Mobile Adventure

Mobile HCI 2005

Tutorial

Development of Interactive Applications for Mobile Devices

- Mobile Human-Computer Interaction -

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Contents

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Definitions

- **What is a Handheld Device?**

  A **portable** device supporting **wireless communications** *and/or* **information management** *(e.g. mobile phone,PDA,smartphone…).*

- **What is a Mobile Phone?**

  Handheld **telecommunication** device for use in an area divided into cells.

- **What is a PDA?**

  Handheld device providing applications for personal **information management**.

- **What is a Smartphone?**

  Handheld device integrating mobile phone, PDA or laptop computer functionalities (e.g. phone, PIM, email…).

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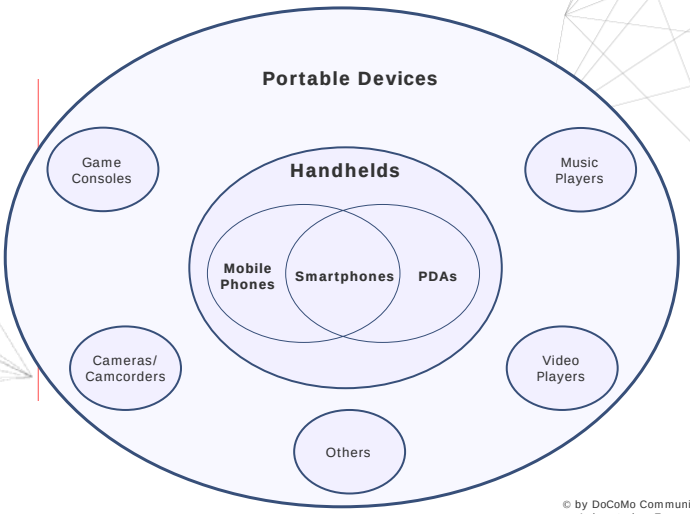
Taxonomy of Portable Devices



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Platform Characteristics

Usage	Communication, lookup, data input **on-the-go**
Form Factor	Fit the **hand** (< 10” x 12”)
Display	**< 640 x 320 pixels**
Input	**Keypad, stylus, wheel**
Connectivity	Slow and unreliable *(compared with a desktop computer)*

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Comparison of Handheld Devices

	Phone	PDA	Smartphone
Usage	Calls, SMS	Information management	Calls,SMS, information management
Form Factor	1 hand	2 hands	1 or 2 hands
Display	> 96 x 65 pixels < 176 x 208 pixels	< 640 x 320 pixels	> 176 x 208 pixels < 640 x 320 pixels
Input	12 keys keypad, voice	Touchscreen (Stylus, virtual keyboard)	Keypad and/or Touchscreen (Stylus, virtual keyboard), keyboard, voice
Connectivity	GSM, GPRS, UMTS… IR, Bluetooth…	IR, Bluetooth…	GSM, GPRS, UMTS… IR, Bluetooth…

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Inputs (1/2)

- **Microphone**
  - Voice Input
  - Voice Commands
- **Keypad**
  - Predictive Text Input (T9)
- **Navigation Controls**
  - 2 or 4 way directional keypad
  - Roller wheel *(can be pushed to make selection or activation)*
  - Rocker control *(can be pushed to make selection, activation and allow to adjust the scrolling speed)*
- **Hardware Buttons**
  - Standard layout
  - Feedback *(tactile, visual and auditive)*
  - Label *or* Icon *(visible, readable and meaningful)*

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Inputs (2/2)

- **Touch screen**
  - Controlled by stylus or finger
  - Activation
  - Selection
  - Scrolling
  - Data Input:
    - (un)dedicated area or electronic ink
    - handwriting recognition
- **On-screen or hardware keyboard**

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Outputs

- **Display**

  - Design for the lowest resolutions:
    4 lines x 12 characters including softkey labels

  - Do not use blank lines to make content separations
    -> guidance issue in case scrolling is necessary

