HCI: Interactive System Design

(Usability Engineering Perspective)

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Usability Engineering UE

Overview of Usability Engineering (UE)

- The need for usability
- What do usability and UE mean?
- What happens without UE?
- UE Lifecycle
- User-Centered Design (UCD) Methodology

Usability Engineering

- Jacob Nielsen: Usability Engineering (1993) Well known book.
- Xristine Faulkner (2000): defines it as follows

"UE is an approach to the development of software and systems which involves user participation from the outset and guarantees the usefulness of the product through the use of a **usability specification** and **metrics**"

- UE refers to the USABILITY FUNCTION aspects of the entire **process** of conceptualizing, executing & testing products (both hardware as well as software), from requirements gathering stage to installation / marketing & testing of their use.

Definition of Usability

- **Usability is the effectiveness, efficiency and satisfaction with which users achieve specific goals in particular environments; where**
  - **Effectiveness is the accuracy and completeness with which specified users can achieve specified goals in particular environments;**
  - **Efficiency is the resources expended in relation to the accuracy and completeness of goals achieved; and**
  - **Satisfaction is the comfort (experience) and acceptability of the work system to its users and other people affected by its use.**

User's Definition of Usability

USABILITY : The ability of a User to Use the product/ system / environment as desired

Usability Engineering: The 'affordance' offered by a product that makes it useable.

Usability does not happen by it self. It has to be "engineered" into the product.

Usability is related to Human Performance

- Capabilities
- Limits
- Consequences

Intuitiveness

Maximum success for first-time users, with minimum training, explanation or thought

Efficiency

Maximum success for long-term users, with minimum time, mental load, physical effort

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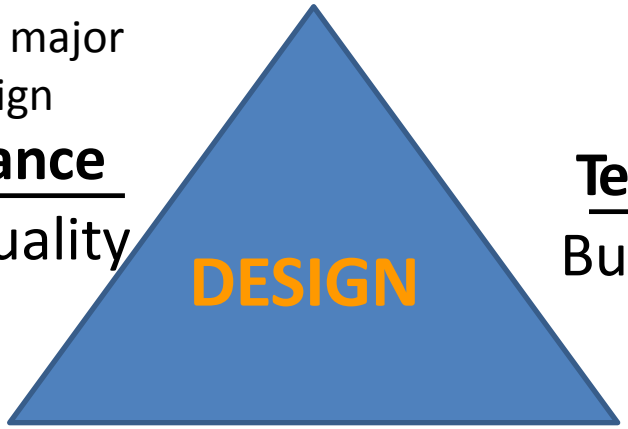
Usability is conceptualized into the product by DESIGN

Usability has three major components in Design

Appearance
Visual Quality



Technology
Build Quality

Interaction
Use Quality

Some Standard Definitions …….

- **'Usability' is the measure of the *quality* of a User's experience when interacting with a product or system**

- **'Usability Engineering' is the processes of deriving, specifying, measuring, constructing and evaluating usability features into products and systems.**

- **Usability Study is the systematic analysis based on heuristics and/or experimental evaluation of the interaction between people and the products including the environment of use.**
  Psychology / Cognitive Science / Behavioral Science

- **Usability Testing is the scientific verification of the specified usability parameters with respect to the Users needs, capabilities, expectations, safety & satisfaction.**

Usability as applied to Product Design
Usability as applied to Human Computer Interaction Usability as applied to Human Environment Interaction
Usability as applied to Systems (including Engineering systems)

The UE Lifecycle UCD Methods (ISO 13407)

SYSTEM LIFE CYCLE						
FEASIBILITY		REQUIREMENTS		DESIGN	IMPLEMENT	RELEASE
USER REQs	CONTEXT OF USE	FUNCTIONAL	TECHNICAL	PROTOTYPE	USEABILITY TESTING	FEEDBACK

Design Stages

Task	Information Produced
Knowing the user	User characteristics, User background
Knowing the task	User's current task, Task analysis
User requirements	User requirements specification
Setting usability goals	Usability specification
Design process	Design Specification
HCI Guidelines & heuristic analysis	Feedback for design iteration
Prototyping	Prototype for user testing
Evaluation with users	Feedback for freezing design
Redesign and evaluate with users	Finished product
Evaluate with users and report	Feedback on product for future systems

The Goals of Usability Engineering

5 Es

- Effective to use - Functional
- Efficient to use - Efficient
- Error free in use - Safe
- Easy to use - Friendly
- Enjoyable in use - Pleasurable Experience

