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B. Human Computer Interface Specification

This appendix contains the design principles that have been followed in deriving the Human Computer Interface (HCI), and the design standards that have been applied to keyboard-to-screen mapping, panels and buttons. It also summarises the approach to designing a new application that uses the HCI.

Where appropriate, references are made to *Handbook of Human Factors and Ergonomics* edited by Gavriel Salvendy. See also *Fujitsu Proposal for BA/POCL Counter Keyboard*.

B.1 Design Principles

In the *Handbook of Human Factors and Ergonomics* Chapter 51, *Software-User Interface Design*, a set of guidelines is identified on which the design principles have been based. The following sections summarise the design principles in terms of these guidelines.

B.1.1 General Design Guidelines

- Strive for consistency.
- Enable knowledgeable frequent users to use shortcuts.
- Provide information feedback.
- Organise sequences of actions into groups.
- Offer simple error handling mechanisms.
- Allow easy reversal of actions.
- Enable users to be in control of the system.
- Reduce short-term memory load.

B.1.2 Data Display Guidelines

- Left justify columns of alphabetic data to allow rapid scanning.
- Label each page to show its relation to other pages.
- Maintain consistent format from one display to another.
- Display data in directly usable forms.
- Use short, simple sentences.
- Use affirmative rather than negative statements.
- Provide an informative header or title for every display.
- When blink coding is used, the blink rate should be 2 to 5 Hz.

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B.1.3 Screen Design Guidelines

- Make appropriate use of abbreviations.
- Avoid unnecessary details.
- Use concise wording.
- Use familiar data formats.
- Use tabular formats with column headings.
- Arrange related items as groups.
- Use highlighting to attract user attention to certain elements.
- Present information in a proper sequence.

B.1.4 Colour Usage Guidelines

- Avoid pure blue for text, thin lines, and small shapes.
- Avoid red and green in the periphery of large-scale displays.
- Not all colours are equally discernible.
- Do not overuse colours.
- Use similar colours to convey similar meanings.
- Use a common background colour to group related elements.
- Use brightness and saturation to draw viewer attention.
- For colour-deficient viewers, avoid single-colour distinctions.

B.1.5 Error Message Guidelines

- Be as specific and precise as possible.
- Be positive: avoid condemnation.
- Be constructive: tell the user what needs to be done.
- Be consistent in grammar, terminology, and abbreviations.
- Use user-centred phrasing.
- Use consistent display formats.
- Test the usability of error messages.
- Try to reduce or eliminate the need for error messages.

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B.2 Design Standards

The desktop applications must be designed with the expectation that a proportion of the user population will present one or more functional limitations. Such functional limitations include:

- Hearing impairment.
- Deafness.
- Low vision.
- Blindness. [Note that the system is not specifically designed for the totally blind.]
- Physical impairment.
- Speech impairment.
- Cognitive impairment.

These limitations and the design standards that should be used to support the varying limitations are given in *Handbook of Human Factors and Ergonomics,* Chapter 60, *Design for people with Functional Limitations Resulting from Disability, Ageing, or Circumstances*. Taking these limitations into consideration has resulted in the statement of Principles of Universal Design. The principles that have been used in the design of the HCI are summarised in the following sections.

B.2.1 Principles of Universal Design

B.2.1.1 PRINCIPLE ONE: Simple and Intuitive Use

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level. To achieve this:

- Minimise complexity.
- Be consistent with user expectations and intuition.
- Accommodate a wide range of literacy and language skills.
- Make essential information clear.
- Provide effective prompting.
- Provide effective feedback.

B.2.1.2 PRINCIPLE TWO: Equitable Use

The design does not disadvantage or stigmatise any group of users. To achieve this:

- Provide equivalent access and efficiency.
- Avoid segregation of users.

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B.2.1.3 PRINCIPLE THREE: Perceptible Information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities. To achieve this provide:

- Multi-sensory (redundant) formats.
- Adequate contrast to detect information and differentiate it from the surroundings.
- Compatibility with a variety of techniques used by people with sensory limitations.

B.2.1.4 PRINCIPLE FOUR: Tolerance of Error

The design minimises the consequence of accidental and unintended actions. To achieve this:

- Provide warning of error.
- Make input reversible.
- Provide failsafes.

B.2.2 Keyboard-to-Screen Mapping

These design principles and the impact of functional limitations have been applied directly to the issue of keyboard-to-screen mapping. The following table identifies the standards that apply to keyboard-to-screen mapping.

Functional impairment	*Design principle applied*
Low vision/[blindness]	• Use direct keypad input.
Physical impairment	• Where simultaneous actions are required, pressing shift or control key while typing another key, for example, provide an alternative method to achieve the same result that does not require simultaneous actions.
Physical impairment	• Provide alternative means for eye-hand co-ordination input devices.

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B.2.3 Panels and buttons

These design principles and the impact of functional limitations have been applied directly to the issue of panels and buttons. The following table identifies the standards that apply to panels and buttons.