- **Speaker**

- **Vibrator**

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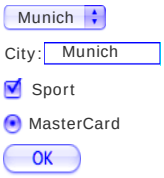
UI Components

- **Menu Bar**
- **Pop-up Menus**
- **Input Fields/Forms**
- **Check Boxes**
- **Option Buttons**
- **Push Buttons**
- **Icons**
- **Sound effects**
- **Progress Bar**
- **Dialog Boxes *(Error message, confirmation message…)***



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UI Environments (1/2)

DoCoMo Euro-Labs

- **Mobile Phones**

- Most mobile phones have their **own UI environment**
  -> inconsistency -> **usability issues** (e.g. learnability)

-The deployment of mobile applications depends on 2 aspects:
- OS
- Manufacturer (3rd application allowed or not)

-**Symbian OS**:
- Especially designed for mobile phones requirements
- Features C++ and Java development

- **I-mode and WAP** are two specific protocols for deploying mobile applications.
  -> Only one of them can be deployed

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UI Environments (2/2)

DoCoMo Euro-Labs

- **PDAs / Smartphones:**

- Windows CE
- Based on the Desktop UI environment from Windows
- Central file System
- Multitasking OS

- Palm OS
- UI environment specifically designed for PDAs
- No central file system *(-> difficult file management)*
- No multitasking OS *(only one active application)*
- Applications state recovering

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i-mode (1/2)

NTT DoCoMo DoCoMo Euro-Labs

- **i-mode Phones**

  - Specific i-mode button

  - Many official and unofficial sites accessible

  - Content on the official sites supervised by NTT DoCoMo

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i-mode (2/2)

NTT DoCoMo DoCoMo Euro-Labs

- **cHTML**

  - Stands for Compact HTML

  - cHTML is the coding language of i-Mode

  - **Subset of HTML leaving out coding** for:
    - JPEG images, image map, background color
    - Tables and frames
    - Multiple character fonts and styles

  - More **appropriate for limited screen-size and low bandwidth** of cellphones.

  - cHTML is **simpler than WML**

  - **No need to develop different site versions** for several i-mode devices

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WAP

- Stands for Wireless Application Protocol
- WML is the coding language for WAP devices
- Multiple versions
- Difficult software upgrade
- Poor Usability:
  - No standard soft keys layout
  - Different user interface guidelines

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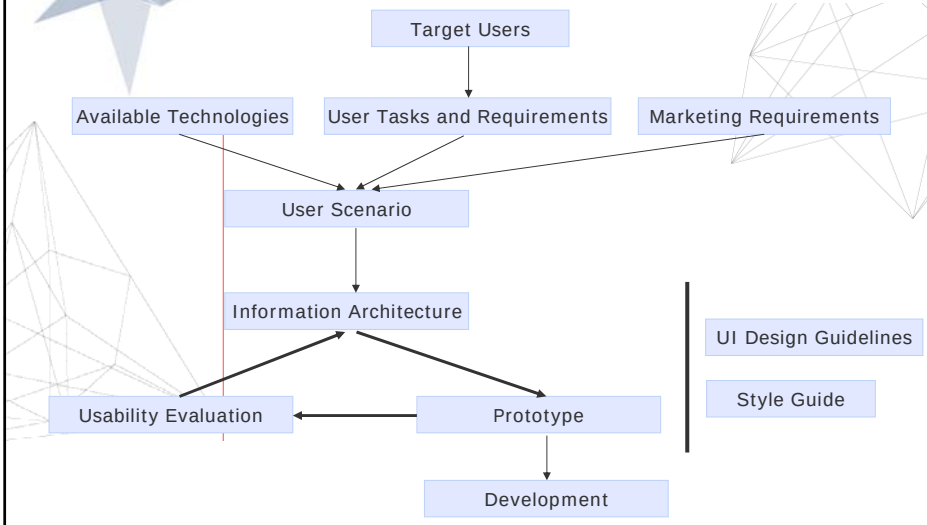
Iterative User-Centered Design Process



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User Tasks and Requirements

- **Available techniques:**

Contextual Task Analysis

Interviews

Questionnaire

Focus Groups

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User Scenario

- **Story used to express product ideas or interactivity experiences.**

- **- Who?**
  - What?
  - How?
  - Why?
  - Where?
  - When?

