4.1 User Interface Design Process

Obstacles and Pitfalls in the Development Path

- Gould (1988) has made these general observations about design :
  a) Nobody ever gets it right the first time.
  b) Development is chock-full of surprises.
  c) Good design requires living in a sea of changes.
  d) Making contracts to ignore change will never eliminate the need for change.
  e) Even if you have made the best system humanly possible, people will still make mistakes when using it.
  f) Designers need good tools.
  g) You must have behavioural design goals like performance design goals.
- Pitfalls in the design process exist because of a flawed design process, including a failure to address critical design issues, an improper focus of attention, or development team organization failures.
- Common pitfalls are :
  a) No early analysis and understanding of the user's needs and expectations.
  b) A focus on using design features or components that are "neat" or "glitzy."
  c) Little or no creation of design element prototypes.
  d) No usability testing.
  e) No common design team vision of user interface design goals.
  f) Poor communication between members of the development team.

4.1.1 Designing for People : The Five Commandments

1. Gain a complete understanding of users and their tasks
2. Solicit early and ongoing user involvement
3. Perform rapid prototyping and testing
4. Modify and iterate the design as much as necessary
5. Integrate the design of all the system components.

4.2 Usability Assessment in the Design Process

- Usability to describe the effectiveness of human performance. In early stages of the product development cycle, usability assessment starts and it will be continue till the process completes.

1. Common Usability Problems

- Mandel lists the 10 most common usability problems in graphical systems as reported by IBM usability specialists. They are :

1. Ambiguous menus and icons.
2. Languages that permit only single - direction movement through a system.
3. Input and direct manipulation limits.
4. Highlighting and selection limitations.
5. Unclear step sequences.
6. More steps to manage the interface than to perform tasks.
7. Complex linkage between and within applications.
8. Inadequate feedback and confirmation.
9. Lack of system anticipation and intelligence.
10. Inadequate error messages, help, tutorials, and documentation.

2. Practical Measures of Usability

a) Are people asking a lot of questions or often reaching for a manual ?

b) Are frequent exasperation responses heard ?

c) Are there many irrelevant actions being performed ?

d) Are there many things to ignore ?

e) Do a number of people want to use the product ?

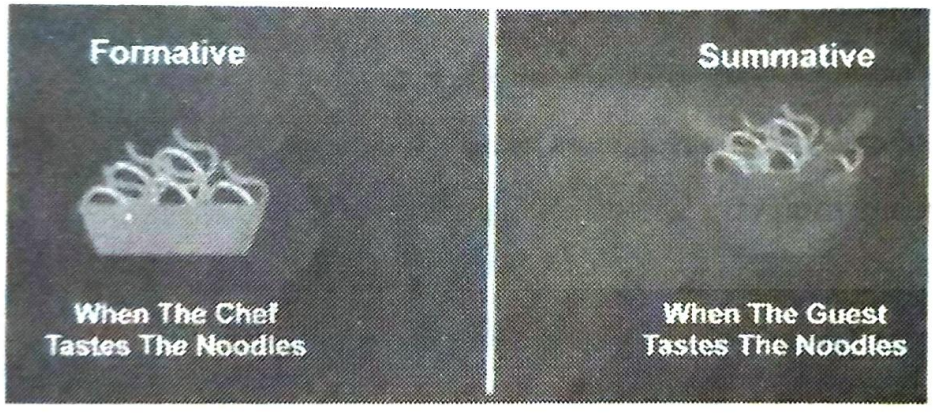
3. Objective Measures of Usability

- According to Shackel, usability is a property of a system or a piece of equipment. The property is not constant, being relative in relation to users, their training and support, tasks and environments.
- Thus, the evaluation is context - dependent. The system or piece of equipment may be usable if it matches the combination of users, tasks, and environment.

- Usability has two sides, one related to subjective perception of the product and the other to objective measures of the interaction. The instruments, scales or aspects needed to isolate these are not explicated by the definition.
- Shackel recognises the ambiguousness of the definition and suggests a set of operational criteria. For a system to be usable it has to achieve defined levels on the following scales :
  a) Effectiveness, meaning the results of interaction in terms of speed and errors;
  b) Learnability, meaning the relation of performance to training and frequency of use, i.e. the novice user's learning time with specified training and retention on the part of casual users;
  c) Flexibility, allowing adaptation to tasks and environments beyond those first specified;
  d) Attitude, meaning "acceptable levels of human costs in terms of tiredness, discomfort, frustration and personal effort".

