Human-Computer Interaction

Chapter 16

In this Lecture you will Learn:

- The importance of good user interface design
- What is meant by metaphors in human–computer interaction
- About different approaches to human–computer interaction
- How to apply the techniques of scenario-based design
- How standards and the law affect interface design

What is the User Interface?

- Users of systems interact with the system to carry out tasks by:
  - Reading and interpreting information about how to use the system
  - Issuing commands to the system
  - Entering words and numbers into the system as data to work with
  - Reading and interpreting the results
  - Responding to and correcting errors

What is the User Interface?

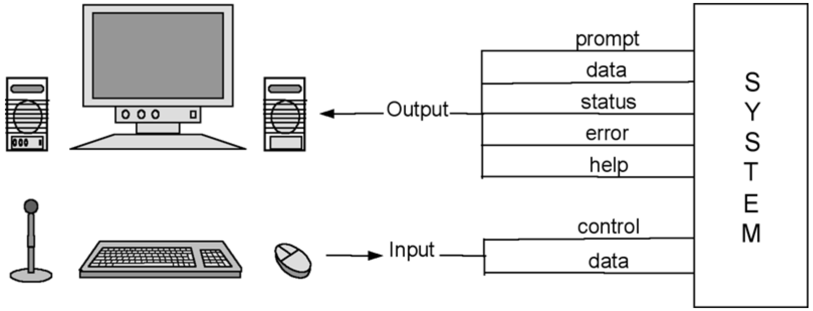
- It is important to note that User Interface are secondary tasks:
  - They are concerned with using the system not with the users' primary objectives.
- If the system has been designed well, the secondary, system-related tasks will be easy to carry out; if it has not been designed well, the secondary tasks will intrude into the process and will make it more difficult for the users to achieve their primary tasks.

Metaphors

- The idea that the user carrying on a dialogue with the system is a **Metaphor**.
- A metaphor is a terms used figuratively to *describe something but not applied literally*
- Two metaphors for Human-Computer Interaction:
  - The Dialogue Metaphor
  - The Direct Manipulation Metaphor

The Dialogue Metaphor

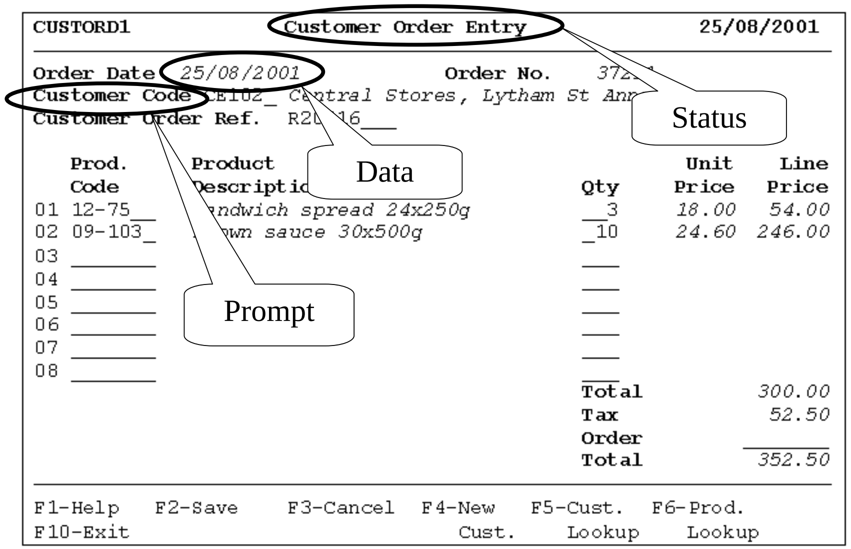
- Communication between the human and the computer is a kind of **Dialogue**
- There is no real conversation, but messages are passed from the human to the computer, the computer responds in some way, and that prompts the human to respond, etc.