- **Example:**

Max just missed the train going from Munich to the Salzburg. He plans to immediately take a taxi but also knows there might be a lot of traffic on the road which might make him even more late! Therefore, Max decides to check the road traffic on his mobile phone. He launches the Traffic application, enters his destination. The current date, time and location are automatically selected based on the clock and GPS receiver of his mobile phone but could be manually edited by Max.

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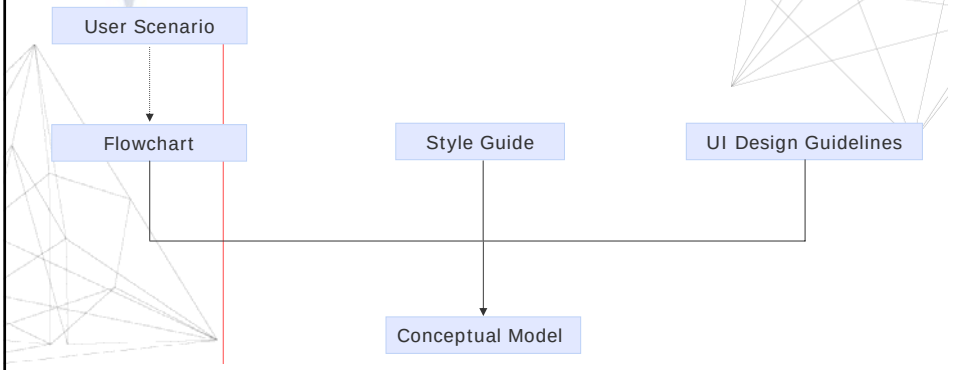
Information Architecture Design Process



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Flowchart (1/3)

- **Definition:**
  Design of the functionalities organization independently of the UI presentation.

- **Main Recommendations:**
  - Reduce a scenario to steps
  - Avoid details

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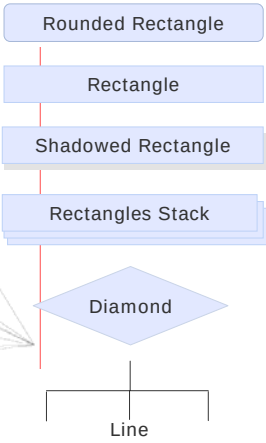
Flowchart (2/3)

- **Shapes:**



Initial or Final step

Single step

Process (can be detailed in a separate flowchart)

Tabbed page

Decision step

Path

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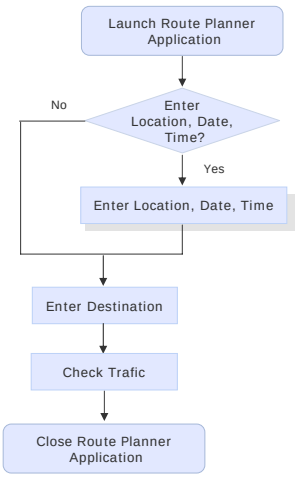
Flowchart (3/3)

- **Exemple:**



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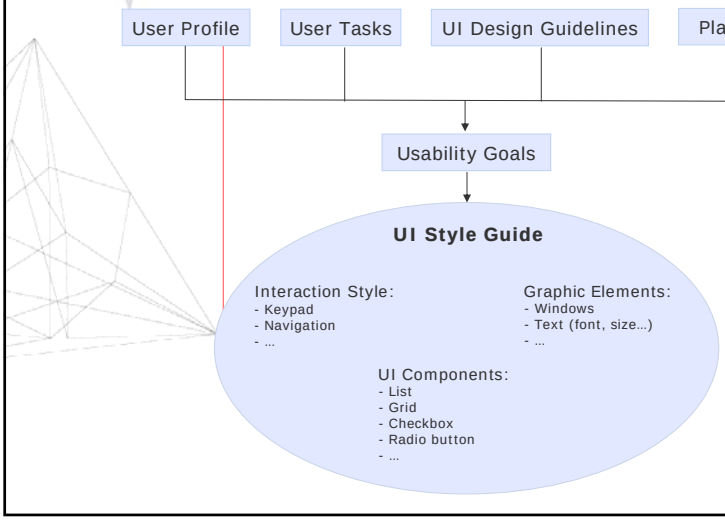
Style Guide