4.3 Formative and Summative Evaluation

- Formative evaluations are used in an iterative process to make improvements before production. Summative evaluations are used to evaluate a shipped product in comparison to a benchmark.
- Formative evaluation takes place during the design process. Summative evaluation is aimed at measures of quality.



- Formative evaluations focus on determining which aspects of the design work well or not, and why. These evaluations occur throughout a redesign and provide information to incrementally improve the interface.
- Formative evaluations of interfaces involve testing and changing the product, usually multiple times, and therefore are well - suited for the redesign process or while creating a new product.

- In both cases, you iterate through the prototyping and testing steps until you are as ready for production as you'll get. Thus, formative evaluations are meant to steer the design on the right path.
- Summative evaluations describe how well a design performs, often compared to a benchmark such as a prior version of the design or a competitor.
- Unlike formative evaluations, whose goals is to inform the design process, summative evaluations involve getting the big picture and assessing the overall experience of a finished product. Summative evaluations occur less frequently than formative evaluations, usually right before or right after a redesign.

4.3.1 Usability Specification for Evaluation

- Mediated evaluation is a key idea behind usability specifications. Usability specifications rely on a task analysis similar to the methods of hierarchical task analysis.
- A user interaction scenario describes work activities that are typical, critical, or novel. Task analysis breaks these activities into subtasks that provide a more precise specification of what users are expected to do.
- For example, a scenario in which a user "searches a digital library for Scriven's article on evaluation" might be analyzed into subtasks such as "accessing the digital library," "initiating the search function," and "specifying search keys for Scriven's article."
- Decomposing a scenario in this way allows the evaluator to state exactly what a given user should be able to do, and what level of performance and/or satisfaction is expected for each subtask.

4.4 Analytic Methods

- Analytic methods can be used in early development process, well before there are users or prototypes available for empirical tests.
- Cost of analytic method is often less expensive to analyse a system than to design and carry out an empirical study.
- Hazard of analytic evaluation is that designers may feel that they are being evaluated.

4.4.1 Model Based Analysis : GOMS Model

- The GOMS is an acronym for Goals, Operators, Methods and Selection. GOMS is a task analysis technique.
- GOMS is family of user interface modeling techniques.

- The GOMS model has four components : *goals, operators, methods and selection rules.*
  1. Goals - Tasks are deconstructed as a set of goals and subgoals. GOMS the goals are taken to represent a 'memory point' for the user
  2. Operators - Tasks can only be carried out by undertaking specific actions. **Example** : To decide which search engine to use.
  3. Methods - It represent ways of achieving a goal. Example : Drag mouse over field.
  4. Selection rules - The method that the user chooses is determined by selection rules

  Example : GOMS for photocopying a paper from journal
- One possible GOMS description of the goal hierarchy for this task is given below. Answers will vary depending on assumptions about the photocopier used as the model for the exercise.
- In this example, we will assume that the article is to be copied one page at a time and that a cover over the imaging surface of the copier has to be in place before the actual copy can be made.

Goal: PHOTOCOPY-PAPER

Goal: LOCATE-ARTICLE

Goal: PHOTOCOPY-PAGE repeat until no more pages

[Select Goal: SELECT-PAGE --> CHOOSE-PAGE-TO-COPY]

Goal: ORIENT-PAGE

OPEN -COVER

POSITION-PAGE

CLOSE-COVER

PRESS-BUTTON

Goal: VERIFY-COPY

LOCATE-OUT-TRAY

EXAMINE-COPY

Goal: COLLECT-COPY

LOCATE-OUT-TRAY

REMOVE-COPY (*outer goal satisfied*!)

Goal: RETRIEVE-JOURNAL

OPEN-COVER

REMOVE-JOURNAL

CLOSE-COVER

Selection rules exist if a spoiled copy was printed. Consider the following :

Rule 1 : SELECT-PAGE **if last page was copied successfully or start of article.**

Note : The goal SELECT-PAGE is only valid if we are at the start of the article or the last copy was successful. If the last copy was spoiled the we must recopy the current page. so only a re-orientation would be required.