Types of Messages in Dialogue

Output	Prompt	Request for user input
	Data	Data from application following user request
	Status	Acknowledgment that something has happened
	Error	Processing cannot continue
	Help	Additional information to user
Input	Control	User directs which way dialogue will proceed
	Data	Data supplied by user

Example of Prompt, Data and Status



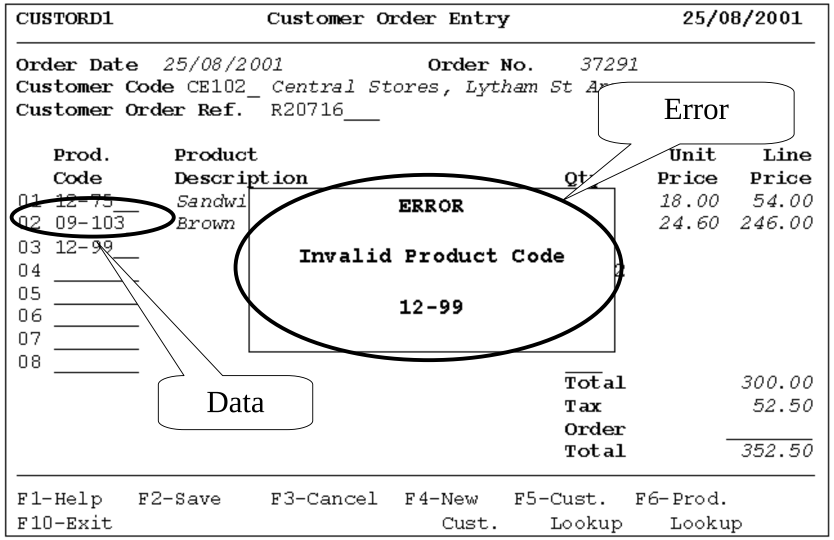
```
CUSTORD1            Customer Order Entry            25/08/2001

Order Date  25/08/2001              Order No.    372
Customer Code CE102_ Central Stores, Lytham St Ann
Customer Order Ref.  R20 16___

   Prod.      Product                               Unit    Line
   Code       Description                Qty       Price   Price
01 12-75__     andwich spread 24x250g    __3       18.00   54.00
02 09-103_      own sauce 30x500g        _10       24.60  246.00
03 _______                               ___
04 _______                               ___
05 _______                               ___
06 _______                               ___
07 _______                               ___
08 _______                               ___
                                         Total            300.00
                                         Tax               52.50
                                         Order           _______
                                         Total            352.50

F1-Help   F2-Save    F3-Cancel  F4-New   F5-Cust.  F6-Prod.
F10-Exit                        Cust.    Lookup    Lookup
```

Example of Error and Data



```
CUSTORD1               Customer Order Entry                25/08/2001

Order Date  25/08/2001              Order No.    37291
Customer Code CE102_ Central Stores, Lytham St Ar
Customer Order Ref.  R20716___

   Prod.      Product                                     Unit    Line
   Code       Description                       Qt        Price   Price
01 12-75__    Sandwi                                      18.00   54.00
02 09-103     Brown                                       24.60  246.00
03 12-99__
04 _______
05 _______
06 _______
07 _______
08 _______
                                                Total            300.00
                                                Tax               52.50
                                                Order
                                                Total            352.50

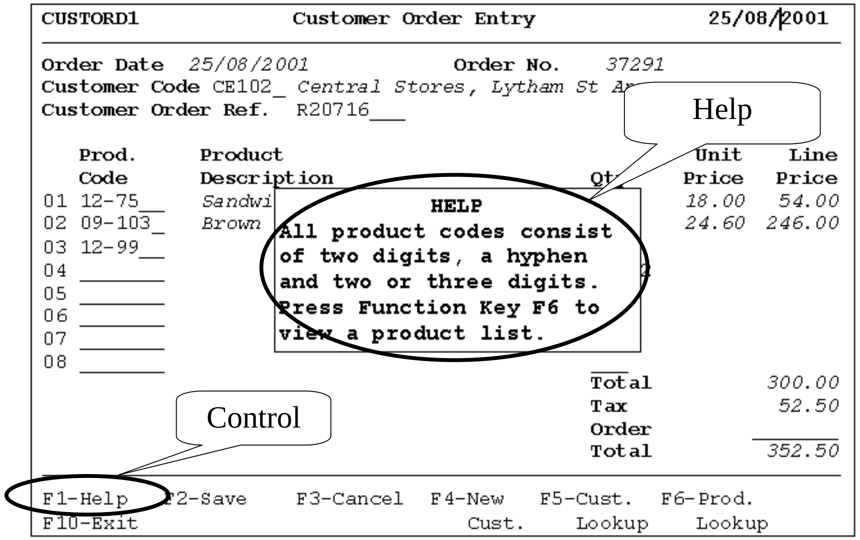
F1-Help   F2-Save    F3-Cancel  F4-New    F5-Cust.   F6-Prod.
F10-Exit                             Cust.     Lookup     Lookup
```

```
ERROR

Invalid Product Code

12-99
```

