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

Meta-Design: Expanding Boundaries and Redistributing Control in Design

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University of Bari, May 2010
Basic Message

- **meta-design = design for designers:** participants can express themselves and engage in personally meaningful activities

- **basic assumption:**
  - future uses and problems cannot be completely anticipated at design time, when a system is developed
  - Users, at use time, will discover mismatches between their needs and the support that an existing system can provide for them

- **meta-design**
  - *extends boundaries* by supporting users as active contributors,
  - *distributes control* among all stakeholders in the design process
  - creates foundations for *cultures of participation*
Background: Research Grants on Meta-Design

- **A Meta-Design Framework for Participative Software Systems** (2006-2009),
  - “Science of Design” Program, NSF-CISE
  - objective: define the scientific foundation for designing participative software systems as socio-technical environments that empower users, as owners of problems, to engage actively and collaboratively in the continual development of software systems
  - more information: [http://l3d.cs.colorado.edu/~SoD/](http://l3d.cs.colorado.edu/~SoD/)
Design: Beyond Binary Choices

- **Turing Tar Pit:** “Beware of the Turing Tar Pit, in which everything is possible, but nothing of interest is easy.”
  - Turing Machines emphasize objective computability → the challenge: subjective computability

- **The Inverse of the Turing Tar Pit:** “Beware of the over-specialized systems, where operations are easy, but little of interest is possible.”
  - domain-specific artifacts and tools provide extensive support for certain problem contexts → but the ability to extend these environments is limited
Meta-Design: Exploring Middle Ground

Turing Tar Pit:
Saw + Wood

Construction
Kits

Inverse of the Turing Tar Pit:
Plastic Car

Saw + Wood

Plastic Car

Construction Kits
Meta-Design: Design for Designers

- new media that allow users to act as designers and be creative

- the creation of context rather than content → underdesign

- does not define a product, but the conditions for a process of interaction

- supports problem solving processes that remain liquid and open (“continuous beta”)
Why Meta-Design

- design for diversity (for “a universe of one” → CLever Project)

- complements planning with situated action

- design as a process is tightly coupled to use and continues during the use of the system

- prerequisite for cultures of participation, (social) creativity, innovation

- transcends a “consumer mindset”
What Do Meta-Designers Do?

- use their own creativity to create socio-technical environments in which other people can be creative

- create **technical** and **social** conditions for broad participation in design activities which are as important as creating the artifact itself
Meta-Design Concepts (in Microsoft Word)  
—  
Users as Co-Developers

- **tailor** and **customize** the system by setting different parameters as their personal preferences

- **extend** and **evolve** existing information structures (e.g., menus, spelling dictionaries, auto-correction tables, …)

- write **macros** to create new operations (an example of “programming by example” or “programming by demonstration”)

- create **programs in VisualBasic** to extend the functionality of the system

- **share** the user-defined extensions
Is End-User Modifiability the Answer to HFAs? The message of this section about HFA is that they contain too much unused functionality—at least in the abstract. But on the other hand, there is often not enough functionality for specific problems. As argued at other places in this book, closed systems are inadequate to capture the unanticipated needs of users in the real world. No matter how much designers at design time try to anticipate the needs of users at use time (see Figure<design/usetime>), the effort will fail.
Putting Owners of Problems in Charge

—

Ill-defined problems cannot be delegated to professional software developers

● interview with a geoscientist (University of Colorado):
  - “I spend in average an hour every day developing software for myself to analyze the data I collected because there is not any available software.
  - Even if there is a software developer sitting next to me, it would not be of much help because my needs vary as my research progresses and I cannot clearly explain what I want to do at any moment.
  - So I spent three months to gain enough programming knowledge to get by.
  - Software development has now become an essential task of my research, but I do not consider myself a software developer and I don’t know many other things about software development.”
Advanced Visual Systems Supporting Unwitting Programmers

More and more end users are required to perform various activities that push them to possibly modify software and/or artefacts in various ways: from simple customization to changing software functionalities.

