Wisdom is not the product of schooling but the lifelong attempt to acquire it.
- Albert Einstein

New Methods, New Goals

Gerhard Fischer and Hal Eden
Fall Semester 2008

Chapter 4, Leonardo Book, September 15, 2008
The Main Message of Chapter 4

- **new methods**: richer set of design methodologies

- **new goals**: from AI to UI
  - Artificial Intelligence (AI) → Intelligence Augmentation (IA)
  - replacement → empowerment
  - emulate → complement

- **reminder: main messages of**
  - chapter 1: inspiration for the new computing
  - chapter 2: usable / unusable
  - chapter 3: universal usability
Hardware-Oriented Design

- humans have to adapt to the technology → example: ENIAC: Electronic Numerical Integrator And Computer
Professional-Dominated Design

- works best for people with the same interests and background knowledge

- technophiles = proud to have mastered esoteric tools and environments

- guru status = they obtained and did not want to lose it
Programming — in the Very Early Days
User-Centered Design

- analyze the needs of the users
- understand the conceptual worlds of the users

<table>
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<tr>
<th>requirements phase</th>
<th>development phase</th>
<th>use phase</th>
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<td>user needs assessment</td>
<td>usability testing</td>
<td>customer feedback</td>
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Human-Computer Interaction

domain expert

professional software developer

compiler developer
A Layered Architecture Creating New Divisions of Labor
—
Human Problem-Domain Interaction

User

Problem Domains

Design Environments

Programming Languages

Assembly Languages

Computer

Domain Designer

Environment Developer

Compiler Developer
Human Problem Domain Interaction — Pinball Construction Kit
A Domain-Oriented Design Environment for Kitchen Design

Janus-Construction

Appliance Palette
- walls
- doors
- windows
- sinks
- stoves

Catalog

Work Area

Clear Work Area
- Load Catalog
- Save In Catalog
- Edit Global Descriptions
- Select Context

Messages
- The length of the work triangle (Double-Bowl-Sink-1, Four-Element-Stove-1, Single-Door-Refrigerator-1) is greater than 23 feet.
- Single-Door-Refrigerator-1 is not near Four-Element-Stove-1.

Commands
- Critique All
Participatory Design

- involve users more deeply in the process as co-designers by empowering them to propose and generate design alternatives

- focus on system development at design time by bringing developers and users together to envision different use contexts

- supports diverse ways of thinking, planning, and acting by making work, technologies, and social institutions more responsive to human needs

- it requires the social inclusion and active participation of the users
Learner-Centered Design

- draws attention to the changing needs of users
- combine HCI interaction principles with educational interaction support
- focuses on creating artifacts that support human understanding as opposed to task achievement
- is an inherently multi-disciplinary design specialty, requiring an understanding of HCI, pedagogy, collaboration, and the psychology of motivation
Collaborative Design

- design activities are knowledge-intensive work, and the knowledge required for solving complicated design problems rarely resides in the head of one designer.

- collaboration in design could take place along several dimensions: spatial, temporal, technological and social.

- the success of many Open Source Software systems and open contents environments such as Wikipedia has demonstrated (given the right sociotechnical conditions) → design through the collaboration of many can flourish as a distributed knowledge system.
Meta-Design

- create design opportunities at use time by creating open systems that can be modified by their users and evolve at use time

- open systems allow significant modifications when the need arises because despite the best efforts at design time, systems need to be evolvable to fit new needs, account for changing tasks

- requires co-creation

- sharing control
Design Time and Use Time

key

- system developer
- user (representative)
- end user

design time

use time

world-as-imagined
prediction
planning

world-as-experienced
reality
situated action
Users, End-Users, Programmers

- computer use at work in 1997
  - 64 million Americans

- estimate for 2012
  - 90 million end users in American workplaces
  - 55 million will use spreadsheets or databases (and therefore may potentially program)
  - 13 million will describe themselves as programmers
  - fewer than 3 million professional programmers

- source:
Super-Appliances versus Domain-Oriented Tools
Rich Tools Sets
Rich Tools Sets
The Evolution of Technology

- from medium to artifacts

- from material to architecture

- from intrinsic properties to goals, objectives, and use contexts

examples:
- 500 hammer story (in 1867) — the main issue is not the material or the medium, but the different task structures

- “software” engineering emphasize the medium/material

- in other domains, e.g., building design: designers do not speak of concrete or steel engineering, but of civil engineering, electrical engineering, bridges, office buildings
The 500 Hammer Story (in 1867)
From the Old to the New Computing

- **old**: what computers can do \(\rightarrow\) techno-centric bias

- **new**: what users can do \(\rightarrow\) human-centric perspective
  - empowerment
  - collaboration
Human-Centric Perspective

- the importance of **usage and activity** rather than technology

- **questions** to be asked:
  - **Who** is using the computer?
  - **What** are they doing?
  - **Where** are they doing the activity?
  - **When** are they able to do it?
  - **Why** are they doing it?
  - **How** do they do it?
**Moore's Law:** the growth of technology as a function of time

there will be more technology tomorrow than there is today
**Microsoft’s Law**: Promised functionality will increase directly with Moore's Law

there will be more functionality promised/offered tomorrow than there is today

![Graph showing growth of promised functionality over time](image)
A qualitative view of trends as observed in Microsoft Word in 2000

- **Pages of Printed Documentation**: 609 in 1985, 1242 in 1995, 50 in 2005
- **Application Size (on disk)**: 0.9MB in 1985, 19MB in 1995, 50MB in 2005
- **Menu Commands**: 37 in 1985, 19MB in 1995, 1100 in 2005
- **Suggested Application Memory**: 384KB in 1985, 1242 in 1995, 100MB in 2005
**Nature’s Law:** Humans' capacity is limited and does not increase over time

our neurons do not fire faster, our memory doesn't increase in capacity, and we do not learn or think faster as time progresses
Empowering Humans with Media and Technologies

- the unaided, individual human mind

![Diagram showing balance between tool-free environment and cognitive disabilities](image-url)
With Tools/Media \rightarrow Humans have more Power

cognitive disabilities

with cognitive tools
Collaborative Minds with Rich Tool Sets

social + technical environment
Mismatch/Match between Needs and Support Tools

mismatch

match between user and tools
Three Generations of Design Methodologies

- **first generation**
  - analysis and synthesis are strictly separate
  - create requirements → create artifacts satisfying these requirements
  - waterfall model
  - technical rationality
  - fail: when design problems cannot be understood well enough to completely and unambiguously describe requirements

- **second generation**
  - design problems are ill-defined and ill-structured
  - problem formulation and problem solving need to be intertwined
  - design expertise is distributed equally among designers, who build artifacts, and users, who understand what they require in an artifact.
  - fail: users are not always able to articulate what they want + neglect of expertise of skilled designers
Third Generation

- the role of the designer to make expert design conjectures: prototypes

- prototypes: need to be open to refutation and rejection by the people for whom they are made

- participation of all stakeholders is still essential → there is no longer the assumption all stakeholders have equal design expertise

- each stakeholder is considered to have a particular expertise, but at the same time is ignorant of other areas → “symmetry of ignorance” (Rittel)

- to overcome “symmetry of ignorance”
  - mutual education
  - boundary objects