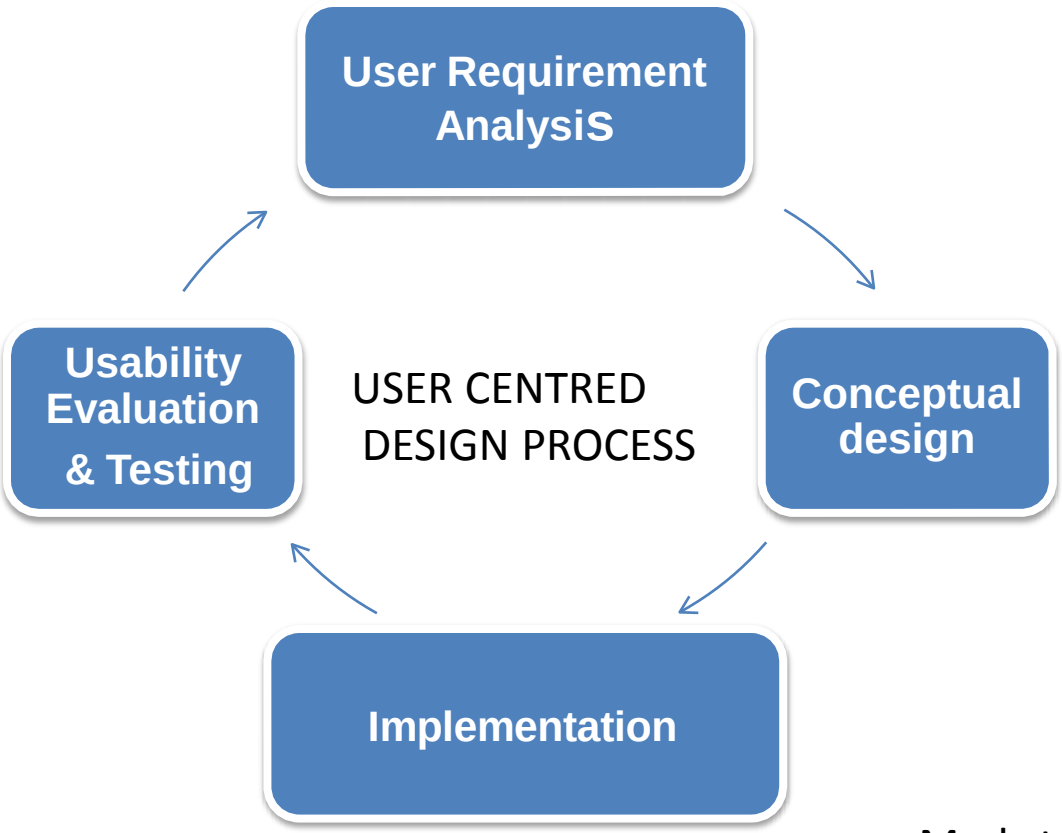
Achieves 5 times Enhancement in Engineering value.

Home Work

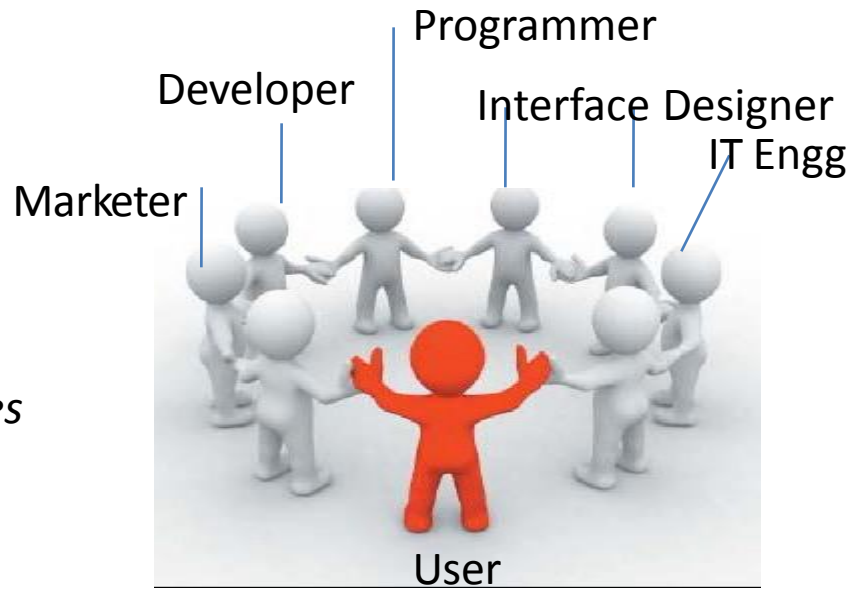
Usability Evaluation

Conduct a quick Usability evaluation of your mobile phone & Compare it with the evaluation of your friends phone.