Software Shaping Workshops (SSWs)

software applications providing each member of a specific professional community, such as a mechanical engineer or medical specialist, with an interactive environment suitable to manage their view of the activity to be performed
Shared Interest: Bari, Milano, and Boulder

Rich Ecology of Participation

- Software design space
- Software engineer
- Meta-designer
- EUD space
- Domain designer
- Power user
- End-user
- Well-informed consumer
- Passive consumer
- Consumer
- Designer

Complexity
A Layered Architecture Supporting Human Problem Domain Interaction
Human Problem Domain Interaction — Pinball Construction Kit
Human Problem Domain Interaction — **Music Construction Kit**
SchemePaint (M. Eisenberg): a programmable application combining direct manipulation with interactive programming
Computational Media

—

Extending Design Opportunities at Use Time

- **print media:** a fixed context for use time is decided at design time

- **computational media:**
  - presentations at use time can take advantage of contextual factors only known at use time (about tasks, users, social systems,.....)
  - examples: specification sheets and usage data, supporting dynamic forms, dynamic websites, user and task specific maps and traffic schedules....

- **evolving existing systems:** users (acting as designers) can transcend at use time the boundaries of the systems as developed at design time
## Concepts of Meta-Design

<table>
<thead>
<tr>
<th>Concept</th>
<th>Implications</th>
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<tbody>
<tr>
<td>convivial tools</td>
<td>allow users to invest the world with their meaning and to use tools for the accomplishment of a purpose they have chosen</td>
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<tr>
<td>domain-orientation</td>
<td>bring task to the forefront; provide time on task</td>
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<tr>
<td>open, evolvable systems</td>
<td>put owners of problems in charge; in open systems, extension is an essential part of use</td>
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<tr>
<td>underdesigned systems</td>
<td>create seeds and constructs for design elaboration at use time</td>
</tr>
<tr>
<td>collaborative work</td>
<td>support design communities and the emergence of power users</td>
</tr>
<tr>
<td>practices</td>
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## Traditional Design versus Meta-Design

<table>
<thead>
<tr>
<th>Traditional Design</th>
<th>Meta-design</th>
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</thead>
<tbody>
<tr>
<td>guidelines and rules</td>
<td>exceptions and negotiations</td>
</tr>
<tr>
<td>content</td>
<td>context</td>
</tr>
<tr>
<td>object</td>
<td>process</td>
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<tr>
<td>perspective</td>
<td>immersion</td>
</tr>
<tr>
<td>certainty</td>
<td>contingency</td>
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<tr>
<td>resolution</td>
<td>emergence</td>
</tr>
<tr>
<td>top-down</td>
<td>bottom-up</td>
</tr>
<tr>
<td>autonomous mind</td>
<td>distributed mind</td>
</tr>
<tr>
<td>creation</td>
<td>co-creation</td>
</tr>
<tr>
<td>specific solutions</td>
<td>solutions spaces</td>
</tr>
<tr>
<td>art</td>
<td>interactive art</td>
</tr>
</tbody>
</table>
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:**
Design Time and Use Time

key

system developer  user (representative)  end user

world-as-imagined
prediction
planning

world-as-experienced
reality
situated action
**Meta-Design**: Extending Other Design Methodologies

- **professionally-dominated design**
  - works best for people with the same interests and background knowledge

- **user-centered design:**
  - analyze the needs of the users
  - understand the conceptual worlds of the users

- **learner-centered design**
  - draws attention to the changing needs of users
  - combine HCI interaction principles with educational interaction support

- **participatory design**
  - involve users more deeply in the process as co-designers
  - focus on system development at design time by bringing developers and users together to envision the contexts of use

- **meta-design:**
  - create design opportunities at use time
  - requires co-creation
The **Seeding, Evolutionary Growth, Reseeding (SER) Model**

**Supporting Meta-Design**

- **at design time:**
  - development of an initial system that can change over time (seed)
  - underdesign: creating design options for users

- **at use time:**
  - support for “unself-conscious culture of design”: users will experience breakdowns by recognizing “bad fit” at use time
  - end-user modifications allow users to address limitations they experience
  - evolutionary growth through incremental modifications

- **reseeding:**
  - significant reconceptualization of the system
  - account for incremental modifications, mitigate conflicts between changes, and establish an enhanced system
The Seeding, Evolutionary Growth, Reseeding (SER) Model

Seeded Information Space → Users → Evolved Information Space → Reseeded Information Space

Seeding

Evolutionary Growth

Developers → Users

Developers → Users
Example Environment for Exploring Meta-Design

**CLever:** Cognitive Levers Project - “Helping People Help Themselves”
Cognitive Levers: Helping People Help Themselves (Clever)
<supported by the Coleman Institute>

