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

Integrating Individual and Social Creativity

—

Creativity Research in the USA and at L3D

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First International Conference "Creativity: A Multifaceted View", Moscow, September 2005

Overview

- **Creativity Research in the USA**

- **The Center for LifeLong Learning and Design (L3D)**

- **Conceptual Frameworks**

- **Socio-Technical Environments in Support of Creativity**

- **Implications**

- **Conclusions**

Creativity Research in the USA

- Creativity — a brief characterization

- Analyzing and describing creativity

- Creativity Support Tools

- Beyond Productivity: Innovation and Creativity

- The Creative Class

- Economic Implications

Creativity — a Brief Characterization

- ***historical creativity*** = ideas and discoveries that are fundamentally novel with respect to the whole of human history

- ***psychological creativity*** = *ideas and discoveries in everyday work practice that are novel with respect to an individual human mind or social community*
    - a capacity inherent to varying degrees in all people
    - needed in most problem-solving situations
    - knowledge workers and designers have to engage in creative activities to cope with the unforeseen complexities of real-world tasks

Creativity: Four Essential Attributes

- **originality** means people having unique ideas (mostly in the realm of *psychological creativity)* or applying existing ideas to new contexts

- **expression** — ideas or new applications are of little use if they are only internalized; they need to be *expressed and externalized*

- **social evaluation** — externalizations allow other people (with different backgrounds and perspectives) to understand, reflect upon, and improve them

- **social appreciation within a community** —rewards, credits, and acknowledgements by others that motivate further creative activities

Individual Creativity

- creative individuals can make a huge difference — for example: movie directors, champions of sports teams, and leading scientists and politicians

- individual knowledge, imagination, inspiration and innovation are the basis for social creativity

- **but:** *"an idea or product that deserves the label 'creative' arises from the synergy of many sources and not only from the mind of a single person"* (Csikszentmihályi)

Social Creativity

- the **Renaissance scholar** (who knows "everything") does **not** exist anymore
    - the individual, unaided human mind is limited
    - the great individual→ the great group/community

- **distinct domain of human knowledge exist** → of critical importance: mutual appreciation, efforts to understand each other, increase in socially shared cognition and practice

- exploit the **"symmetry of ignorance"** as an opportunity
    - none of the stakeholders solving a complex problem can guarantee that their knowledge is superior or more complete compared to other people's knowledge
    - to overcome the "symmetry of ignorance" → activate as much knowledge from as many stakeholders as possible with the goal of achieving mutual education and shared understanding

Creativity —The "Wrong" Image?
"The Thinker" by Auguste Rodin

Analyzing and Describing Creativity

- **Csikszentmihalyi, M. (1996) Creativity — Flow and the Psychology of Discovery and Invention, HarperCollins Publishers, New York, NY**

- **Bennis, W., & Biederman, P. W. (1997) Organizing Genius: The Secrets of Creative Collaboration, Perseus Books, Cambridge, MA.**
  - none of us is as smart as all of us → **social creativity**
  - great groups and great leaders create each other → **individual and social creativity**
  - people in great groups have blinders on → **group-think**
  - great groups are voluntary associations; people are in them, not for money, not even for glory, but because they love the work, they love the project → **motivation**
  - examples: Disney (animated movie), Xerox-Parc (personal computing), Manhattan project (atomic bomb), …..

- **John-Steiner, V. (2000) Creative Collaboration, Oxford University Press, Oxford.**

Creativity Support Tools

- **a recent workshop supported by the National Science Foundation**

- **for details see:**
    http://www.cs.umd.edu/hcil/CST/

- includes a web page with URLs to **"Resources for Creativity Support Tools":**
    http://www.cs.umd.edu/hcil/CST/resources.html

- see slides of **individual presentations:**
    http://www.cs.umd.edu/hcil/CST/schedule.html

Beyond Productivity: Innovation and Creativity

- **National-Research-Council (2003) Beyond Productivity: Information Technology, Innovation, and Creativity, National Academy Press, Washington, DC.**

  - challenge for the 21st century is to "work smarter, not harder"

  - explore collaborative efforts between persons in information technologies (IT) and creative practices (CP; fine arts, movie making) → artists and technologists should find common ground

  - **assumption:** exposing a culture (or a practice) to alien influences and experiencing marginality or even dissent are correlated with creativity → from "communities of practice" to "communities of interest"

  - **objective-1 (IT → CP):** how can information technology provide new tools and media for artists and designers that enable new types of work?

