

Human-Centered Design

CSCI 497T/597T

What is Human-Centered Design?

- Development driven by real users and their goals, not just technology.
 - Makes the most of human skill
 - Directly relevant to the work in hand
 - Supports the user, doesn't constrain
- Gould and Lewis principles for a “useful and easy to use computer system”
 - Early focus on users and tasks
 - Empirical measurement
 - Iterative design

Human-Centered Design – How?

1. Spiral design
 - repeated iterations of cheap prototypes
2. Early focus on users and tasks
 - user analysis: who the users are
 - task analysis: what they need to do
 - involving users as evaluators, consultants, and sometimes designers
3. Empirical Measurements
 - users are involved in every iteration – every prototype is evaluated somehow

1. Spiral Design

- Early iterations use cheap prototypes
 - **Parallel design** is feasible: build & test multiple prototypes to explore design alternatives
- Later iterations use richer implementations, after UI risk has been mitigated
- More iterations generally means better UI
- Only mature iterations are seen by the world

2. User Analysis

- Identify characteristics of target user – Age, gender, culture, language
 - Education (literacy? numeracy?) – Functional limitations (ability-based design)
 - Technology experience (computers? typing?)
 - Motivation, attitude
 - Relevant environment and other social context
 - Relevant relationships and communication patterns

Skills Evaluation: Sensory

- Visual function
 - acuity, field, tracking, scanning
- Visual perception
 - depth, spatial relationships
- Tactile function
- Auditory function

Skills Evaluation: Cognitive

- Memory
- Problem-solving
- Sequencing
- Language

Skills Evaluation: Motor

- Range of motion
- Muscle strength
- Muscle tone
- Balance
- Tremor/involuntary movement
- Functional grasp patterns

Task Analysis

- Identify the individual tasks the assistive technology might address
- Each task is a goal (*what*)
- Start with a high-level activity
- Then decompose it hierarchically into subtasks (*how*)

Essential Parts of Task Analysis

- What needs to be done?
 - Goal
- What must be done first to make it possible
 - Preconditions
 - Tasks on which this task depends
 - Information that must be known to the user
- What steps are involved in doing the task?
 - Subtasks
 - may be further decomposed, recursively

Other Questions to Ask About a Task

- Where is the task performed?
- What is the environment like?
 - noisy, dirty, dangerous, crowded
- How often is the task performed?
- What are its time or resource constraints?
- What can go wrong?
 - exceptions, errors, emergencies
- Who else is involved in the task?
- What assistive technology (if any) is the client currently using for the task?

Hints for Better Task Analysis

- Questions to ask
 - Why do you do this? (goal)
 - How do you do it? (subtasks)
- Look for weaknesses in current situation
 - Goal failures
 - Wasted time
 - User irritation or fatigue

Empirical Methods to Gather Data

- Contextual Inquiry
 - Observe client doing the tasks in their real environment
 - Establish a master-apprentice relationship
 - Client shows how and talks about it
 - You watch and ask questions
 - Challenge your own assumptions
 - Share your assumptions openly with client
 - Probe surprises
- Other methods: focus groups, surveys, journaling, interviews

Participatory Design (PD)

- Users are actively involved in development
- [Nothing about us without us](#)
- Should be used if you want to draw on existing artifacts
- Not suited for radical design changes

Participatory Design (Cont.)

- Data collection
 - Observations, interviews, collaborative design and cooperative prototyping guided by a well-defined research question
 - Users and designers cooperatively envision new designs, and inform each other's perception of their practicality and utility
- Data analysis
 - Analyze artifacts at breakdowns
 - Analyze videos, interviews and prototypes collected from sessions with the users
- Outcome
 - Working with the users, the product is evolved from the existing artifact

Examples of paper based prototyping techniques for PD.

- Pictive
 - Some design components are prepared by the developers
 - Pen, pencil, sticky notes, paper etc. are used by the users
 - Video recording devices are used to record what happens