Example of Control and Help



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02 09-103_    Brown                                       24.60  246.00
03 12-99__
04 _______
05 _______
06 _______
07 _______
08 _______
                                                Total            300.00
                                                Tax               52.50
                                                Order
                                                Total            352.50

F1-Help   F2-Save    F3-Cancel  F4-New    F5-Cust.   F6-Prod.
F10-Exit                             Cust.     Lookup     Lookup
```

```
             HELP
All product codes consist
of two digits, a hyphen
and two or three digits.
Press Function Key F6 to
view a product list.
```

The Direct Manipulation Metaphor

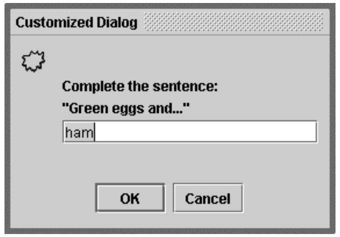
- The interface gives the impression that you are manipulating physical objects on the screen through the use of the mouse:
  - Drag and Drop an icon
  - Shrink or Expand a window
  - Push a button
  - Pull down a menu

Event-driven Interfaces

- Graphical User Interfaces (GUI) are **Event-driven**
- The window manager *responds to events and changes the state of objects* in the window system
- In a complex interface like a word-processor, the user can choose from many actions; the system has to respond correctly whichever is chosen and maintain correct state information

Event-driven Interfaces

- Sometimes modal dialogues are used – the user can interact with only the dialogue box until he or she closes the dialogue window
- Sometimes the user can be constrained by disabling and enabling elements of the interface to limit his or her choice of action



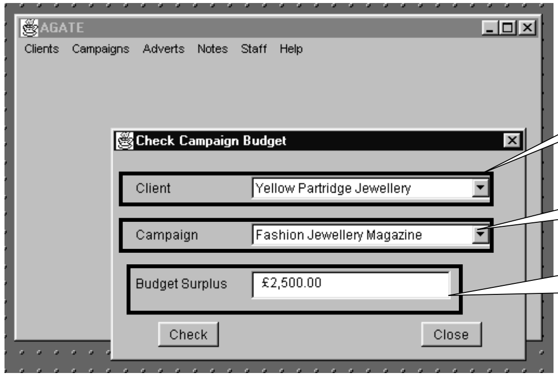
Customized Dialog

Complete the sentence:
"Green eggs and..."

ham

Constraining User Interaction

- It makes no sense for the user to pick a campaign if they haven't already selected a client, or to click [Check] if they haven't selected a campaign



Check Campaign Budget

Client: Yellow Partridge Jewellery

Campaign: Fashion Jewellery Magazine

Budget Surplus: £2,500.00

First the user selects a client

Then the user selects a campaign

Finally the user clicks on Check and the budget is displayed

Characteristics of Good Dialogues

- Regardless of whether a system is being developed for a text-based environment or for a GUI environment, there are a number of important general characteristic of good dialogue design.
  - Consistency
  - Appropriate User Support
  - Adequate Feedback from the System
  - Minimal User Input

Characteristics of Good Dialogues - Consistency

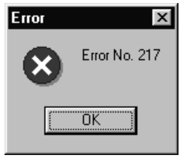
- Helps users to learn the application
- Even better if all applications within an organization have consistent standards
  - Example, **[F1]** always call out Help
- Company style guides or style guides from Microsoft and Apple can be applied

Characteristics of Good Dialogues - Appropriate User Support

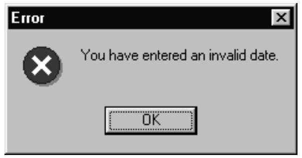
- Provide error and warning messages
- If the user has gone wrong the dialogue should help them to set the situation right
- Avoid hidden content on web pages
- Error messages should be informative not cryptic, and use terms the user will know
- Use warning messages to prevent likely errors, but don’t overdo it and irritate users

Characteristics of Good Dialogues

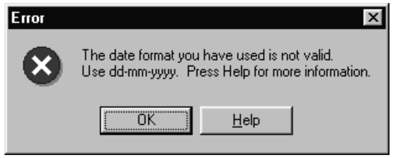
- Which error message is most helpful?


Error

Error No. 217

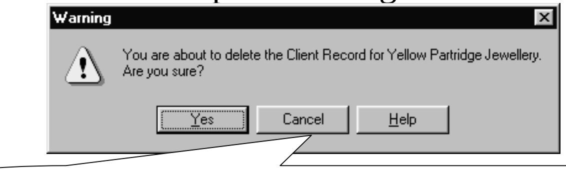

