media	Dr Jane Lessiter	Research Psychologist
Intellect	George Fullam	Technical Services Consumer Electronics
Ipsos-Insight	Carolyn Budd	Research Manager
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Ipsos-RSL	Sarah Gale	Associate Director Broadcast and Ambient Media
Ipsos-RSL	Simon Riley	
Independent Television Commission (ITC)	Greg Bensberg	Project Manager Spectrum Planning, Digital Television Project Team Member
ITC	Andrew Dumbreck	Project Manager – New Media
ITC	Andrew Stirling	Senior Technology Advisor
ITC/I2 Media	Dr Jonathan Freeman	Project Manager – New Media / (CEO I2)
Loughborough University	Victoria Haines	Principal Researcher - Ergonomics and Safety Research Centre
Mentor	Andrew Wheen	Consultant
NetGem	Keith Armour	Chief Country Officer

Organisation	Name	Job Title
Office of the e-Envoy	Sarah Walton	
Office of the e-Envoy	Jason Burg	Assistant Director, Channels
Pace Microtechnology	James Mellor	Marketing Manager
Pace Microtechnology	Richard Lindsay Davies	Strategic Marketing Manager
Philips Components	Wim Lemay	Business Development Manager
Philips Design	Fred Brigham	Senior Project Manager – Project Office
Philips Design	Damian Mycroft	Design Account Manager
Philips Design	Michael Heesemans	Senior Consultant – Interactive Design
Philips Semiconductors	David Johnston	Digital Director
RNIB	Denise Evans	Head of Broadcasting and Talking Images
RNIB	Clive Miller	Digital Broadcasting Development Officer
RNIB	Dan Vale	Campaigns Manager
RNIB	Leen Petre	European Campaigns Manager - Public Policy Dept.
RNID	Brian Grover	
RNID	Mark Hoda	European Campaigns Officer
RNID	John Low	
RNID	Mark Morris	Head of Parliamentary and Legal Affairs
Sony	Richard Brown	Quality/Technical Manager
Sony	Tony Abbott	Manufacturers Representative on Digital Television Project Steering Board
Stallards Consultancy Services	Gerry Stallard	Consultant - Broadcast Media Access
University of Brighton	Mark Rice	Research Officer - School of Computing, Mathematical and Information Science
Voice of the Listener & Viewer	Jocelyn Hay	Chairman