  - **objective-2 (CP → IT):** how can art and design raise important questions for information technology and help to push forward research and product development agendas in computer science and information technology?

  - **objective-3 (IT + CP):** how can successful collaboration of artist, designers, and information technologists be established?

The Creative Class

- **Florida, R. (2002) The Rise of the Creative Class and How It's Transforming Work, Leisure, Community and Everyday Life, Basic Books, New York, NY.**

  - the creative class derives its identity from its members' roles as being creative

  - creative class = people in science, engineering, architecture, design, education, arts, music, entertainment whose function is to create new ideas, new technology, and new creative content

  - creativity is now the *decisive* source of competitive advantage

  - creativity is multi-dimensional: technological, economic, artistic, cultural

  - creativity cannot be switched on and off at predetermined times; it is an odd mixture of work and play

  - creativity is largely driven by intrinsic awards → example: open source movement as a gift culture

  - tension between creativity and organization: the creative process is social, not just individual, and thus forms of organization are necessary; but elements of organization can and frequently do stifle creativity

  - **claim:** the deep and enduring changes of our age are not technological but social and cultural

Democratizing Creativity

- **Hippel, E. v. (2005) Democratizing Innovation, MIT Press, Cambridge, MA.**

  - creativity and innovation are being democratized — meaning: users of product and services are increasingly able to innovate for themselves

  - integrate and complement manufacturer-creativity and user--creativity

  - the needs of users for products are highly heterogeneous in many fields

  - users may value the process of innovating and being creative because of the enjoyment and learning that it brings them → in personally meaningful problems

  - **claim:** users' ability to innovate is improving radically and rapidly as a result of the steadily improving quality of computer software and hardware, improved access to easy-to-use tools and components for innovation, and access to a steadily richer innovation commons

  - meta-design → design that users can be creative and act as designers themselves

  - **examples:** open source, Wikipedia (www.wikipedia.org) = user-contributed online encyclopedia

Economic Implications

- **Friedman, T. L. (2005) The World is Flat: A brief history of the twenty-first century, Farrar, Straus and Giroux, New York**

  - the playing field is leveled → many countries compete for global knowledge work
  - **US tax returns in India** (tax returns: knowledge work, but rule-based)
    - 2003:   25,000
    - 2004:   100,000
    - 2005:   400,000
  - the changing world (in less than 50 years):
    - sold in China
    - made in China
    - designed in China
    - dreamed up in China
  - **basic assumption:** the more "creative work" will stay in the USA → combine technical knowledge (e.g., how to write computer programs) with business, scientific knowledge, and take advantage of local contexts
  - **question:** what are the educational implications of these changes? how do we educate students for finding a job in the world of tomorrow?

L³D's Research Focus and Intellectual Identity

- **Artificial Intelligence (AI) → Intelligence Augmentation (IA)**
  - replacement → empowerment
  - emulate → complement (exploit unique properties of new media)

- **instructionist learning → constructionist learning**
  - learning about → learning to be
  - when the answer is known → when the answer is not known

- **individual → social (distributed intelligence, social creativity)**
  - knowledge in the head → knowledge in the world
  - access → informed participation
  - **within cultures → across cultures**

- **generic → specific**
  - design → meta-design (adaptive, adaptable, situated)
  - general → customization, personalization

- **desktop → ubiquitous computing**

Conceptual Frameworks

- **social creativity**
    - individual and social creativity
    - social creativity → distances (spatial, temporal, technical) and diversity (conceptual, multiple voices)

- **meta-design**

- **communities**
    - Communities of Practice (CoPs)
    - Communities of Interests (CoIs)

Individual versus / and Social Creativity

"The strength of the wolf is in the pack,
and the strength of the pack is in the wolf."— Rudyard Kipling

- **social**
    - Rodin's sculpture "The Thinker" dominates our collective imagination as the purest form of human inquiry — the lone, stoic thinker
    - the reality is that scientific and artistic forms emerge from the joint thinking, passionate conversations, and shared struggles

