Center for
LifeLong Learning & Design
University of Colorado at Boulder

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

Meta-Design:
A Framework for the Future of End-User Development (EUD)

Gerhard Fischer and Hal Eden
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Topics

- end-users and end-users development

- design time and use time

- meta-design

- SER model

- examples:
    - CLever/MAPS → more on Feb 28
    - Envisionment and Discovery Collaboratory → more on Feb 19 and 21
    - Interactive Art → more on March 12
    - Wikis and Group Scribble → more on March 21
    - 3D Warehouse
    - Macros (in Word)

- motivation

- meta-design = a global culture change

Core Message

The future success of End-User Development (EUD) depends on
creating socio-technical environments (communities and tools
that end users are motivated to
learn and use in daily work practices

→ meta-design

Computer Scientists and End-Users

- **computer scientist / programmers**
  - find computers intrinsically interesting
  - like computers because they get to program

- **end-users:**
  - are the owners of problems, have the domain knowledge, are competent practitioners and like computers because they get their work done
  - regard computers as useful machines capable of helping them work more productively, creatively, and with greater pleasure
  - end-user programmers are motivated by their domain and not by the merits of producing high-quality, dependable code
  - enormous diversity between end-users

- **ultimate goal / belief:** end-users will use, tailor, extend and create their own computational artifacts if they have a supportive socio-technical environment

- **communities of users will develop:** power users, local developers, gardeners

Number of "Programmers" (in the USA)

- **3 million** professional programmers

- **12 million** people in workplaces that "do programming" at work

- **50 million** use spreadsheets and databases → they may potentially program doing
    - spreadsheets systems
    - web authoring tools
    - business process authoring tools
    - graphical languages

Objectives of End-User Software Engineering (EUSE)

- The number of end users creating software is far larger than the number of professional programmers.
    - These end users are using various languages and programming systems to create software in forms such as spreadsheets, dynamic web applications, and scientific simulations.
    - This software needs to be sufficiently dependable, but substantial evidence suggests that it is not.

- Solving these problems involves not just software engineering issues, but also several challenges related to the users that the end user software engineering intends to benefit.
    - End users have very different training and background, and face different motivations and work constraints, than professional programmers.
    - They are not likely to know about such things as quality control mechanisms, formal development processes, system models, language design characteristics, or test adequacy criteria, and are not likely to invest time learning about them.

Design Time and Use Time

key

system developer   user (representative)   end user

design
time

use
time
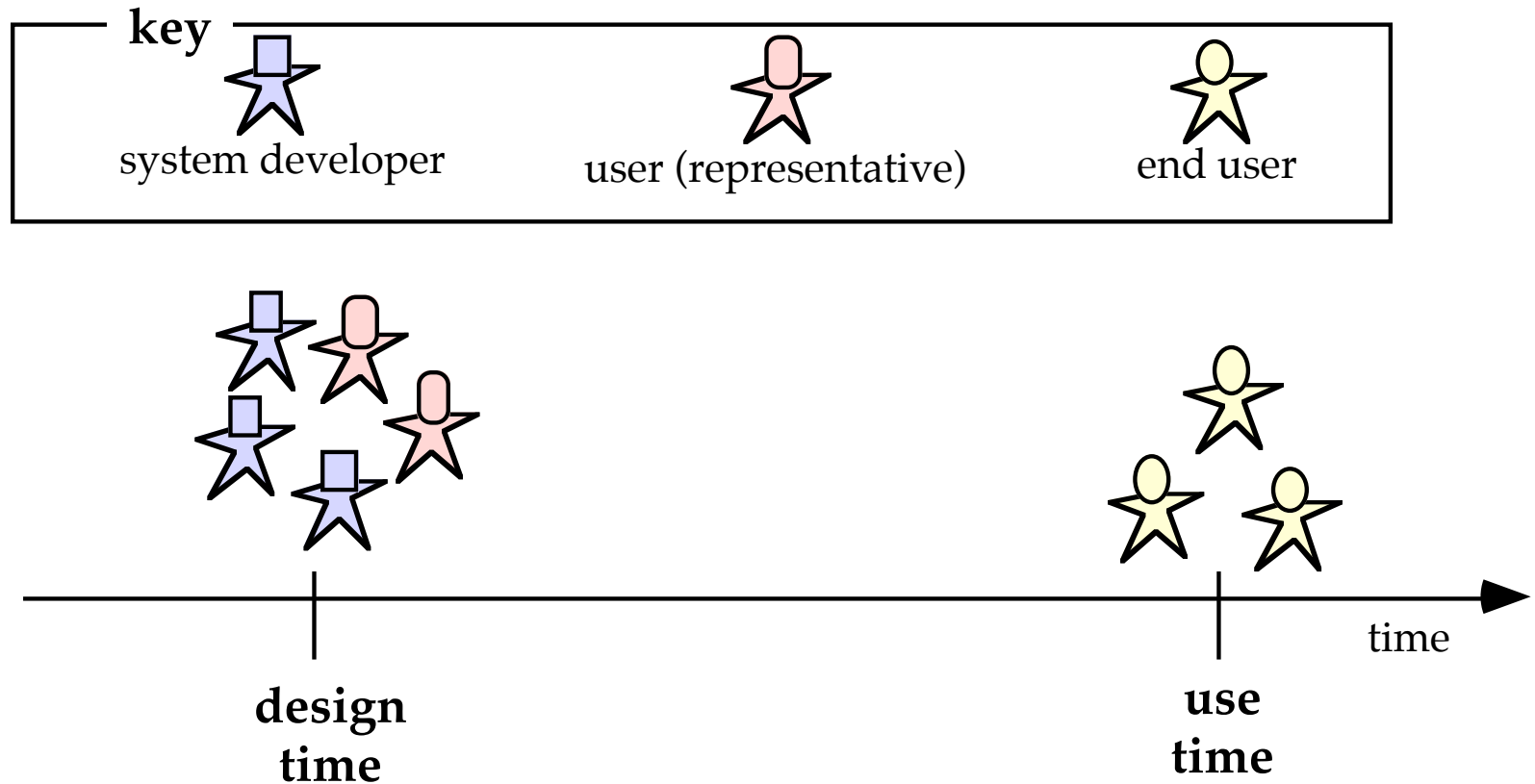
time

world-as-imagined
prediction
planning

world-as-experienced
reality
situated action

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

End-User Development
—
a Necessity: not a Luxury

- **an interview, a geoscientist:**

  "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.