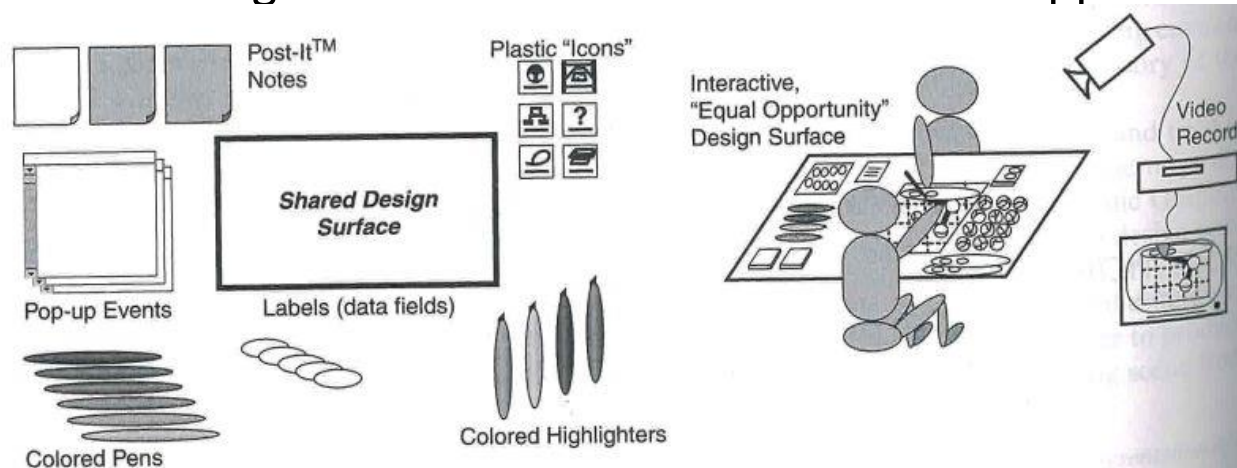


Figure 9.11 PICTIVE design objects and PICTIVE setting.

Examples of paper based prototyping techniques for PD.

- Card
 - The same principle as Pictive but with screen dumps
 - The cards are used to explore workflow options with the user

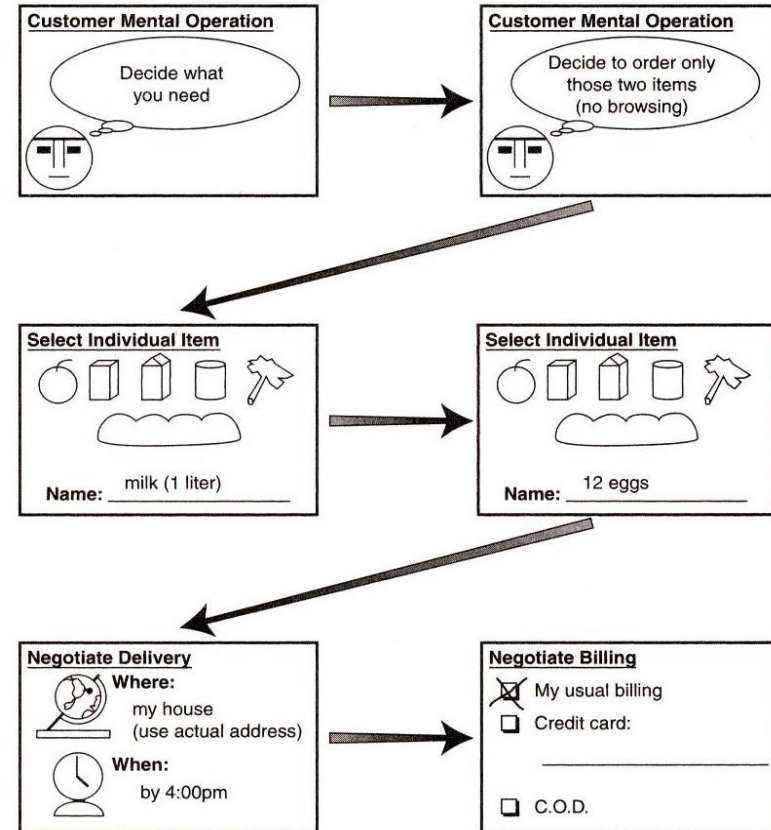


Figure 9.12 Example of CARD.

3. Empirical Measurements

- This means that the reactions and performance of intended users to...
 - printed scenarios, manuals and help, systems simulations, prototypes should be observed, measured and analyzed as early in the design and development process as possible
- Choose evaluation metric(s) such as
 - efficiency: time on task
 - success rate
 - errors: frequency or severity
 - fatigue: how many times task can be done
- Set quantitative and qualitative targets
 - “get dressed in 2 minutes”
 - “make coffee without assistance”
 - “control my bed while hand is holding something else”
- Use the metrics and targets in subsequent process
 - evaluate on system models
 - predict outcome
 - measure on prototypes

Example: User Analysis

Paul: One of my big dreams in life is to be able to carry a cup of coffee around my house

Abilities:

Right leg amputee, user of forearm crutches

Unable to hold a cup of liquid while using crutches



Example: Task Analysis

- Goal: carry a cup of hot liquid
- Key constraints: safety, no spilling, reasonable time limit, multiple times per week, no assistance
- Context: at home, kitchen counter to dining room table or living room

Example: Collecting Data

- Interviews
- Contextual inquiry
- Participatory design



Example: Solution

Assistive Technology: Coffee Crane



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References

- Muller, M. J. *Participatory design: The third space in HCI*. In J. Jacko & A. Sears (Eds.), *The Human-Computer Interaction Handbook*. Mahwah, NJ: Lawrence Erlbaum Associates
- [Designing assistive technology: The human-activity-assistive technology-context \(HAAT\) model](#)