Functional impairment	*Design principle applied*
Low vision/[blindness]	• Use upper and lower case to maximise readability. • Make sure that letters and messages stand out distinctly from each other by using sufficient: – leading space between the letters of a word – space between lines – distance between messages • Keep letters and symbols on visual output as simple as possible. • Vary the size of controls (also texture or shape) with the most important being larger to facilitate their location and identification. • Provide controls whose shapes are associated with their functions. • Provide sufficient space between controls for easy tactile location and identification as well as easier labelling. • Supplement colour coding with use of different button or key shapes or letter or graphic labels.
Physical impairment	• Avoid screen refresh rates or update flicker or flashing frequencies that are most likely to trigger seizure activity.
Cognitive impairment	• Use simple screen layouts, or provide the user with the option to look at one thing at a time. • Keep language as simple as possible. • Accompany words with pictures or icons. • Use Arabic rather than Roman numerals.

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Functional impairment	*Design principle applied*
Cognitive impairment	• Use attention-attracting techniques: underlining, boldface, and grouping techniques. • Highlight important information. • Reduce the number of controls. – Limit the number of choices where practical – Use layering of controls where only the most frequently used or necessary controls or commands are visible unless you open a door or ask for additional levels of commands (e.g. hiding less frequently used controls, or at least grouping the most frequently used controls together and placing them prominently). • Simplify the controls – Minimise dual purpose controls. – Use direct selection techniques where practical (selection techniques where the person need only make a single, simple, non-time-dependent movement to select). – Provide a busy indicator or a progress indicator when a product is busy and cannot take further input, or when there is a delay before the requested action is taken. – Integrate, group and otherwise arrange controls to indicate function or sequence of operation. • Make labels easy to understand – Place the label on or immediately adjacent to the control. – Place a line around the button and label to show association. – Use simple concise language. – Avoid abbreviations in labelling. – Leave space around keys (it makes it easier to match labels to keys and to add special labels).

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Functional impairment	*Design principle applied*
Cognitive impairment	• Reduce, eliminate or provide cues for sequence – Allow use of programmable function keys or use a 'default' mode. – Using pre-programmed buttons for common sequences. – Simplify required sequences, limiting the number of steps. – Arrange controls to indicate sequence of operation. – Add memory cues or simple operating instructions where possible. – Cue required sequence of action. – Provide an easy exit that returns the user to the original starting point from any point in the program or sequence. • Build on users' experiences – Lay out controls to follow functions. – Make operation of controls follow movement stereotypes. – Use common layouts or patterns for controls. – Use common colour-coding conventions in addition to textual or graphic labelling. – Standardise by using the same shape, colour, icon or label for same function or action.

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B.2.4 Keyboard Layout

The design principles and impact of functional limitations apply directly to the issue of keyboard layout. Keyboard layouts should comply with the appropriate sections of the BS7179 Part 4 and ISO 9241 Part 4 standards. The following table identifies the additional standards that apply to keyboard layout.

Functional impairment	*Design principle applied*
Low vision/[blindness]	• Arrange controls in groupings that facilitate tactile identification (for example, use small groups of keys that are separated from the other keys, or place frequently used keys near tactile landmarks such as along the edges of a keyboard). • Use established layouts for keyboards.

B.2.5 Bar-code Reader

The design principles and impact of functional limitations apply to bar-code readers. The following table identifies the standards that apply.

Functional impairment	*Design principle applied*
Physical impairment	• Provide for operation with left and right hand.
Cognitive impairment	• Use direct selection techniques where the person need only make a single, simple, non-time dependent movement to select. • Keep things as simple as possible.

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B.2.6 Printers

The design principles and impact of functional limitations apply to printers. The following table identifies the standards that apply.

Functional impairment	*Design principle applied*
Low vision/[blindness]	• Provide sufficient space between controls for easy tactile location and identification as well as easier labelling. • Locate controls adjacent to what they control.
Physical impairment	• Ensure that objects can be inserted and removed with minimal user reach and dexterity. • Provide a simple funnelling system or other self-guidance or orientation mechanism that will properly position the object for insertion. • Provide visual contrast between the insertion point and the rest of the device (making a more obvious 'target'). • Provide ample ejection distance to facilitate easy gripping and removal.
Cognitive impairment	• Use direct selection techniques where the person need only make a single, simple, non-time dependent movement to select. • Keep things as simple as possible.

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B.3 New Applications

The process that should be used for designing new applications is based on the one identified in *Handbook of Human Factors and Ergonomics,* Chapter 11, *Allocation of Functions*. The process model has four levels:

- Level 1

  Identify the required functions and an appropriate level for analysing the tasks and their constituent sub-tasks.

- Level 2

  Identify the cognitive processes required for each function by identifying performance and operational requirements.

- Level 3

  Specify performance criteria:

  – specific criteria such as completion time.

  – general criteria such as scope and validity.

- Level 4

  Specify who performs each function. This may be the application, a human or a combination of both.

This analysis enables the designer to identify metaphors that apply to that particular application by:

- Identifying candidate metaphors based on the existing applications and the designer's intuition and inventiveness.
- Identifying software metaphor matches by analysing the user's goals and scenarios.
- Identifying likely mismatches in terms of useful and harmful mismatches.
- Helping users to manage mismatches by providing strategies that allow action reversals, give no response to wrong actions and provide online help.

The metaphors to be used are described elsewhere in the Style Guide and are:

- Panels and Buttons.
- Icons, Captions and Colour.