  Even if the software developer can mange to write a program for me, I will not know if he or she has done it right without looking at the code.

  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."

- **observations:**

  - this geoscientist obviously is not just an end-user; his software has thousands of lines and he has considerable programming skills

  - it is equally obvious that he is not a software professional and does not intend to become one

Different Design Methodologies

<see "Overview of Design" Lecture, Jan 22>

- **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

- **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 the contexts of use

- **meta-design:**
  - create design opportunities at use time
  - requires co-creation

Meta-Design — How We Think About It

- "if you give a fish to a human, you will feed him for a day — if you give someone a fishing rod, you will feed him for life" (Chinese Proverb)

- **meta-design** extends this to:

    "if we can provide the knowledge, the know-how, and the tools for making fishing rods, we can feed the whole community"
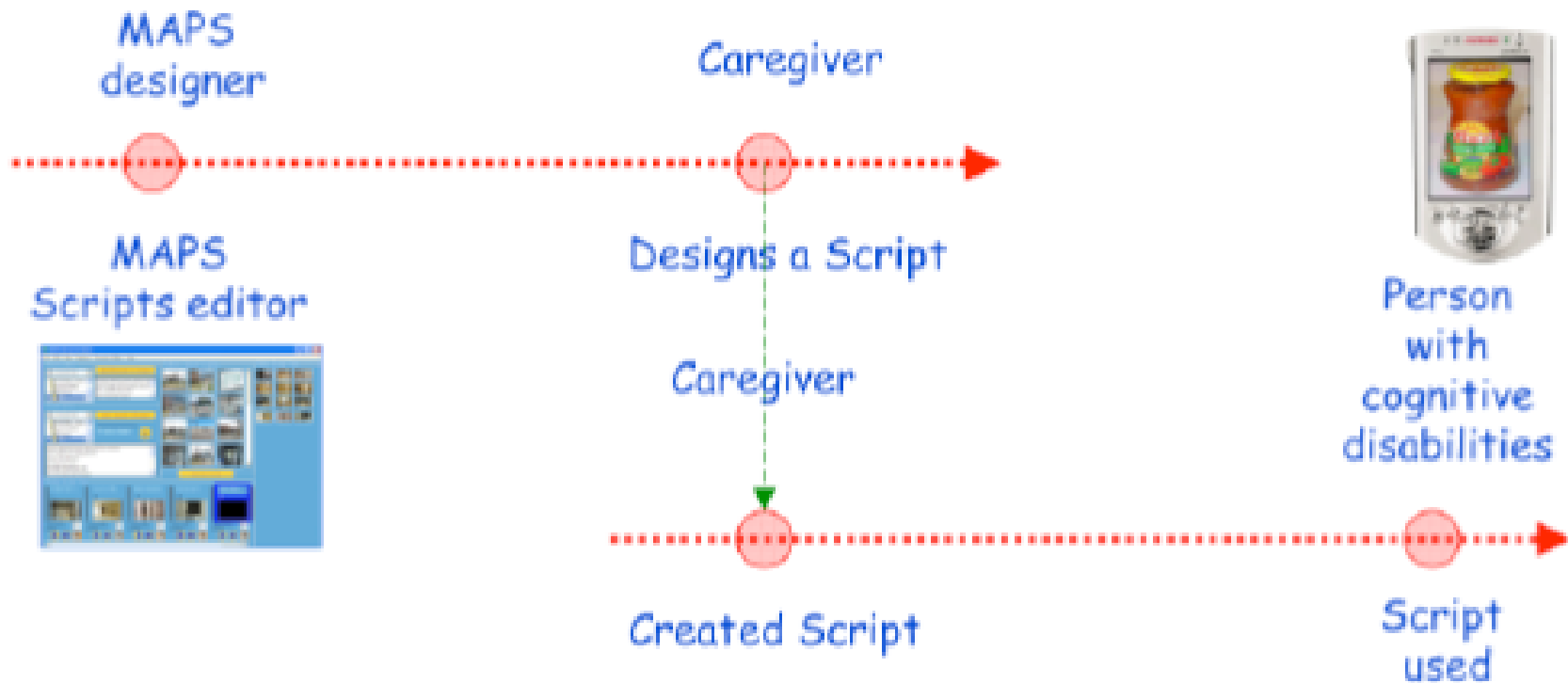
Meta-Design

- **meta-design =** creating new media and new technologies that allow users to act as **designers and be creative** (rather than being confined to consumers)

- **meta-design emphasizes**
  - the creation of context rather than content
  - puts the tools rather than the object of design in your hands
  - does not define a product, but the conditions for a process of interaction

Why meta-design?