Goal : PHOTOCOPY-PAPER

Goal : LOCATE-ARTICLE

Goal : PHOTOCOPY-PAGE repeat until no more pages

[**Select** **Goal** : SELECT-PAGE --> CHOOSE-PAGE-TO-COPY]

Goal : ORIENT-PAGE

OPEN -COVER

POSITION-PAGE

CLOSE-COVER

PRESS-BUTTON

Goal : VERIFY-COPY

LOCATE-OUT-TRAY

EXAMINE-COPY

Goal : RETRIEVE-JOURNAL

OPEN-COVER

REMOVE-JOURNAL

CLOSE-COVER

Goal : COLLECT-COPY

LOCATE-OUT-TRAY

REMOVE-COPY (*outer goal satisfied*!)

- Closure to Outer Goal, must force user to collect copy last.

4.4.1.1 Advantages and Disadvantages of GOMS

Advantages :

1. Easy to construct a simple GOMS model and saves time.
2. Helps discover usability problems.
3. Gives several qualitative and quantitative measures.
4. Less work than usability study.

Disadvantages :

1. Only work for goal directed tasks.
2. Not for the novice user.
3. Not ideal for leading edge technology systems.
4. Not as easy as heuristics analysis, guidelines.

4.5 Empirical Methods

- Empirical evaluation means that information is derived from actual users of the system or people who resemble users.

4.5.1 Field Study

- One way to ensure the validity of empirical evaluation is to use field study methods, where normal work activities are studied in a normal work environment.
- Field studies can be valuable in formative evaluation, just as they are in requirements analysis. A field study is often the only way to carry out a longitudinal study of a computer system in use, where the emphasis is on effects of the system over an extended period of time.
- Suchman's study of document copier systems is a classic example of a field study. Suchman observed people using a sophisticated photocopier equipped with sensors to track users' actions, and the system offers helpful prompts and feedback.
- In a comprehensive field study, hundreds of such episodes might be collected. The amount and richness of the data emphasize the key disadvantage of fieldwork, the data obtained has high validity but can be extremely difficult to condense and understand.
- Field study observations may also be rated for severity.

4.5.2 Usability Testing in a Laboratory

- As the name suggests, lab usability testing is testing run in special environments (laboratories) and supervised by a moderator. A moderator is a professional who is looking to obtain feedback from live users.
- During a moderated test, moderators are facilitating test participants through tasks, answering their questions, and replying to their feedback in real - time.
- Laboratory studies do not have the overhead of installing or updating a system in a real work site, so they permit rapid cycles of user feedback and prototyping.
- A usability lab is a specially constructed observation room that is set upto simulate a work environment (e.g., an office), and instrumented with various data collection devices.

❑ **1. Laboratory studies :** Performed under laboratory conditions.

- **Advantages :**
  a. Specialist equipment available.
  b. Uninterrupted environment.
- **Disadvantages :**
  a. Lack of context.
  b. Different to observe several users cooperating.

❑ **2. Field studies :** Conducted in the work environment or in "the field".

- **Advantages :**
  a. Natural environment
  b. Context retained
  c. Longitudinal studies possible
- **Disadvantages :**
  a. Distractions, interrupts
  b. Noise

4.5.3 Controlled Experiments

- A controlled experiment can be designed to compare and contrast the devices. The first step in planning an experiment is to identify the variables that will be manipulated or measured. An independent variable is a characteristic that is manipulated to create different experimental conditions.

- A dependent variable is an experiment outcome; it is chosen to reveal effects of one or more independent variables.
- The independent and dependent variables of an experiment are logically connected through hypotheses that predict what causal effects the independent variables will have on dependent variables.
- In a within - subjects design, the same participants are exposed to all levels of an independent variable. In contrast, a between-subjects design uses independent groups of participants for each test condition.
- Within - subjects design is also called repeated measures. Within - subjects designs are popular and convenient, fewer participants are required, and potentially large effects of individual variability are controlled.
- The simplest method is random assignment : Each participant is placed randomly in a group, with the constraint that groups end up being the same size.

4.5.4 Heuristic Evaluation

- A third expert - based approach is the use of models. Certain cognitive and design models provide a means of combining design specification and evaluation into the same framework.
- For example, the GOMS (Goals, Operators, Methods and Selection) model predicts user performance with a particular interface and can be used to filter particular design options. Similarly, lower - level modelling techniques such as the keystroke - level model provide predictions of the time users will take to perform low - level physical tasks.
- Design methodologies, such as design rationale, also have a role to play in assessment at the design stage. Design rationale provides a framework in which design options can be evaluated.
- Dialog models can also be used to estimate dialog sequences for problems, such as unreachable states, circular dialogs and complexity. Models such as state transition networks are useful for evaluating dialog designs prior to implementation.