Error

You have entered an invalid date.


Error

The date format you have used is not valid.
Use dd-mm-yyyy. Press Help for more information.

- Is this a helpful warning?

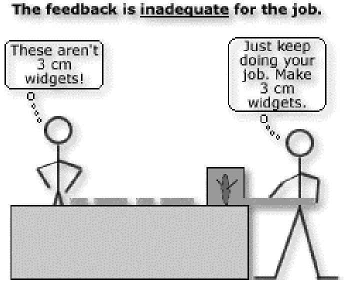

Warning

You are about to delete the Client Record for Yellow Partridge Jewellery.
Are you sure?

The warning is not ideal. Yes appears to be the default, which is risky if the user hits Return. The question asks ‘Are you sure?’, but the answers are Yes, Cancel and Help. Would Yes, No and Help be better? Or should the question be ‘Do you wish to proceed?’?

Characteristics of Good Dialogues - Adequate Feedback

- The user expects some response when they press a key or click a button
- If they get no response, users tend to try again or press another key, sometimes these key presses get buffered and produce unexpected results

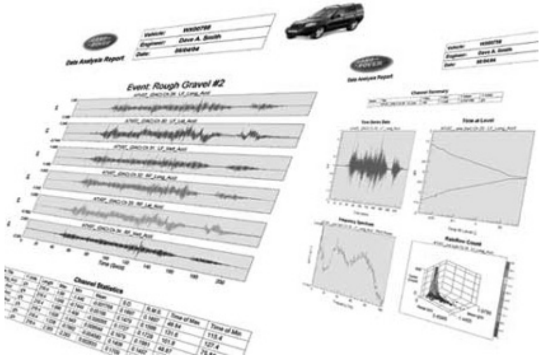

The feedback is inadequate for the job.
These aren't 3 cm widgets!
Just keep doing your job. Make 3 cm widgets.

Characteristics of Good Dialogues - Minimal User Input

- Try to design systems so that users do not have to make unnecessary key presses or mouse clicks
  - Use codes and abbreviations
  - Let users select from a list
  - Let users edit incorrect values rather than retype them
  - Provide information that can be derived automatically
  - Use defaults
  - Use accelerator keys for menus

Style Guides

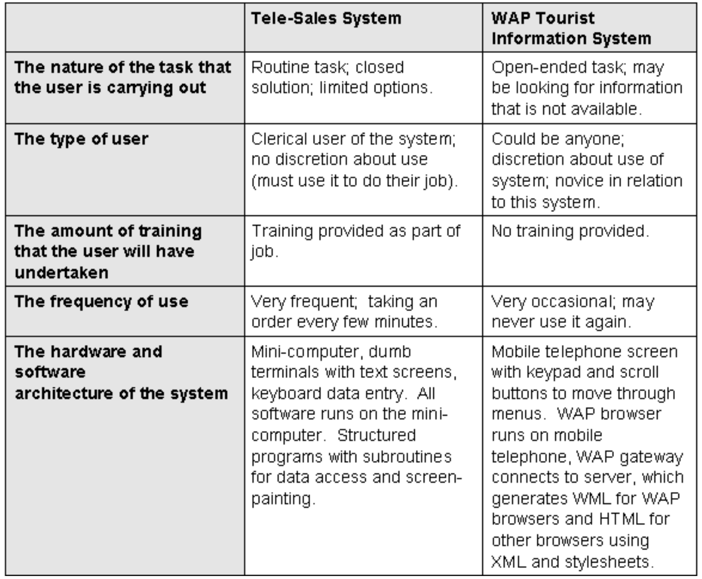
- Microsoft and Apple provide guidelines on design of interfaces for their platforms
- Large organizations may have their own style guides



Approaches to Interface Design

- Design is influenced by
  - Nature of the task the user carries out
  - Type of user
  - Amount of training user will have received
  - Frequency of use
  - Hardware and software architecture
- Approaches can be **Informal** or **Formal**

User Interface Design Factor Example

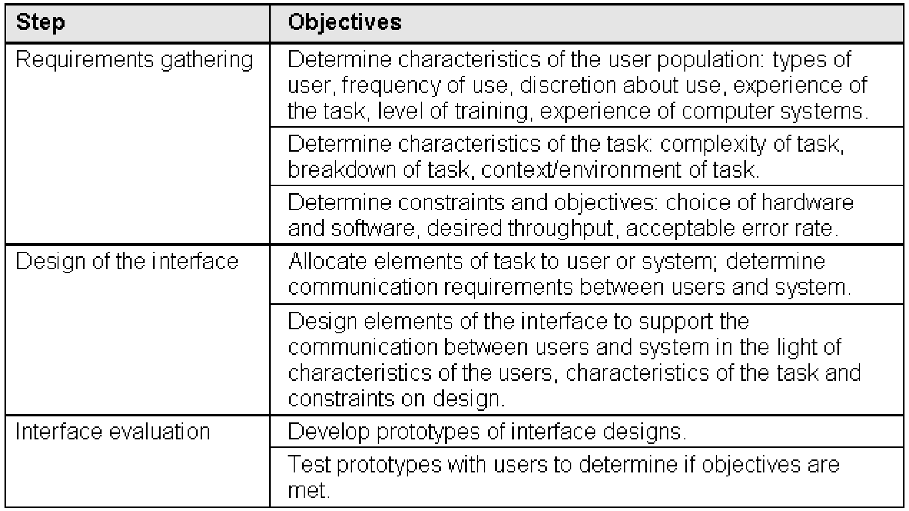


	Tele-Sales System	**WAP Tourist Information System**
The nature of the task that the user is carrying out	Routine task; closed solution; limited options.	Open-ended task; may be looking for information that is not available.
The type of user	Clerical user of the system; no discretion about use (must use it to do their job).	Could be anyone; discretion about use of system; novice in relation to this system.
The amount of training that the user will have undertaken	Training provided as part of job.	No training provided.
The frequency of use	Very frequent; taking an order every few minutes.	Very occasional; may never use it again.
The hardware and software architecture of the system	Mini-computer, dumb terminals with text screens, keyboard data entry. All software runs on the mini-computer. Structured programs with subroutines for data access and screen-painting.	Mobile telephone screen with keypad and scroll buttons to move through menus. WAP browser runs on mobile telephone, WAP gateway connects to server, which generates WML for WAP browsers and HTML for other browsers using XML and stylesheets.

Formal Design Approach

- Formal approaches include
  - Structured Approaches
  - Ethnographic Approaches
  - Scenario-based Approaches
- All carry out three main steps in HCI design
  - Requirements Gathering
  - Design of the Interface
  - Interface Evaluation

Steps in HCI Design and Objectives



Step	Objectives
Requirements gathering	Determine characteristics of the user population: types of user, frequency of use, discretion about use, experience of the task, level of training, experience of computer systems.