- design for **diversity** (for "a universe of one" → **CLever Project**) → see guest lecture on February 28

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

- addresses and overcome problems of **closed systems**

- prerequisite for **social creativity** and innovation

- transcends a **"consumer mindset"**

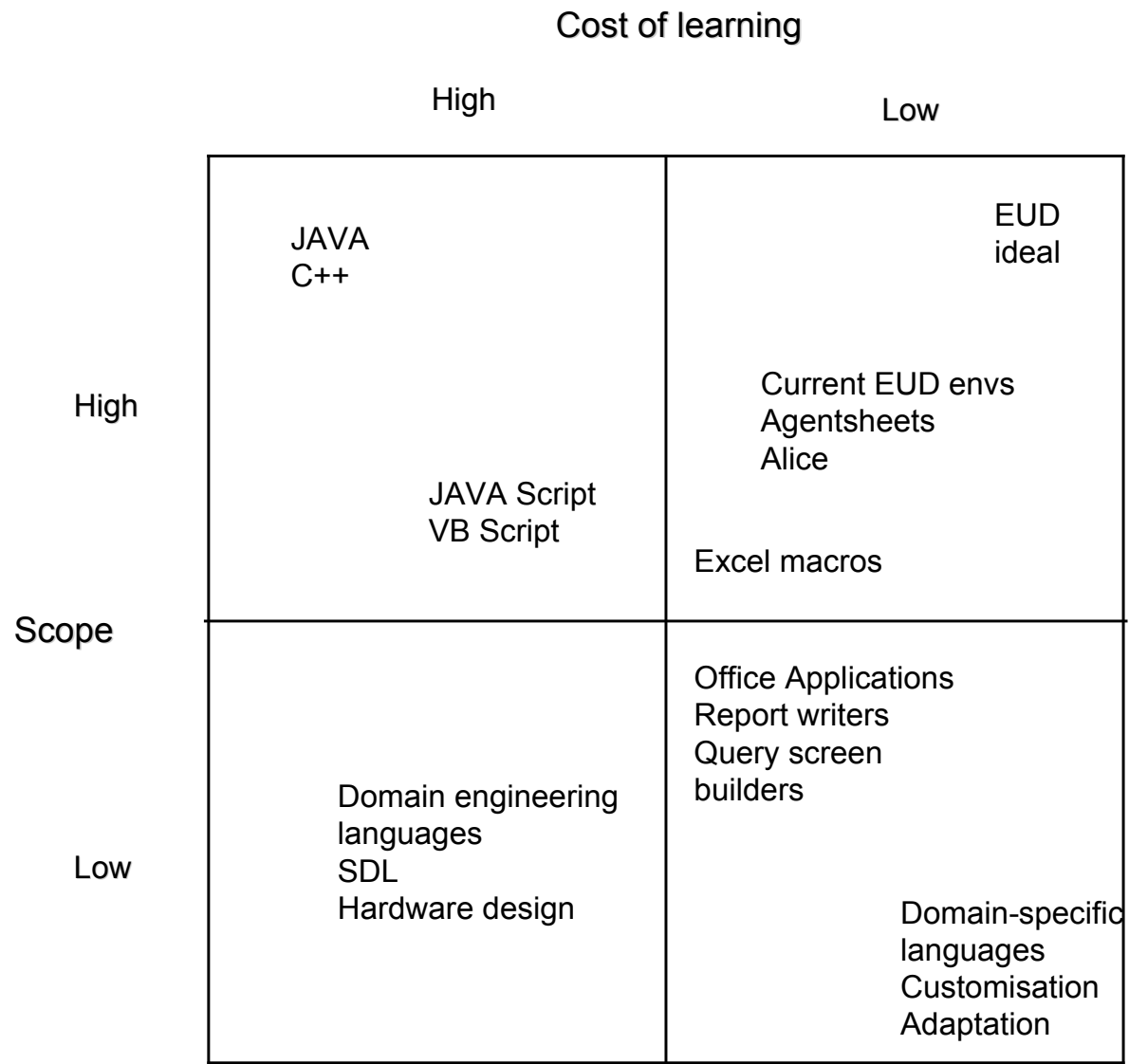# Meta-Design in the Cognitive Lever (CLever) Project

MAPS designer

MAPS Scripts editor

Caregiver

Designs a Script

Caregiver

Person with cognitive disabilities

Created Script

Script used

# MAPS Script Editor

MAPS Handheld Prompter

Claims

- **meta-design** (= allowing people to act as designers) is **more than a technical problem**

- **meta-design**
  - design for "hackability" and "remixability"
  - design for cooperation, not control

- meta-design needs to provide tools, environments, and substrates for end user development — this **is necessary, but not sufficient**

- **meta-design** creates **new mindsets**, new **sources of creativity**, **cultures changes**, and **innovative societies** by providing new insights into
  - learning and working
  - communicating
  - design and design communities
  - collaboration
  - co-creation

Cost-Scope Trade-offs in EUD Tools

Cost of learning

High   Low

JAVA C++	EUD ideal
	Current EUD envs Agentsheets Alice
JAVA Script VB Script	
	Excel macros
Domain engineering languages SDL Hardware design	Office Applications Report writers Query screen builders
	Domain-specific languages Customisation Adaptation