		Rating out of 10	
Effective to use	- Functional		
Efficient to use	- Efficient		
Error free in use	- Safe		
Easy to use	- Friendly		
Enjoyable in use	- Pleasurable		
	Total :		



•UE is based on a **User-Centered Design (UCD)** approach to analysis and design. It concentrates on those aspects of products & services that have a bearing on their effective, efficient & pleasurable USE by humans.

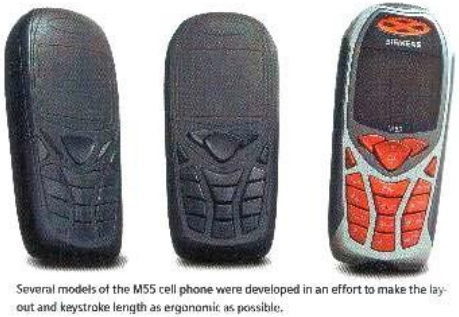


ISO 13407, 1999

"Human-centered design is an approach to interactive system development that focuses specifically on making systems usable. It is a multi-disciplinary activity."

The UCD Methodology.

User Centered Design Processes: UCD



Several models of the M55 cell phone were developed in an effort to make the lay-out and keystroke length as ergonomic as possible.

Definition of UE & other Related Fields

HCI: Human Computer Interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. *ACM - Association for Computing Machinery.*

Human Factors & Ergonomics: Stress on human physical issues (physiology) and on optimizing work processes

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User Interface Design: Focuses on interface layer assuming all deeper functions are fixed.

HCD- Human Centered Design: Approaches to software engineering with user focus at all stages of software design

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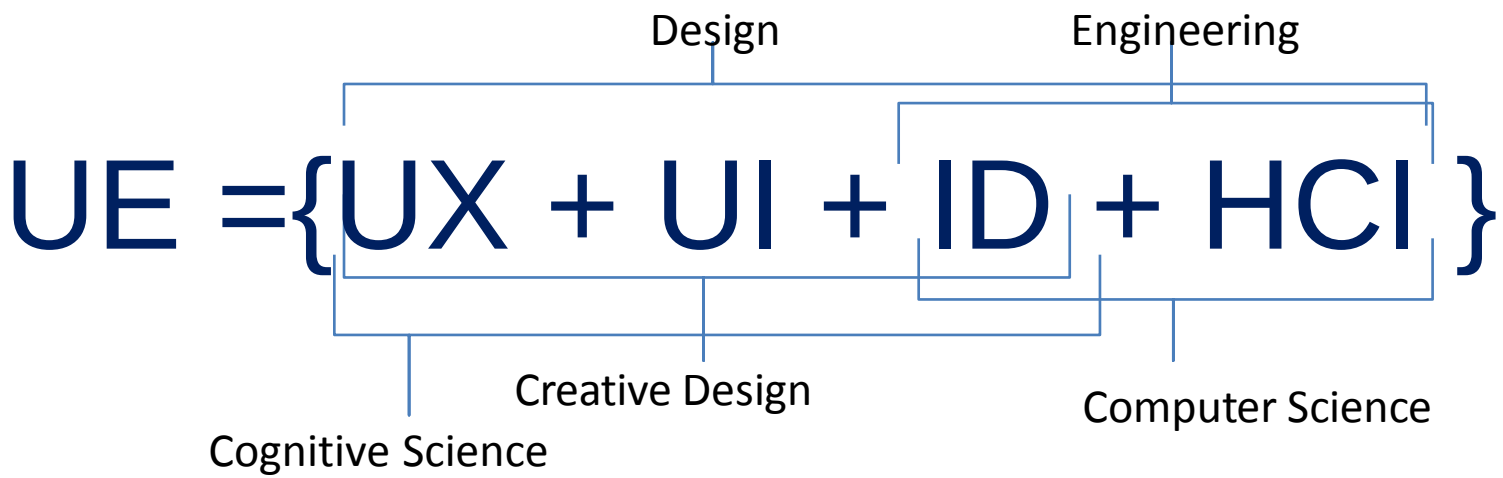
ID – Interaction Design: wider scope in terms of devices beyond computers. More emphasis on cognitive & experiential factors.

UE- Usability engineering: focuses on design & implementation processes. It is essentially research & design based activity .

There are overlaps in the above fields. Each is independent. UE has all of them.