- **individual:**
    - human collaboration is not only needed but central to social creativity
    - individuals participating in collaborative inquiry and creation, need the individual reflective time depicted by Rodin's sculpture
    - without such reflection it is difficult to think about contributions to social creativity

Our Focus: Design Problems

- **design** (Herbert Simon "Sciences of the Artificial")
    - **natural science**: how things are
    - **design**: how things ought to be

- **design problems** are
    - **complex** → requiring **social creativity** in which stakeholders from different disciplines have to **collaborate**
    - **ill-defined** → requiring the **integration of problem framing and problem solving**
    - **have no (single) answer** → **argumentation**
    - **unique** → **the answer is not known**

Distance "Spatial Dimension" — Voices from Far Away

- bringing spatially distributed people together: supports the shift that **shared concerns rather than shared location** becomes the prominent defining feature of a group of people interacting with each other

- allows more people to be included, thus **exploiting local knowledge**

- success model: **open source communities**

- transcending the barrier of spatial distribution is of particular importance in **locally sparse populations**

Distance "Temporal Dimension" — Voices from the Past

- design processes often take place over many years, with initial design followed by extended periods of **evolution and redesign**

- importance of
    - design rationale

    - redesign and reuse ("complex systems evolve faster if they can build on stable subsystems")

Distance "Conceptual Dimension" — Voices from Collaborators

- ***Communities of Practice (CoPs)****,* defined as groups of people who share a professional practice and a professional interest (supported by **domain-oriented design environments**)

- ***Communities of Interest (CoIs)****,* defined as groups of people (typically coming from different disciplines) who share a common interest, such as framing and solving problems (supported by **Envisionment and Discovery Collaboratory**)

Distance "Technological Dimension"

"You cannot use smoke signals to do philosophy.
Its form excludes the content". (Postman, 1985)

- **claim: there is no media-independent communication and interaction**
    - tools, materials, and social arrangements always mediate activity
    - the possibilities and the practice of design are functions of the media with which we design

- **some global objectives:**
    - media as extensions of human
    - intelligence augmentation
    - domain orientation to support human problem-domain interaction
    - beyond the desktop: ubiquitous computing
    - digital fluency to make domain experts independent of information technologists

Meta-Design

- **meta-design =** how to create new media that allow users to act as designers and be creative

- **why meta-design?**
    - design as a process is tightly coupled to use and continues during the use of systems
    - address and overcome problems of closed systems
    - transcend a "consumer mindset"

Some Important Aspect of Meta-Design

- **Chinese Proverb***: "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"*

- **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"*

- **socio-technical environments** supporting meta-design must
  - support emerging, unintended, and subversive uses, not just anticipated ones
  - not only build new technologies but seed new practices, new genres, new communities
  - avoid that most of the design intelligence is forced to the earliest part of the design process, when everyone knows the least about what is really needed

Communities of Practice (CoPs)
—
Homogenous Design Communities

- **CoPs =** practitioners who work as a community in a certain domain

- **examples:** architects, urban planners, research groups, software developers, software users, kitchen designers, computer network designer,

- **learning:**
  - masters and apprentices
  - legitimate peripheral participation (LPP)
  - develop a notion of belonging

- **problems:** *"group-think"* → when people work together too closely in communities, they sometimes suffer illusions of righteousness and invincibility

- **systems:** domain-oriented design environments (e.g.: kitchen design, computer network design, voice dialogue design, …..)

Communities of Interest (CoIs)
—
Heterogeneous Design Communities

- **CoIs =** bring different CoPs together to solve a problem

- **membership** in CoIs is defined by a shared interest in the framing and resolution of a design problem

- **diverse cultures**
  - people from academia and from industry
  - software designers and software users
  - students and researchers from around the world

- **fundamental challenges:**
  - establish common ground by creating boundary objects
  - build a shared understanding of the task at hand
  - learn to communicate with others who have a different perspective
  - primary goal: not "moving toward a center" (CoP) but **"integrating diversity and making all voices heard"**