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Conceptual Model Design (1/2)

- **User Mental Model <---> Conceptual Model Design**
- **Highest level of UI design**
- **Main Issues:**
  - How to define the process?
  - How to present major displays?
  - How to define the navigation?

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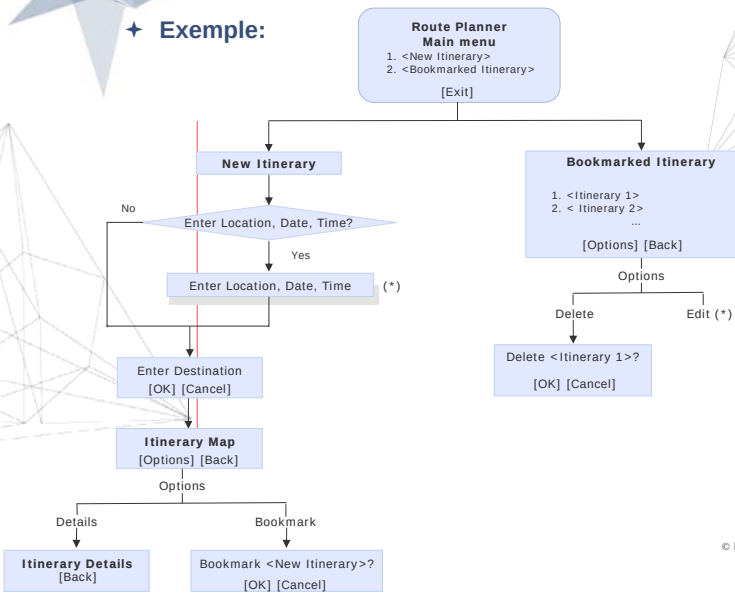
Conceptual Model Design (2/2)

- Exemple:



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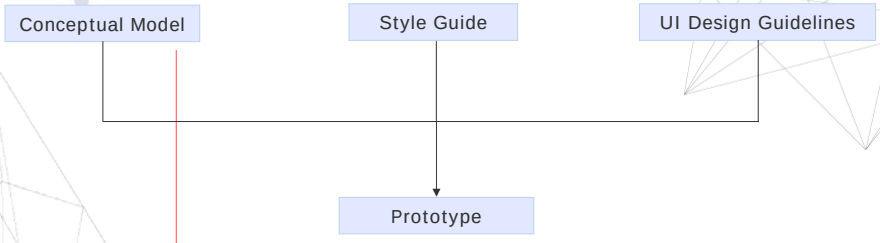
Prototype Design Process



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Prototype: Definition and Techniques

- **Proof of concept used to save time and resources**
- **Techniques:**
  - Paper Prototype
  - High-Fidelity Prototype

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Paper Prototype

- **Fast and easy technique**
- **Allows quick iterations**
- **Very suitable for user tests**
- **Material:**
  - Device model *(Blinder)*
  - UI Pages

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High-Fidelity Prototype

- Clickable demo or interactive prototype
- Very suitable for presentations
- Realistic environment for user tests

- Material:

  - Clickable demo
  or
  - Handheld device
  or
  - Desktop emulator

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UI Development using Flash (1/2)

- WYSIWYG
  -> Immediate results thus enabling quick changes

- Enhanced UI designs:
  - Animation
  - Rich graphics
  - Sound
  - Interactivity…