Scope

High

Low

Reduce the cognitive burden of learning → shrink the conceptual distance between actions in the real world and programming
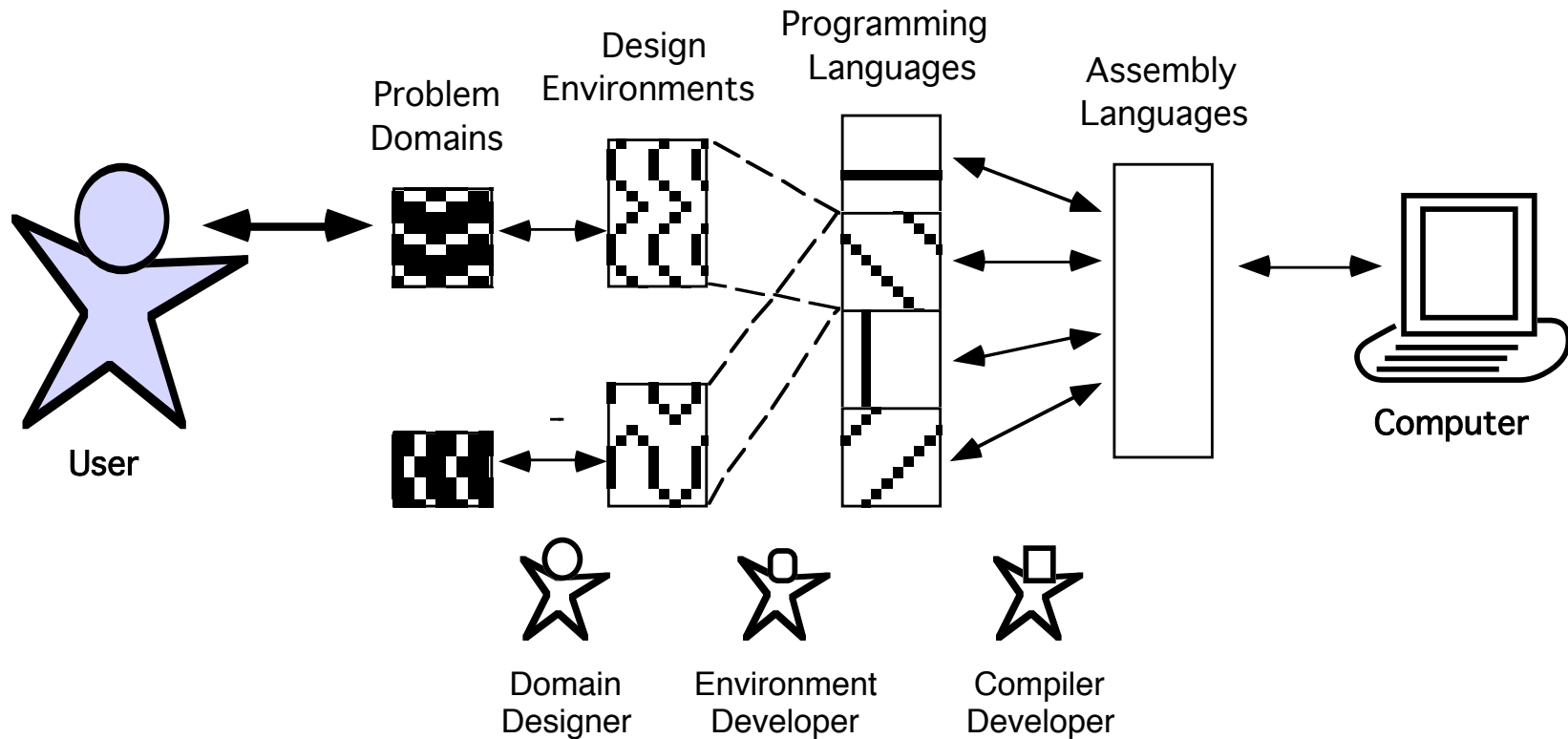
What Do Meta-Designers Do?

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

- create the 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-correct 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

A Macro for Unwrapping Text
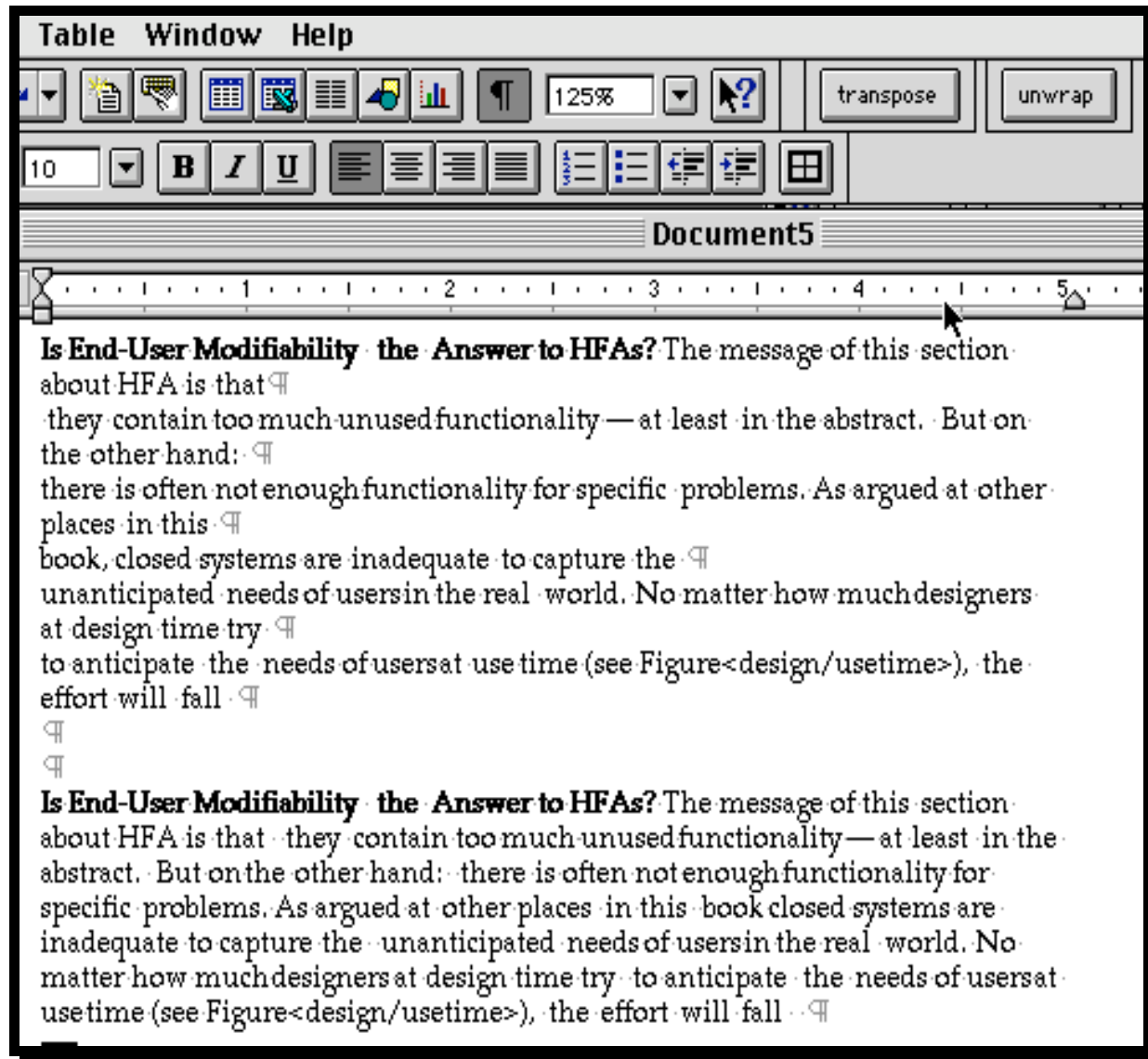
Meta-Design Aspects in the Envisionment and Discovery Collaboratory: Closed versus Open Systems