CoIs and Boundary Objects

Boundary
Objects
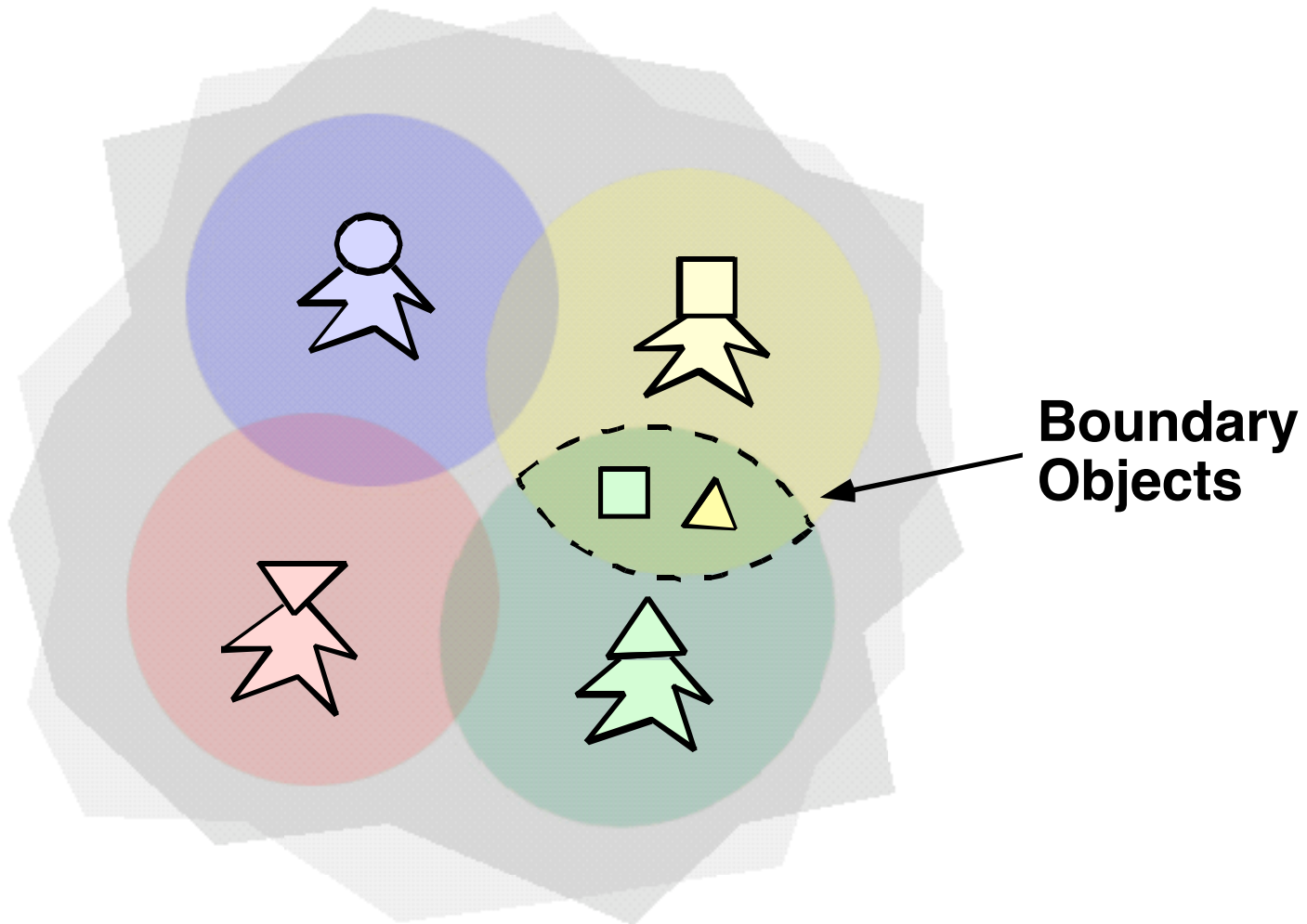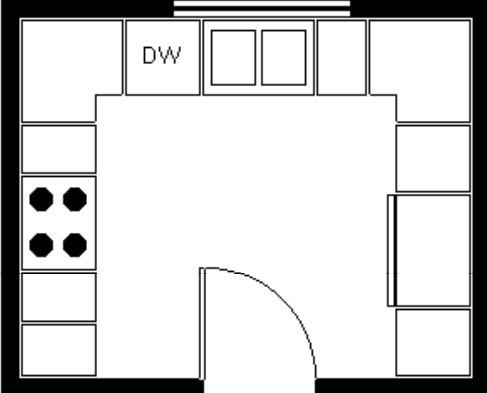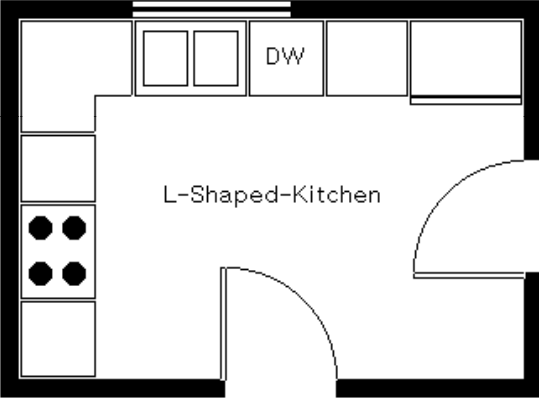
Socio-Technical Environments in Support of Creativity