Relationship between UE & Human Computer Interaction; Interaction Design; Experience Design; GUI Design



UX = User Experience
UI = User Interface
ID = Interaction design
HCI = Human Computer Interaction
UE = Usability Engineering

Please note : UE is written as 'Usability' as well as 'Use-ability'.

UE vs Software Engineering

- Key difference (Karat and Dayton, 1995):
  - "In most cases of the design and development of commercial software, usability is not dealt with at the same level as other aspects of SE, (e.g.
    - Clear **usability objectives** are not set; and
    - Resources for appropriate activities are not given priority by project management)."
- To produce *usable* interactive products requires (Mayhew, 1999):
  - **UI design principles** and guidelines.
  - **Structured methods** for achieving usability.

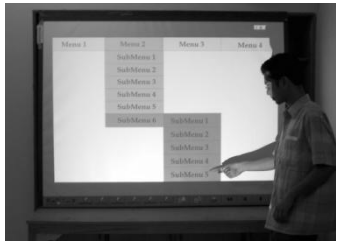
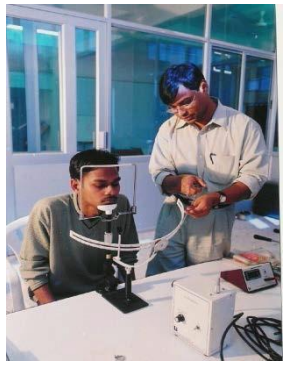
Usability Testing & UE – the Difference

- Usability engineering
  - Methodical approach to producing user interface + Experience + function + aesthetics
  - A way to deliver a product that works

- Usability Testing
  - Part of process of UE
  - Real users performing real tasks

Usability Testing

- **Analytical Evaluation:**
  - **By simulating *how* the user's activity will be performed.**
  - Heuristic evaluation **measures design against a list of usability factors.**
- **Empirical Evaluation:**
  - **By building and testing a *prototype*.**
  - Formal usability testing **tests a component of the design under controlled conditions - actual users; thus needs a usability laboratory.**


Cost-justifying Usability

$1 spent on usability = $10 saved (Nielsen, 1993).

Rs. 50 spent saves Rs 500 worth of trouble shooting due to poor design

Ignoring UE …….

Frustrated users Low productivity

Poor user interface design is the cause

High costs Support/Help desk costs

Entering data incorrectly

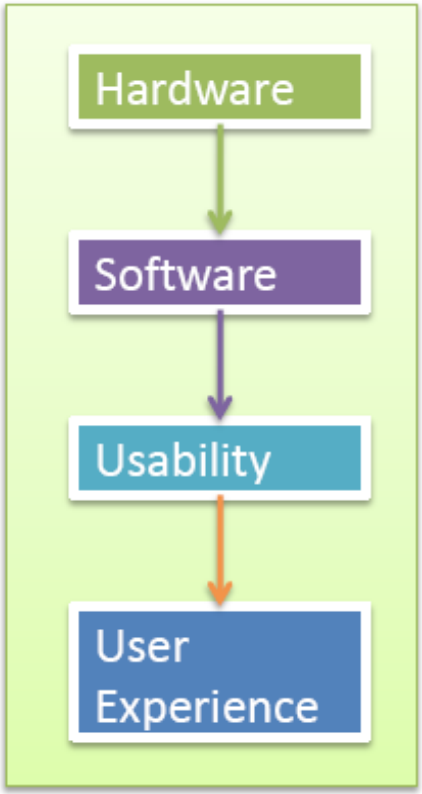
Deleting data

Loss of market share , good will Competitors rush in.

Mobile / Tablet / Device companies now are heavily investing in UE as the value adder as well as product differentiator.

They do not consider ‘cost’ as a constraining factor as far as UE is concerned.

Evolution of HCI and understanding of Users



- User as 'cog' in the system – (1970's)
- User a source of error (80's),
- User a social actor (90's)
- User as a consumer now (2000's)

Previous approaches are insufficient

- When user is a consumer, his needs need to be understood in order for the product to stay in the market....
- User experience with interactive products start determining which ones will sell.

The UE processes is based on **four fundamental axioms of Design**

- **User is the only constant entity of an artificially created system.**
- **User is the starting point of all design**
- **User is the final datum of reference for all design decisions**
- **User is the measure of all things.**

Nielsen (1993) identified 5 attributes that contribute to usability:

•**Learnability**. The user should be able to promptly start performing their tasks with the system.

•**Efficiency**. Once the user has learned the system, a high level of productivity should be possible.