	Determine characteristics of the task: complexity of task, breakdown of task, context/environment of task.
	Determine constraints and objectives: choice of hardware and software, desired throughput, acceptable error rate.
Design of the interface	Allocate elements of task to user or system; determine communication requirements between users and system.
	Design elements of the interface to support the communication between users and system in the light of characteristics of the users, characteristics of the task and constraints on design.
Interface evaluation	Develop prototypes of interface designs.
	Test prototypes with users to determine if objectives are met.

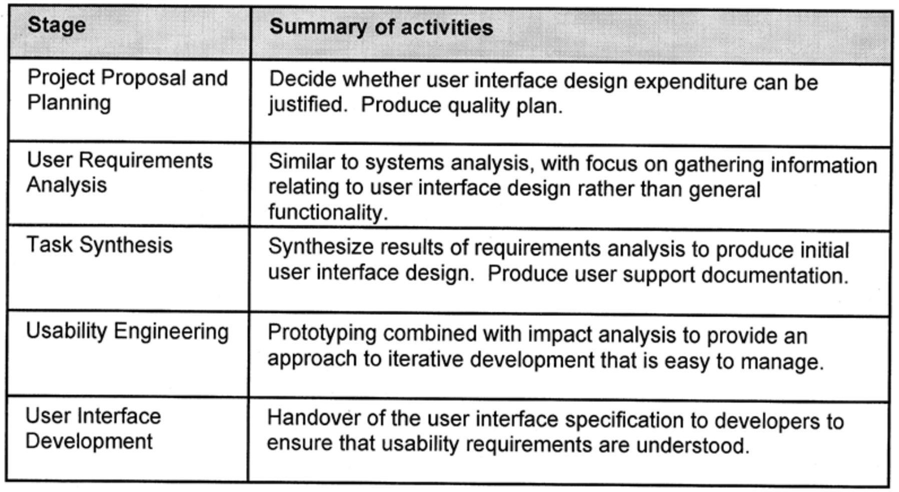
Structured Approaches

- Relate to structured approaches to analysis and design prevalent in 1980s and early 1990s
- Allow for activities to be carried out in parallel
- Model life cycle as stages, steps and tasks
- Concentrate on understanding tasks and allocating tasks between the users and the system
- Make extensive use of checklists to characterize users, tasks and environment
  - STUDIO (**ST**ructured **U**ser-interface **D**esign for **I**nterface **O**ptimisation)
  - The RESPECT User Requirement Framework

Five Stage in STUDIO

- STUDIO is divided into **Stages**, and each Stage is broken into **Steps**.
- The activities undertaken in each of the Stages are:
  - Project Proposal and Planning
  - User Requirements Analysis
  - Task Synthesis
  - Usability Engineering
  - User Interface Development

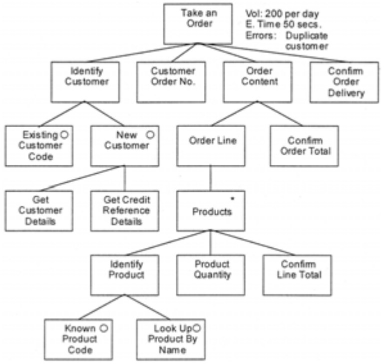
Summary of Activities in STUDIO



Stage	Summary of activities
Project Proposal and Planning	Decide whether user interface design expenditure can be justified. Produce quality plan.
User Requirements Analysis	Similar to systems analysis, with focus on gathering information relating to user interface design rather than general functionality.
Task Synthesis	Synthesize results of requirements analysis to produce initial user interface design. Produce user support documentation.
Usability Engineering	Prototyping combined with impact analysis to provide an approach to iterative development that is easy to manage.
User Interface Development	Handover of the user interface specification to developers to ensure that usability requirements are understood.

Techniques in STUDIO

- Uses a number of techniques
  - Task hierarchy diagrams
  - Knowledge representation grammars
  - Task allocation charts
  - Statecharts



Benefits of Structured Approaches

- Breakdown into stages and steps makes project management easier
- Provide standards in diagrams and documentation that improve communication
- Specification is comprehensive and is therefore more likely to result in a good quality system

Criticisms of Structured Approaches

- Tend to be very bureaucratic, with lots of forms and checklists
- Evaluation of usability under laboratory conditions (as with RESPECT) lacks ‘ecological validity’

Ethnographic Approaches

- Rooted in ethnographic approaches in sociology and anthropology
- Researcher seeks to be involved in the situation he or she is studying
- Only this way can the situation be properly understood
- Qualitative rather than quantitative

Ethnography

- Hammersley and Atkinson (1995) provide a definition of Ethnography:
  - In its most characteristic form it involves the ethnographer participating, overtly or covertly, in people’s daily lives for an extended period of time, watching what happens, listening to what is said, asking questions – in fact, collecting whatever data are available to throw light on the issues that are the focus of the research.

Ethnographic Approaches

- Interface designer needs to be immersed in the task of the users
- Recognizes that different users experience the task subjectively
- Criticizes some methods for failing to address the context of the task
- Use a variety of data gathering techniques, including interviews, discussions, video-taping users, prototyping
- Structured approaches respond by adding a ‘**Contextual Analysis**’ checklist

Contextual Enquiry

- One method of ethnographic analysis
- Developed by John Whiteside and others at Digital Equipment Corporation (DEC)
- Used to carry out evaluation of the usability in normal working environment

Scenario-based Approaches

- Less formal than structured approaches but more formal than ethnography approaches
- Use scenarios as a tool in requirements gathering, interface design and interface evaluation
- Scenarios are step-by-step descriptions of a user’s actions
- Closest of the three approaches to use case modelling and fits well with it

Scenario-based Approaches

- Scenarios can be
  - Textual descriptions
  - Storyboards
  - Prototypes
  - Video mock-ups

Example Scenario in Existing System

- Scenario describing Peter Bywater of Agate adding a new note

Peter starts up the word-processor.

He types in a title for the note and changes its style to *Title*.

He types in two paragraphs describing his idea for an advertisement for the Yellow Partridge campaign to be used in fashion magazines in Europe during the summer of 1999.

He types his initials and the date and time.

He uses the short-cut keys to save the file.

The save-as dialogue box appears and, using the mouse, he changes to the *Summer 1999 Campaign* folder in the *Yellow Partridge* folder on the server.

He scrolls to the bottom of the list of files already in the folder and reads the title of the last note to be added, *Note 17*, he calls the new note *Note 18* and clicks on Save.

He exits from the word-processor.

Example Scenario for the New System

- Scenario describing how a user might add note in the new system

The user selects Add a Note from the menu. A new window appears.

From the list box at the top of the window she selects the name of the client.

A list of campaigns appears in the list box below, and she selects a particular campaign.

A list of adverts appears in the next list box, and she selects a specific advert.

She types a few paragraphs into a text box to describe her idea for the advert. She fills the space on screen and a vertical scrollbar appears and the text in the text box scrolls up.

She enters her initials into a text box, and the system checks that she is allocated to work on that campaign.

The date and time are displayed by the system, and the Save button is enabled.

She clicks on the Save button and the word Saved appears in the status bar.

The text box, the text field for initials and the date and time are cleared.

Scenario-based Approaches

- Can be used (among other things) to
  - **Gather Requirements** – Describe what the user does now
  - **Envision Solutions** – Describe possible ways of working
  - **Evaluate System** – Write test cases that follow scenarios
  - **Document the System** – Write manual sections that follow scenarios

Scenario-based Approaches

- Scenarios can be worked through with the users, building prototype solutions