- **Domain-Oriented Design Environments (DODEs)**

- **Envisionment and Discovery Collaboratory (EDC)**

Domain-Oriented Design Environments (DODEs)

- support reflective practitioners in specific domains by bringing tasks to the forefront

- support individual creativity by supporting
  - reflection-in-action
  - critiquing
  - simulation

A DODE for Kitchen Design: Construction
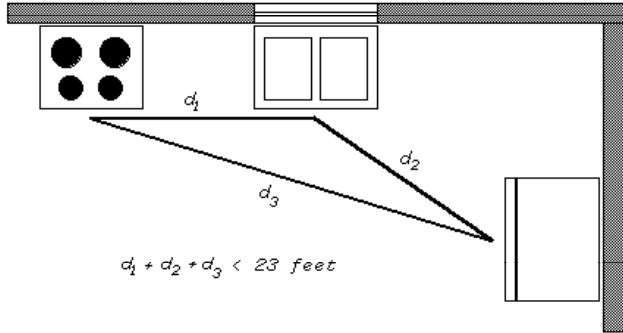
Janus-Construction

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

Appliance Palette

walls

doors

windows

sinks

stoves

Catalog

L-Shaped-Kitchen

Work Area

DW

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*
▶ ■

A DODE for Kitchen Design: Argumentation

Janus-Argumentation

Answer (Refrigerator, Sink, Stove)

The distance between sink, stove and refrigerator, the *work triangle*, should be less than 23 feet.

$$d_1 + d_2 + d_3 < 23 \text{ feet}$$

Figure 10: the work triangle
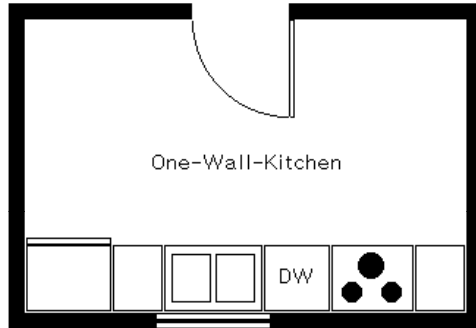
Argument (Walking Distance)
The work triangle is an important concept in kitchen design. The work triangle denotes the center front distance between the three main appliances: *sink*, *stove* and *refrigerator*. This length should be less than 23 feet to avoid unnecessary walking and to ensure an efficient work flow in the kitchen!

Argument (Small Room)
In small kitchens where the work triangle is less than 16 feet,

Viewer: Default Viewer

Catalog Example

One-Wall-Kitchen

DW

The length of the work triangle (Stove, Refrigerator, Sink) is less than 23 feet.