•**Memorability.** The casual user should be able to return to the system after not having used it for some time, without having to relearn everything.

•**Errors.** Users should not make many errors using the system, and if they do, they should be able to easily recover from them. Catastrophic errors should not occur.

•**Satisfaction.** Users should like using the system and should be subjectively satisfied when using it. The system should be pleasant to use.

Digging Deeper into Usability

What makes a product usable ?

Is it all subjective ?……. Can we measure Usability?

Stanton & Barber 1996 proposed measuring the following :

Learnability Effectiveness Attitude Flexibility Compatibility

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Learnability: A product (system) should allow users to reach the acceptable levels of competency and the performance within a specified time.

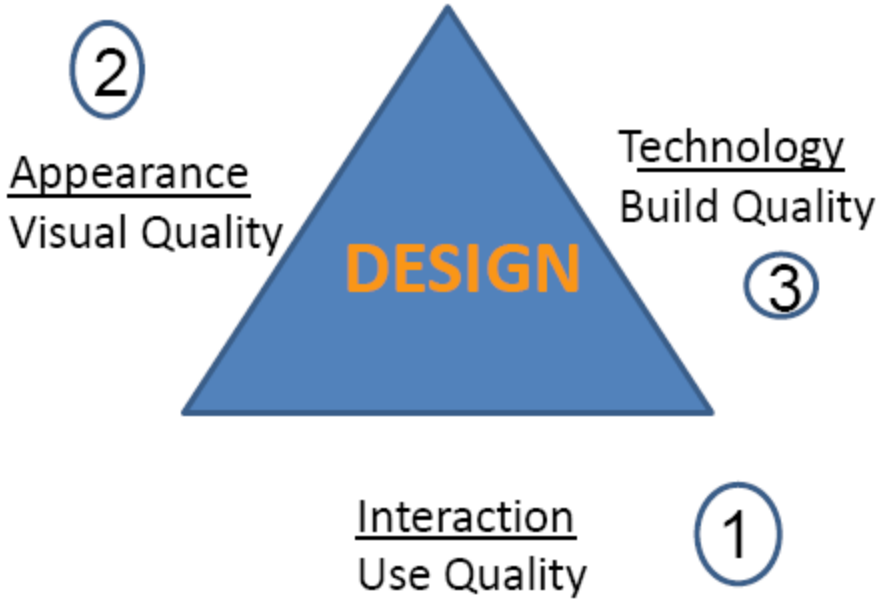
Learnability - **Help the users to master the system**
Consistency - **Let the users have to learn only once**
Familiarity - **Build on users' prior knowledge**
Standards - **Respect established cultural and**
- **application specific conventions .**
Self-descriptiveness - **Make objects and controls intuitive**
Help - **Provide easy access to 'help' resource**

'Intuitive' User Interfaces do not require investing resources in 'Learning'. Such interfaces follow the User's Mental Model of Interaction

Designing User Interface for Mobiles / Tablets

UI

1 , 2, 3.



Technological feasibility is different from Usability.

Engineering / Software should not dictate usability

What is involved in GUI design ?

- Designing for ease of use

– Usability : Semantics , Dialogue, Communication
Mental Models

- Designing for attractiveness

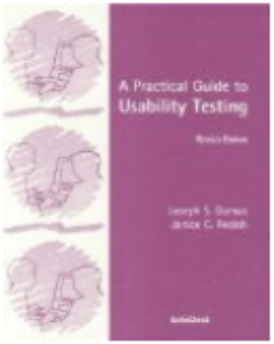
- Aesthetics

– User Experiences ....

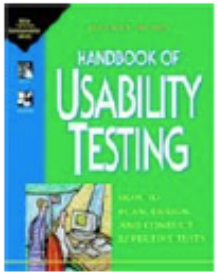
- Designing for contextual awareness

Culture , Behavior

Some Usability Books

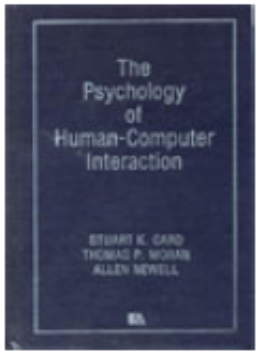


. A Practical Guide to Usability Testing by Joe Dumas & Ginny. Redish (1993)



2. Handbook of Usability Testing by Jeffrey Rubin (1994)

3. Usability Engineering by Jakob Nielsen (1993)Morgan Kaufman , Academic Press London.



The Psychology of Human Computer Interaction Stuart Card, Thomas Moran & Allen Newell (1983)