4.5.5 Cognitive Walkthrough

- Heuristic evaluation can be carried out on a design specification so it is useful for evaluating early design. But it can also be used on prototypes, storyboards and fully running systems. It is a flexible, relatively cheap approach. Hence it is often considered a discount usability technique.

- The general idea behind heuristic evaluation is that several evaluators independently review a system to come up with probable usability problems.
- Each evaluator assesses the system and notes violations of any of heuristics that would indicate a probable usability problem.
- The evaluator also assesses the severity of each usability problem, based on four factors : how common is the problem, how easy is it for the user to overcome, will it be a one - off problem or a persistent one and how seriously will the problem be perceived ? These can be combined into an overall severity rating on a scale of 0 - 4 :

  0 = I don't agree that this is a usability problem at all

  1 = Cosmetic problem only : Need not be fixed unless extra time is available on project

  2 = Minor usability problem : Fixing this should be given low priority

  3 = Minor usability problem : Important to fix, so should be given priority

  4 = Usability catastrophe : Imperative to fix this before product can be released (Nielsen)

❑ Advantages :

- Permits early evaluation of designs at the prototyping stage or without a mockup.
- Helps the designer assess how the features of their design fit together to support users' work.
- Provides useful feedback about action sequences.
- Assists designer by providing reasons for trouble areas.
- Provides indications of the users' mental
- Processes, which helps build a successful interface that accommodates users.

❑ Disadvantages :

- Relies on analysis rather on user testing.
- Provides a detailed examination of a particular task rather than an overview of the interface.
- Provides no quantitative data.

4.6 Evaluation Framework

- Any kind of evaluation is guided explicitly or implicitly by a set of beliefs, which are often under - pined by theory. These beliefs and the methods associated with them are known as an 'evaluation paradigm'.

- Four evaluation paradigms are
  a) 'quick and dirty' b) usability testing
  c) field studies d) predictive evaluation
- 'quick and dirty' evaluation describes the common practice in which designers informally get feedback from users or consultants to confirm that their ideas are in - line with users' needs and are liked. Quick & dirty evaluations are done any time. The emphasis is on fast input to the design process rather than carefully documented findings.
- Usability testing involves recording typical user's performance on typical tasks in controlled settings. Field observations may also be used. As the users perform these tasks they are watched and recorded on video and their key presses are logged. This data is used to calculate performance times, identify errors and help explain why the users did what they did.
- Field studies are done in natural settings. The aim is to understand what users do naturally and how technology impacts them.
- Predictive evaluation : Experts apply their knowledge of typical users, often guided by heuristics, to predict usability problems. Another approach involves theoretically based models.

4.6.1 Decide : A Framework to Guide Evaluation

DECIDE is a framework that is used to guide evaluation

1. Determine the goals the evaluation addresses.
2. Explore the specific questions to be answered.
3. Choose the evaluation paradigm and techniques to answer the questions.
4. Identify the practical issues.
5. Decide how to deal with the ethical issues.
6. Evaluate, interpret and present the data.

4.7 Universal Design

- Universal design is the process of designing interactive systems that are usable by anyone, with any range of abilities, using any technology platform.
- The design and composition of an environment so that it may be accessed, understood and used.

a) To the greatest possible extent

b) In the most independent and natural manner possible

c) In the widest possible range of situations

d) Without the need for adaptation, modification

- Universal design should incorporate a two level approach :

1. User-Aware design : Pushing the boundaries of 'mainstream' products, services and environments to include as many people as possible.
2. Customisable design : Design to minimize the difficulties of adaptation to particular.

4.7.1 Universal Design Principle

- Universal design principles are as follows :

a. Equitable use : The design is useful and marketable to people with diverse abilities

b. Flexibility in use : The design accommodates a wide range of individual preferences and abilities.

c. Simple and intuitive to use : Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

d. Perceptible information : The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

e. Tolerance for error : The design minimizes hazards and the adverse consequences of accidental or unintended actions.

f. Low physical effort : The design can be used efficiently and comfortably and with a minimum of fatigue

g. Size and space for approach and use : Appropriate size and space is provided for approach, reach, manipulation and use regardless of user's body size, posture, or mobility.