- Integration with other technologies (C++, XML)

- Designs deployment across multiple devices and platforms with minimal redevelopment effort
  -> Easy customization for different screen sizes and form factors

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UI Development using Flash (2/2)

- **Faster development times with less cost**
  - **1/3 of the C++ development time**
  - **reduced dependency between UI designers and developers** since usually, UI designers pass their concepts to developers for coding and can only see the end result afterwards
  - **Quick re-design** of prototypes based on user tests findings or customer requirements
- **Tools**
  - UI development with **Macromedia Flash MX Professional**
  - Device deployment with **Macromedia Flash Lite** *(Mobile version of Flash Player)*.

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Prototype example (1/2)

2. Bookmarks

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Prototype example (2/2)

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Usability Evaluation Methods

- **Methods:**
  - Usability Inspection Methods
  - User Tests
  - Observation
- **Heuristic Evaluation**
  - Expert evaluation based on heuristics *(e.g. Ergonomic Criteria)*
- **Cognitive Walkthrough**
  - Evaluation of the UI by following user tasks

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User Tests

- Test goal
- Test preparation *(budget, material, procedure)*
- Test users *(profile, number)*
- Test tasks

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Ergonomic Criteria (1/9)

- 1.Guidance
  - 1.1 Prompting
  - 1.2 Grouping/Distinction
    - 1.2.1 Grouping/Distinction by Location
    - 1.2.2 Grouping/Distinction by Format
  - 1.3 Immediate Feedback
  - 1.4 Legibility
- 2. Workload
  - 2.1 Brevity
    - 2.1.1 Concision
    - 2.1.2 Minimal Actions
  - 2.2 Information Density
- 3. Explicit Control
  - 3.1. Explicit User Action
  - 3.2. User Control
- 4. Adaptability
  - 4.1 Flexibility
  - 4.2 User Experience
- 5. Error Management
  - 5.1 Error Protection
  - 5.2 Quality of Error Messages
  - 5.3 Error Correction
- 6. Consistency
- 7. Significance of Codes
- 8. Compatibility

Bastien, J.M.C. & Scapin, D.L. (1993). *Critères Ergonomiques pour l'Évaluation d'Interfaces Utilisateurs (version 2.1)*. Technical report Ndeg.156, May 1993. INRIA. Programme 3 Artificial intelligence, cognitive systems, and man-machine interaction.

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Ergonomic Criteria (2/9)

1. Guidance

It refers to the means available to advise, orient, inform, instruct, and guide the users throughout their interactions with a computer (**messages, alarms, labels**, etc.), including from a lexical point of view.

1.1 Prompting

It refers to the means available in order to **lead the users to making specific actions** whether data entry or other tasks. This criterion also refers to all the means that help users to know the alternatives when several actions are possible depending on the contexts.

The Prompting also concerns status information that is information about the actual state or context of the system, as well as information concerning help facilities and their accessibility.

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Ergonomic Criteria (3/9)

1.2 Grouping/Distinction

It Concerns the visual organization of information elements in relation to one another. This criterion takes into account the topology (**location**) and some graphical characteristics (**format**) in order to indicate the relationships between the various elements displayed, to indicate whether or not they belong to a given class, or else to indicate differences between classes. This criterion also concerns the organization of items within a class.

1.2.1 Grouping/Distinction by Location

The criterion *Grouping/Distinction by Location* concerns the relative positioning of elements in order to indicate whether or not they belong to a given class, or else to indicate differences between classes. This criterion also concerns the relative positioning of elements within a class.

1.2.2 Grouping/Distinction by Format

The grouping/distinction of elements can be achieved by format and/or by location. Location and format correspond to different display features (topology vs. added graphics). For instance, menu options can be distinguished either or both with location (e.g., most frequent options at the top, less frequent options further down) and format (e.g., a line separator between a set of options concerning text layout and a set of options concerning character types).