- **example for a closed system: SimCity —** too much crime
  - solution supported: build more police stations (**fight crime**)
  - solution not supported: increase social services, improve education (**prevent crime**)

- **important goal of EDC:** create end-user modifiable versions of SimCity, because:
  - background knowledge can never be completely articulated
  - the world changes

- **user control:**
  - end-user modifiability
  - conviviality (independence of high-tech scribes)
  - ownership (putting owners of problems in charge)

Interactive Art: *Face Poiesis*

(creating new faces by mixing features from previously created faces)

original creators: Toshihiro Anzai and Rieko Nakamura
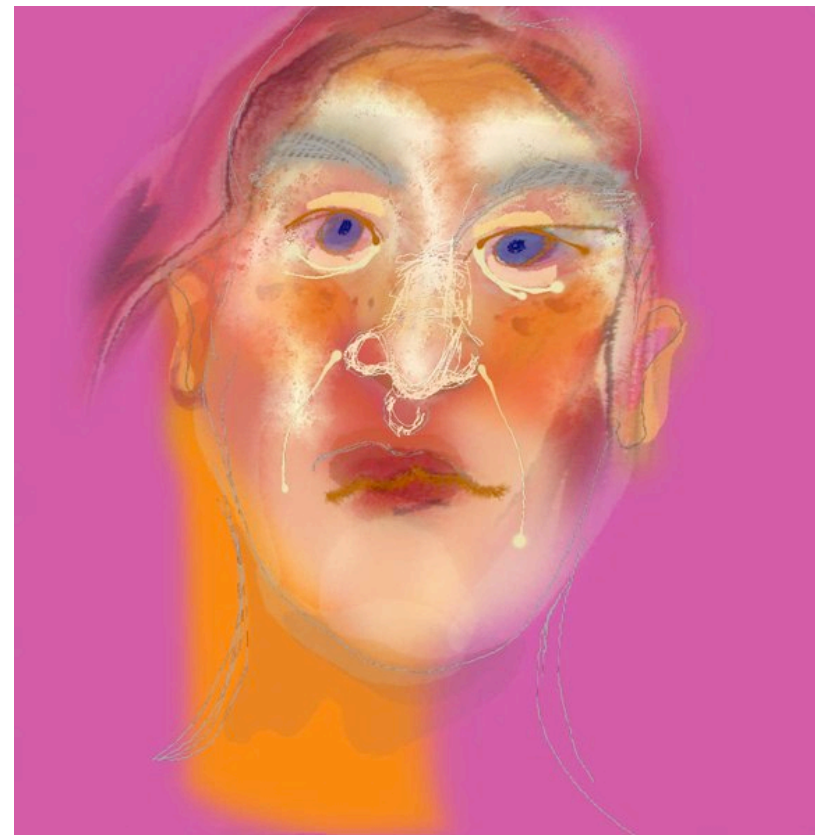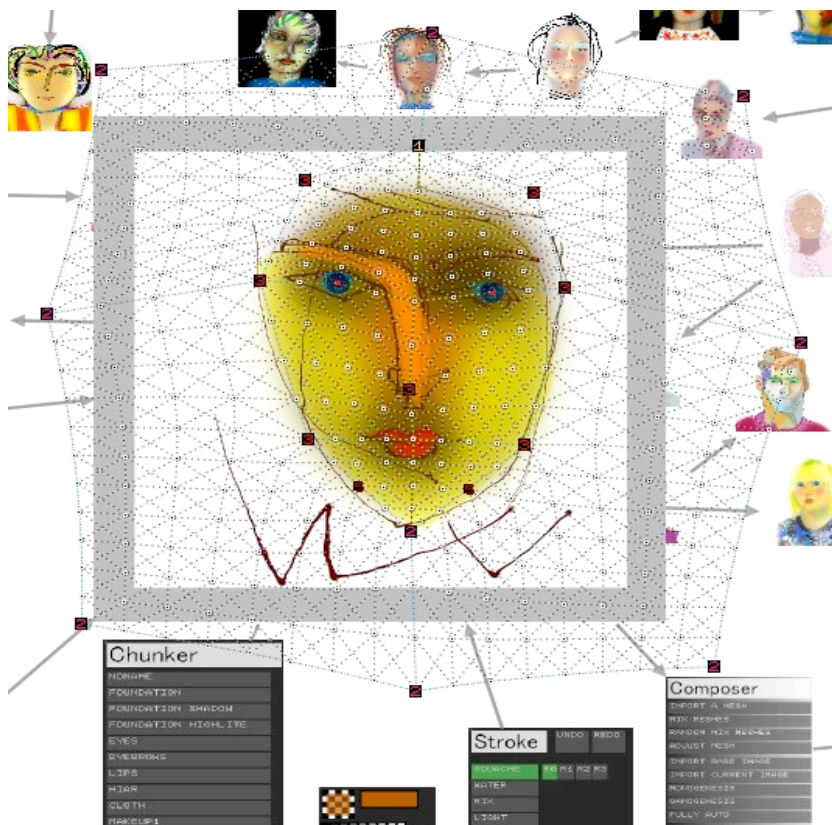
Interactive Art: The Electronic Café Project
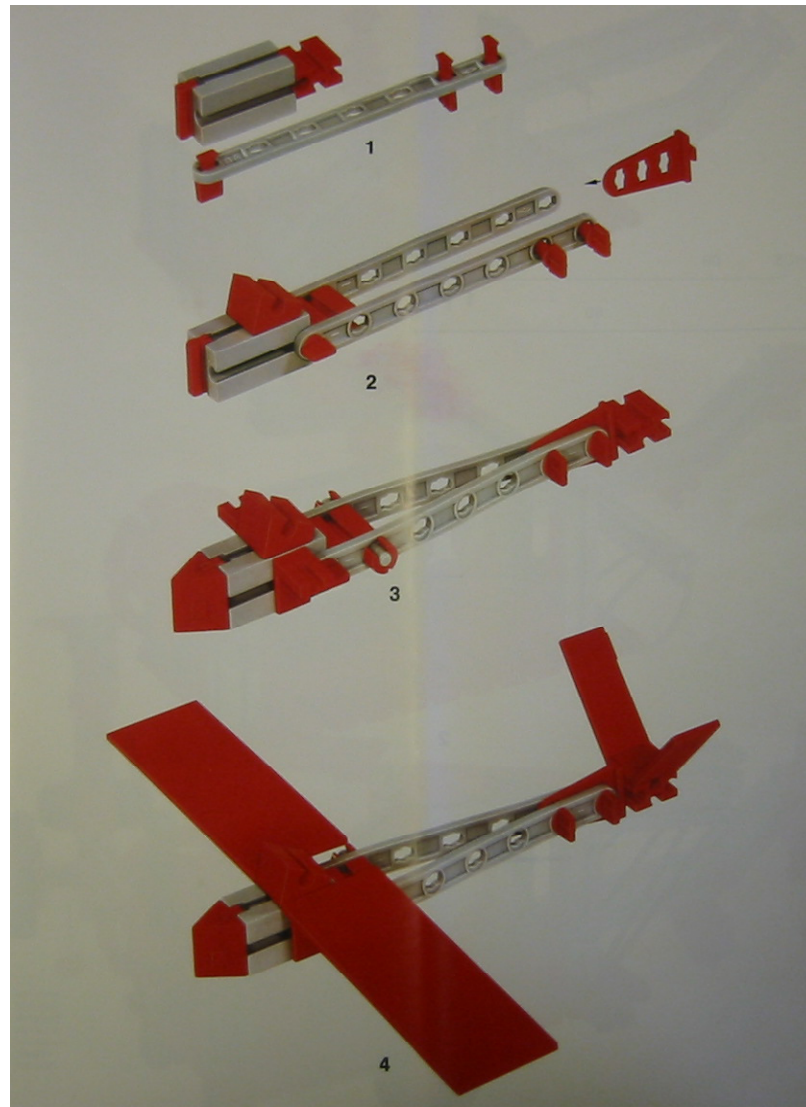
original creators: Kit Galloway & Sherrie Rabinowitz (founded 1984)