- Scenarios can be used to develop ‘design claims’ (Carroll, 1995), which justify design decisions in terms of the scenarios
- If textual scenarios are used, large volumes of text result and must be managed carefully

Design Claims

- Claims for the new design scenario

The Save button is disabled until the user has selected a client and a campaign, entered some text and entered his or her initials. This prevents the user attempting to save the note before all data has been entered and getting an error message.

The initials of the user could be entered automatically from their network login, but observation shows that the creative staff often work together as a group and different people will come up with ideas that they record as notes. It would be inconvenient for them to be logging in and out of the system each time a different person wants to enter a new note. For this reason, they are required to enter their initials.

The initials, date, time and text fields are cleared after a note is saved, but the client, campaign and advert list boxes are left untouched so that the user can enter another note for the same advert or campaign without having to reselect these items.

Achieving Usability

- Usability is not ‘user-friendliness’
- Usability can be measured (Shackel, 1990)
  - **Learnability** – time and effort required to achieve a particular level of performance
  - **Throughput** – Speed with which tasks can be achieved, number of errors
  - **Flexibility** – Ability to respond to changing tasks and environment
  - **Attitude** – How positive an attitude users have

Standards and Legal Requirements

- International standards do not have force of law
  - **ISO 9241** – Standard for ergonomic requirements for work with Visual Display Terminals
  - **ISO 14915 –** Standard for Multimedia User Interface Design

Standards and Legal Requirements

- EU Council Directive of May 1990
- In the UK implemented in law as the Health and Safety (Display Screen Equipment) Regulations 1992
- All workstations must comply with minimum requirements and employers have a duty in law to ensure the health and safety of employees using display screen equipment

Standards and Legal Requirements

- Employers are required to:
  - Analyse Risks
  - Take Action to Reduce Risks
  - Ensure Workstations Meet Requirements
  - Plan Work Activities to Include Breaks
  - Provide Eyesight Tests for Users
  - Provide Corrective Appliances for Eyes
  - Provide Relevant Training
  - Provide Information to Employees

Standards and Legal Requirements

- Employers must take into account the following principles in designing, choosing, commissioning and modifying software and in designing tasks for people that require them to use display screen equipments
  - Software must be suitable for task
  - Software must be easy to use and adaptable to the user's knowledge and experience
  - Employer may not use software to check up on employees without their knowledge
  - Systems must give feedback to users about performance
  - Systems must display information suited to users
  - Principles of software ergonomics must be applied to the way people process data

Standards and Legal Requirements

- In Singapore the Ministry of Manpower published Guidelines for Work with Visual Display Unit or Visual Display Terminal (VDT) in 2000
- In Hong Kong the first Regulation to be considered under the Occupational Safety and Health Ordinance (OSHO) 1997 was the Occupational Safety and Health (Display Screen Equipment) Regulation