Ergonomic Criteria (4/9)

1.3 Feedback

It concerns system responses to users' actions. These actions may be simple keyed entries or more complex transactions such as stacked commands. In all cases **computer responses** must be provided, they should be **fast**, with **appropriate** and **consistent timing** for different types of transactions. In all cases, a fast response from the computer should be provided with information on the requested transaction and its result.

- *Tactile feedback: e.g. when attaching an add-on device to a mobile device*
- *Aural feedback: e.g. when the add-on device has been recognized*
- *Visual feedback: e.g. displayed on the mobile device after recognition of the add-on device*

1.4 Legibility

It concerns the lexical characteristics of the information presented on the screen that may hamper or facilitate the reading of this information (character **brightness**, **contrast** between the letter and the background, font **size**, inter-words **spacing**, line spacing, paragraphs spacing, line length, etc.).

Ergonomic Criteria (5/9)

2. Workload

It concerns all interface elements that play a role in the reduction of the users' perceptual or cognitive load, and in the increase of the dialogue efficiency.

2.1 Brevity

It concerns the perceptual and cognitive workload both for individual inputs and outputs, and for sets of inputs (i.e., sets of actions needed to accomplish a goal or a task).

2.1.1 Concision

It concerns **perceptual and cognitive workload** for **individual inputs or outputs**.

2.1.2 Minimal Actions

It concerns workload with respect to the **number of actions** necessary to accomplish a goal or a task. It is here a matter of limiting as much as possible the steps users must go through.

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Ergonomic Criteria (6/9)

2.2 Information Density

It concerns the **density of the set(s) of information** presented on the screen. Thus an item can be relevant but not presented in a sufficiently concise way.

✦ 3. Explicit Control

The criterion *Explicit Control* concerns both the system processing of explicit user actions, and the control users have on the processing of their actions by the system.

3.1 Explicit User Action

The criterion *Explicit User Action* refers to the relationship between the computer processing and the actions of the users. This relationship must be explicit, i.e., **the computer must process only those actions requested by the users and only when requested to do so.**

3.2 User Control

It refers to the fact that **the users should always be in control of the system processing** (e.g., interrupt, cancel, pause and continue). Every possible action by a user should be anticipated and appropriate options should be provided.

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Ergonomic Criteria (7/9)

✦ 4. Adaptability

The adaptability of a system refers to its capacity to behave contextually and according to the users' needs and preferences.

4.1 Flexibility

The criterion *Flexibility* refers to the means available to the users to **customize** the interface in order to take into account their working strategies and/or their habits, and the task requirements.

4.2 User Experience

It refers to the means available to take into account the **level** of user experience.

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Ergonomic Criteria (8/9)

5. Error Management

The criterion *Error Management* refers to the means available to prevent or reduce errors and to recover from them when they occur. Errors are defined in this context as invalid data entry, invalid format for data entry, incorrect command syntax, etc.

5.1 Error Protection

The criterion *Error Protection* refers to the means available to **detect and prevent** data entry errors, command errors, or actions with destructive consequences.

5.2 Quality of Error Messages

The criterion *Quality of Error Messages* refers to the **phrasing** and the **content** of error messages, that is: their relevance, readability, and specificity about the nature of the errors (syntax, format, etc.) and the actions needed to correct them.

5.3 Error Correction

The criterion *Error Correction* refers to the **means available** to the users to correct their errors.

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Ergonomic Criteria (9/9)

6. Consistency

The criterion *Consistency* refers to the way interface design choices (codes, naming, formats, procedures, etc.) are maintained in similar contexts, and are different when applied to different contexts.

7. Significance of Codes

The criterion *Significance of Codes* qualifies the **relationship between a term and/or a sign and its reference**. Codes and names are significant to the users when there is a strong semantic relationship between such codes and the items or actions they refer to.

8. Compatibility

The criterion *Compatibility* refers to the **match between users' characteristics** (memory, perceptions, customs, skills, age, expectations, etc.) and **task characteristics** on the one hand, and the **organization of the output, input, and dialogue for a given application**, on the other hand.

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