at: http://www.ecafe.com/

Meta-Design and Technical Construction Kits: An Airplane

Meta-Design and Technical Construction Kits: A Tipper Truck

# Consumer and Designers — Beyond Binary Choices

- **claims:**
  - there is nothing wrong being a consumer (watching a tennis match, listening to a concert, ...)
  - the same person wants to be a consumer in some situations and in others a designer
  - consumer / designer is not an attribute of a person, but of a context
    consumer / designer ≠ f{person} → f{context}

- **problems:**
  - someone wants to be a designer but is forced to be a consumer → *personally meaningful activities*
  - someone wants to be a consumer but is forced to be a designer → *personally irrelevant activities*

Consumer and Designers — A Continuum

CONSUMER ◄- -► DESIGNER

passive consumer

well-informed consumer

end-user

power user

domain designer
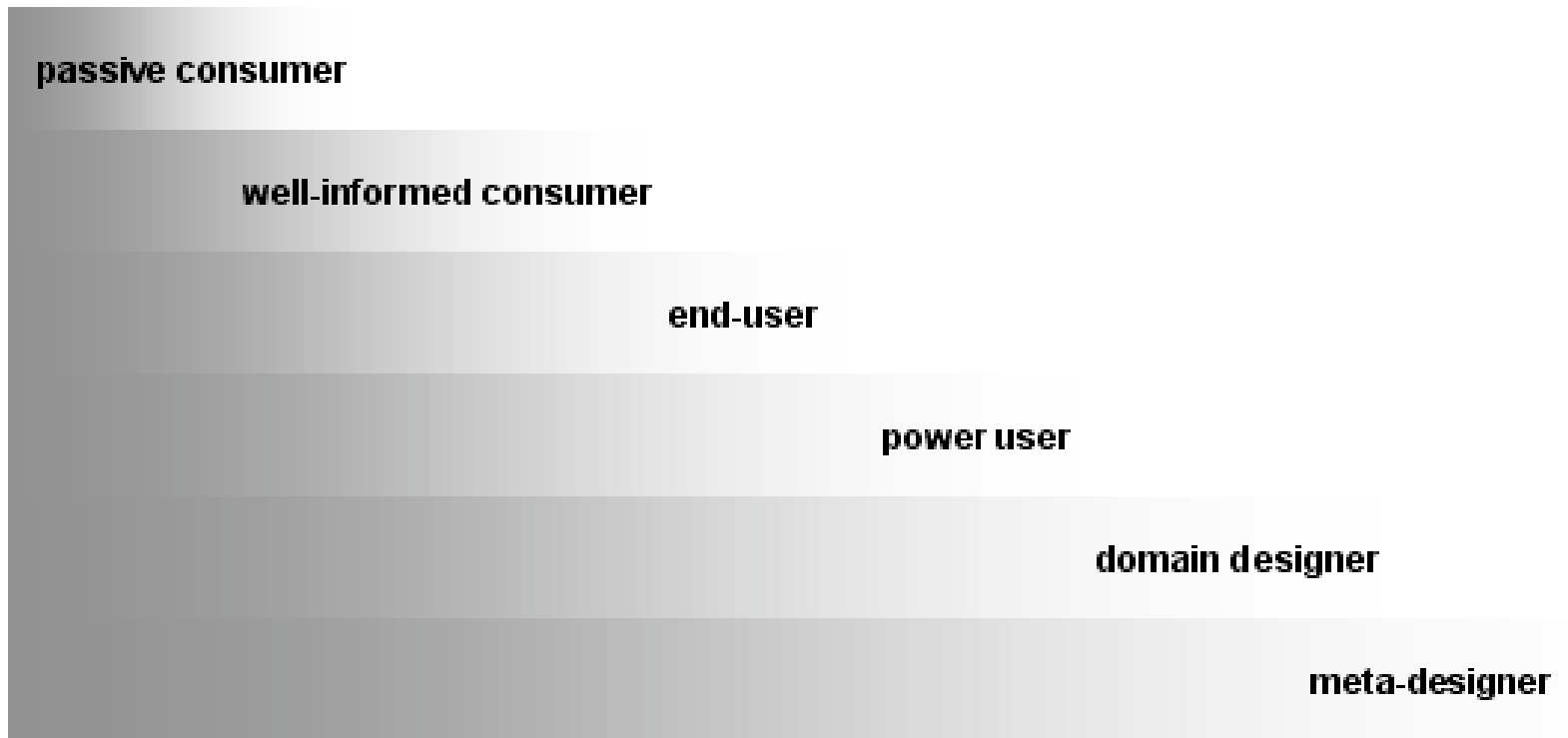
meta-designer

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
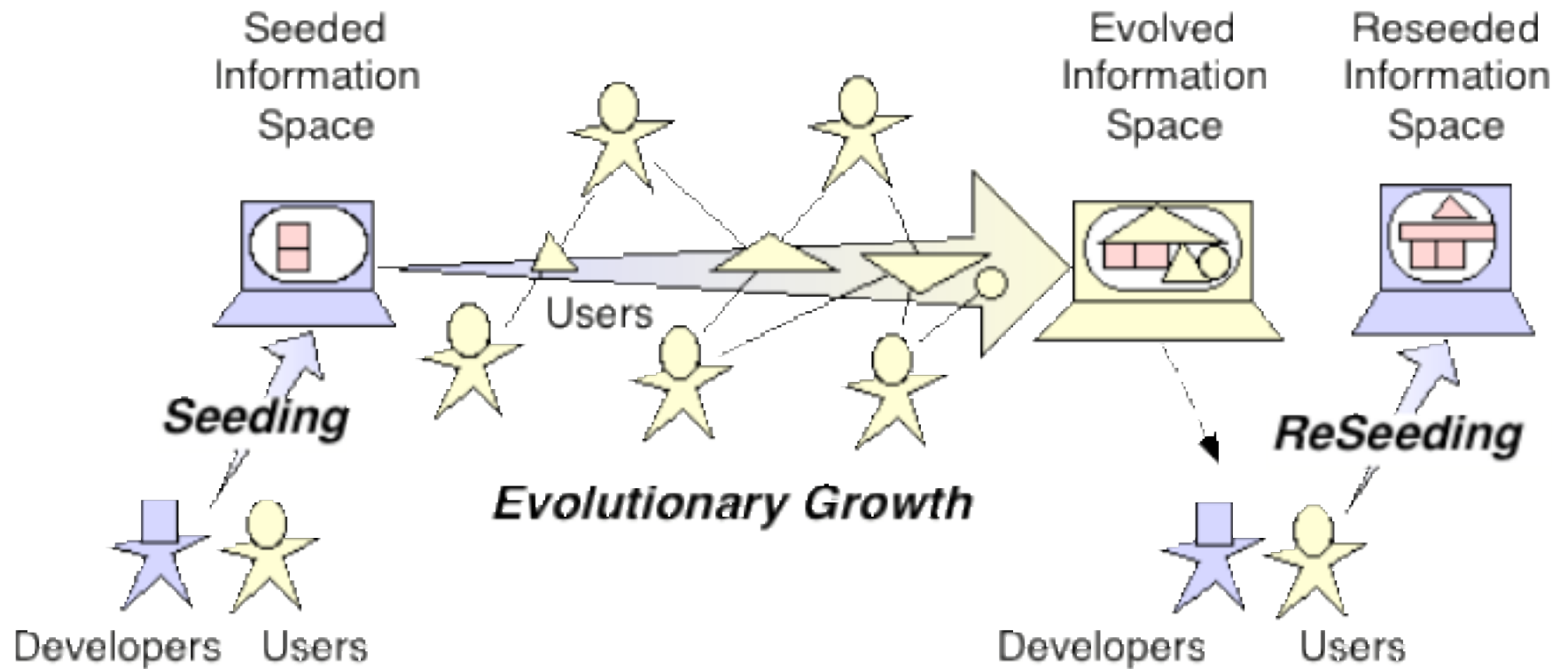
Web 2.0: A Focus on Meta-Design

- **source:** Tim O'Reilly *"What is Web 2.0 — Design Patterns and Business Models for the Next Generation of Software"*
  at: http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html