- to support people with cognitive disability by increasing their independence
- new insight into distributed intelligence by identifying new relationships between external and internal scripts
- creating “eye glasses for the mind” to demonstrate that anatomy does not need to be destiny
- application areas: human-centered public transportation systems, smart care,
Selected CLever Projects

- **Web2gether: Online Community Environment** — supporting the members of a community (not only information management)

- **TEA: The Evaluation Assistant** — matching the needs of individuals to specific technologies

- **MAPS: Memory Aiding Prompting Systems** — creating new “knowledge” (scripts) by end-users who have no interest or technical knowledge

- **Mobility-for-All: Human Centered Public Transportation Systems** — from “anywhere, anytime, anyone” ⇒ right information, right person, right time, right way (exploiting the power of ubiquitous, wireless technologies)

- **Lifeline: Remote Monitoring** — reuse of the technological infrastructure for a different purpose
The Story Shown in the Multi-Media Presentation

- **specific**: a woman with cognitive disabilities (memory problems, no capacity for planning and remembering) and her mother

- **general**: the scenario shows socio-technical environments to help people with
  - cognitive disabilities
  - elderly people (e.g., with Alzheimer)
  - out-of-town visitors
  - foreigners
  - everyone

- many people can not use current public transportation systems

- innovative technologies to “simplify” their use
  - personal device such as personal digital assistants (PDAs),
  - mobile phones,
  - global positioning systems (GPS),
  - web-based collaboration tools
Web2Gether: Contribution to our Evolving Framework of Meta-Design

- **participatory design**: socio-technical environments constructed by different social groups who participated throughout this research

- **design through cycles of closure and opening**

- **co-evolution of design and context**: shaped to fit the needs of the context — and at the same time the context was reevaluated

- **seeding process**: not restricted to creating initial content, but supporting structured activities, the technology, and the envisioned use community

- **integration of innovations** into the practices of users and the merging of new with existing organizational structures
End-User Development (by Caregivers) in the Memory Aiding Prompting System (MAPS)
The MAPS Script Editor: Design for Designers
Use of MAPS in Mobility-for-All

This is your Bus, Get ready to get on

Script Use Time
Assessment and Implications

Expanding Boundaries and Redistributing Control

- **expanding boundaries:**
  - power of the few $\rightarrow$ wisdom of the crowds
  - socio-technical environments are living entities
  - breaks down the sharp distinction between designers and users: users become co-designers

- **redistributing control:**
  - developers and user-designers: sharing control
    - benign dictatorship
    - council control
    - complete decentralized
  - control is desired only for personally meaningful problems
  - the pitfalls associated with a “do-it-yourself” society
Contributions of Meta-Design

- **improves the quality of life:** Web2gether and MAPS: an attempt to improve the quality of life for people with cognitive disabilities.

- **democratizes design and innovation:** meta-design eliminates the constraint that users are restricted to what is given to them.

- **makes all voices heard:** participation and contributions of different stakeholders with various backgrounds.

- **changes professional practice:** creation of convivial tools and deprofessionalization (Illich)

- **revolutionizes the creation of systems:** creates foundation for social production and mass collaboration.

- **establishes new paradigms in learning and teaching:** focus on community-based learning theories with innovative collaborative technologies.
Meta-Design: Transforming Application Areas


Meta-Design: Transforming Application Areas — Continued


Mindsets, Cultures, and Environments for Meta-Design

- how we can educate and support skilled domain workers
  - who are neither novices nor naive users, but
  - who are interested in their work and
  - who see the computer as a means rather than as an end

- how we can create co-evolutionary environments
  - in which users change, because they learn, and
  - in which systems need to be changed, because users become co-developers and engage in end-user modification and programming
Summary

- **meta-design offers:**
  - to invent and design a culture in which all participants in collaborative design processes can express themselves and engage in personally meaningful activities

- **meta-design requires**
  - a new *mindset* of all participants
  - designers giving up some *control* at design time
  - *active contributors* and not just passive consumers at use time

- **meta-design raises many issues and research problems of fundamental importance** including
  - new design methodologies
  - a new understanding of cognition, collaboration, and motivation
  - the design of new media and new technologies