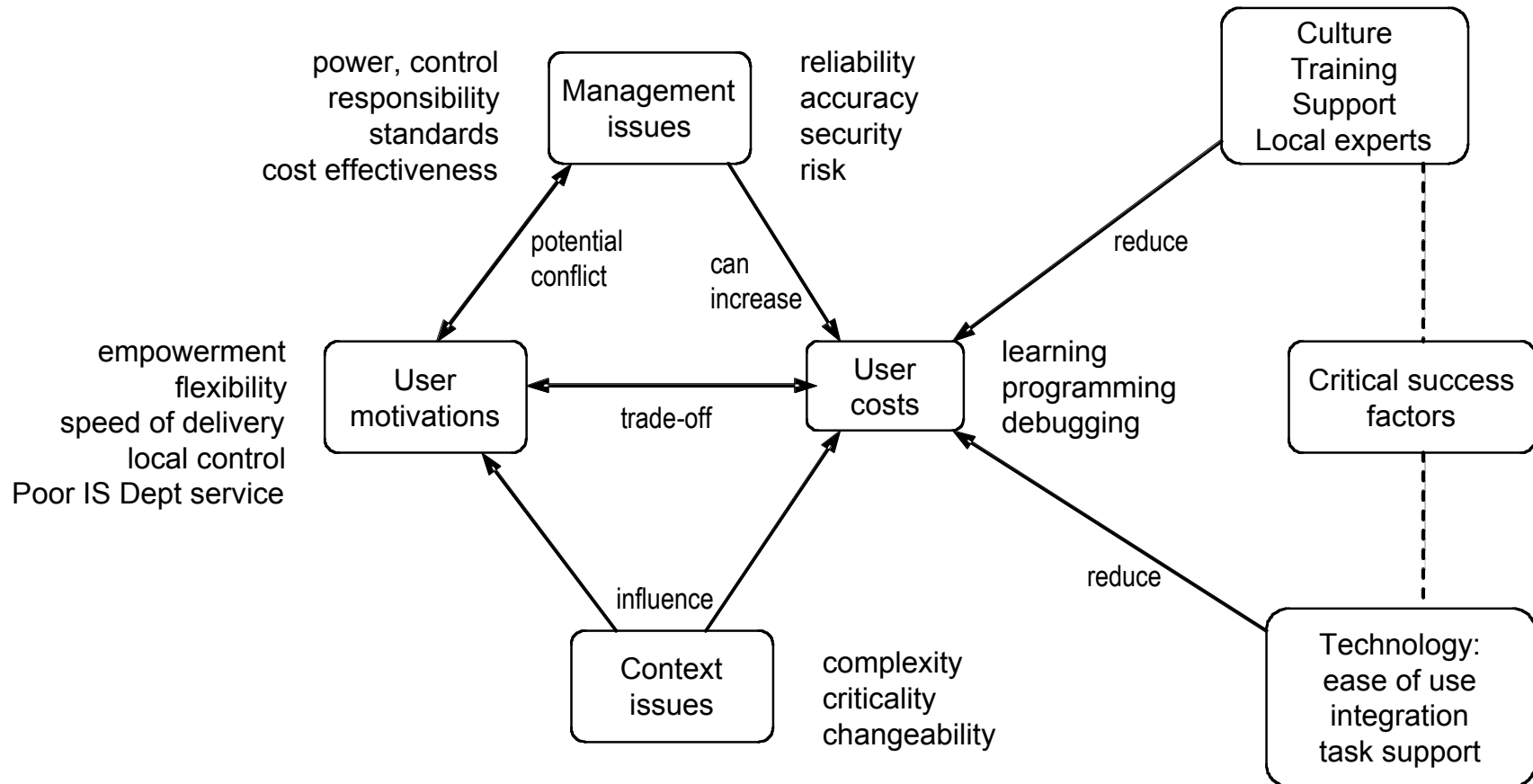| **Web 1.0**		**Web 2.0**
Britannica Online	→	Wikipedia
personal website	→	blogging
publishing	→	participation
content management systems	→	wikis
scheduled software releases	→	continuous improvements
individual contributions	→	collective intelligence

- **claim**: network effects from user contributions (= knowledge sharing) are the key to market dominance in the Web 2.0 era

Relationships between Social and Managerial Issues in EUD

power, control
responsibility
standards
cost effectiveness

Management issues

reliability
accuracy
security
risk

Culture
Training
Support
Local experts

potential conflict

can increase

reduce

empowerment
flexibility
speed of delivery
local control
Poor IS Dept service

User motivations

trade-off

User costs

learning
programming
debugging

Critical success factors

influence

Context issues

complexity
criticality
changeability

reduce

Technology:
ease of use
integration
task support

Motivational Aspects and Meta-Design

- **what will make humans want to become designers/active contributors over time?**
  - serious working and learning does not have to be unpleasant but can be personally meaningful, empowering, engaging, and fun
  - comment by an artist: *"programming is not hard, but it is boring"*

- **what will make humans want to share?** → requires: mindset change, culture change, community knowledge bases, gift cultures, social capital
  - more details: Fischer, G., Scharff, E., & Ye, Y. (2004) "Fostering Social Creativity by Increasing Social Capital." In M. Huysman, & V. Wulf (Eds.), Social Capital and Information Technology, MIT Press, Cambridge, MA, pp. 355-399.

- **who is the beneficiary and who has to do the work?** → organizational rewards

Utility = Value / Effort

- **increase in value: motivation and rewards for a "design culture"**
  - feeling in control (i.e., independent from "high-tech scribes")
  - being able to solve or contribute to the solution of a problem
  - mastering a tool in greater depth
  - making an ego-satisfying contribution to a group
  - enjoying the feeling of good citizenship to a community ("social capital")

- **decrease in effort:**
  - meta-design is hard
  - extending meta-design to design for design communities

Meta-Design Theory and the 3D-Warehouse

- **use of the SER model?**
  - criteria for a seed?
  - evolutionary growth mechanisms and support
  - need for reseeding? when? by whom?

- **motivation**
  - what motivates Google/SketchUp?
  - what motivates the participants?
  - any rewards for the participants?

- **quality of contributions**
  - better or worse for end-user contributions versus professional contributions
  - who determines quality?

Meta-Design: Transforming Application Areas

- **design:** customization, personalization, tailorability, end-user development, design for diversity

- **architectural design:** underdesign, support for "unself-conscious culture of design"

- **teaching and learning:** teachers as facilitator, learning communities, courses-as-seeds

- **informed participation:** beyond access, social creativity

Meta-Design: Transforming Application Areas — Continued

- **open source:** a success model of decentralized, collaborative, evolutionary development (Eric Scharff, PhD thesis)

- **living organizational memories:** livingOM (Jonathan Ostwald), Web2Gether (Rogerio dePaula), Swikis

- **digital libraries:** community digital library (Michael Wright and Tamara Sumner)

- **interactive art:** collaboration, co-creation, puts the tools rather than the object of design in the hands of users (Elisa Giaccardi)
  - examples: http://www.sito.org/ — **Gridcosm, HyGrid**

Conclusions

- **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