Visited Nodes
⇒   Answer (Refrigerator, Sink, Stove) Section

Commands
▶
Show Example: "Answer (Refrigerator, Sink, Stove)"
Show Example Answer (Refrigerator, Sink, Stove)
▶■

Show Outline   Resume Construction
Search For Topics   Show Construction
Show Argumentation   Show Example
Show Context   Show Counter Example

A DODE for Computer Network Design

The Envisionment and Discovery Collaboratory (EDC)

- **the EDC supports:**
  - social creativity
  - meta-design

- **underlying problem solving approach: reflection-in-action**
  - action space: face-to-face collaboration
  - reflection space: web-based

- **application areas:**
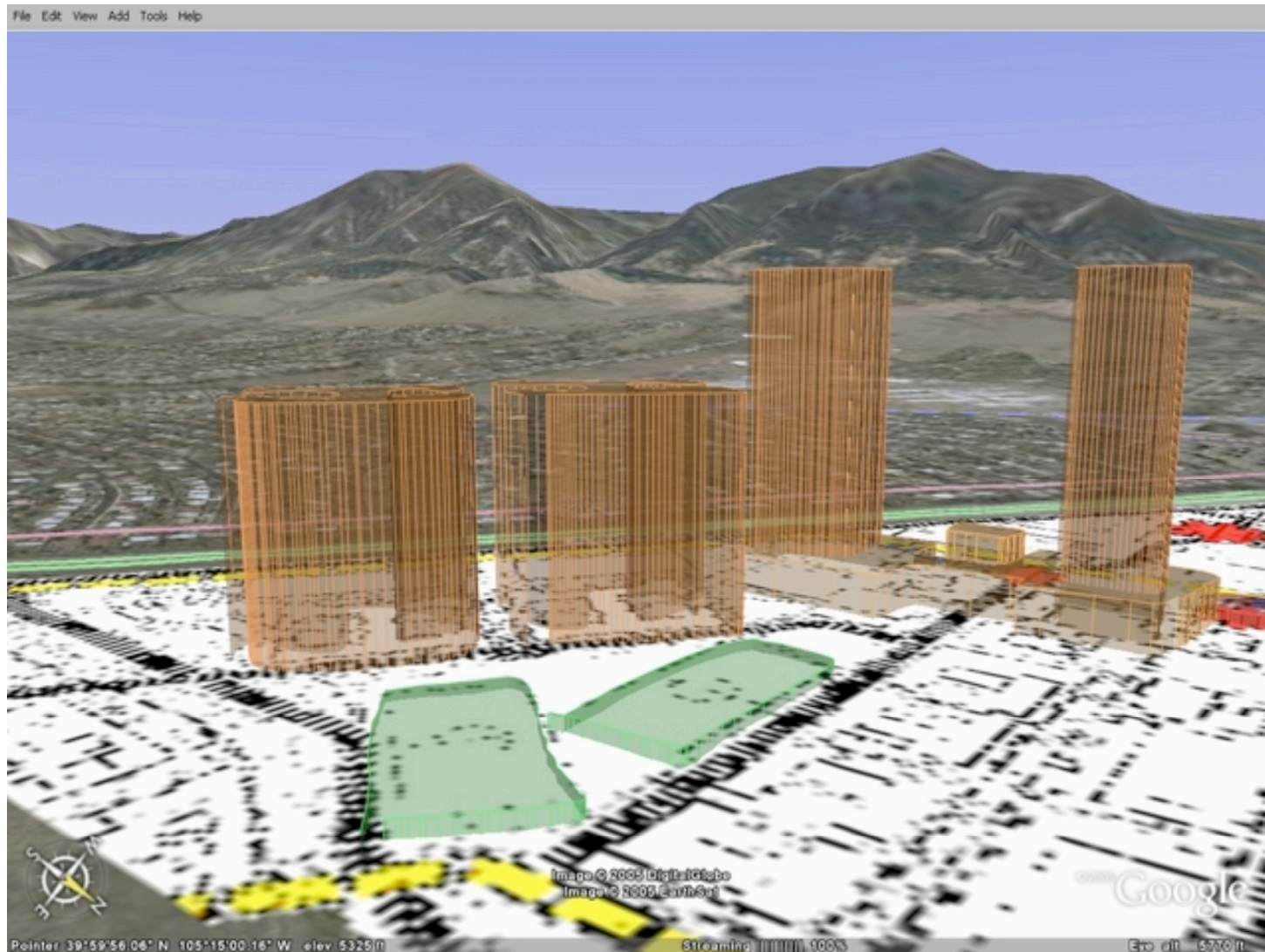 - urban planning
  - emergency management

The Envisionment and Discovery Collaboratory

Face-to-Face Collaboration around the EDC Action Space
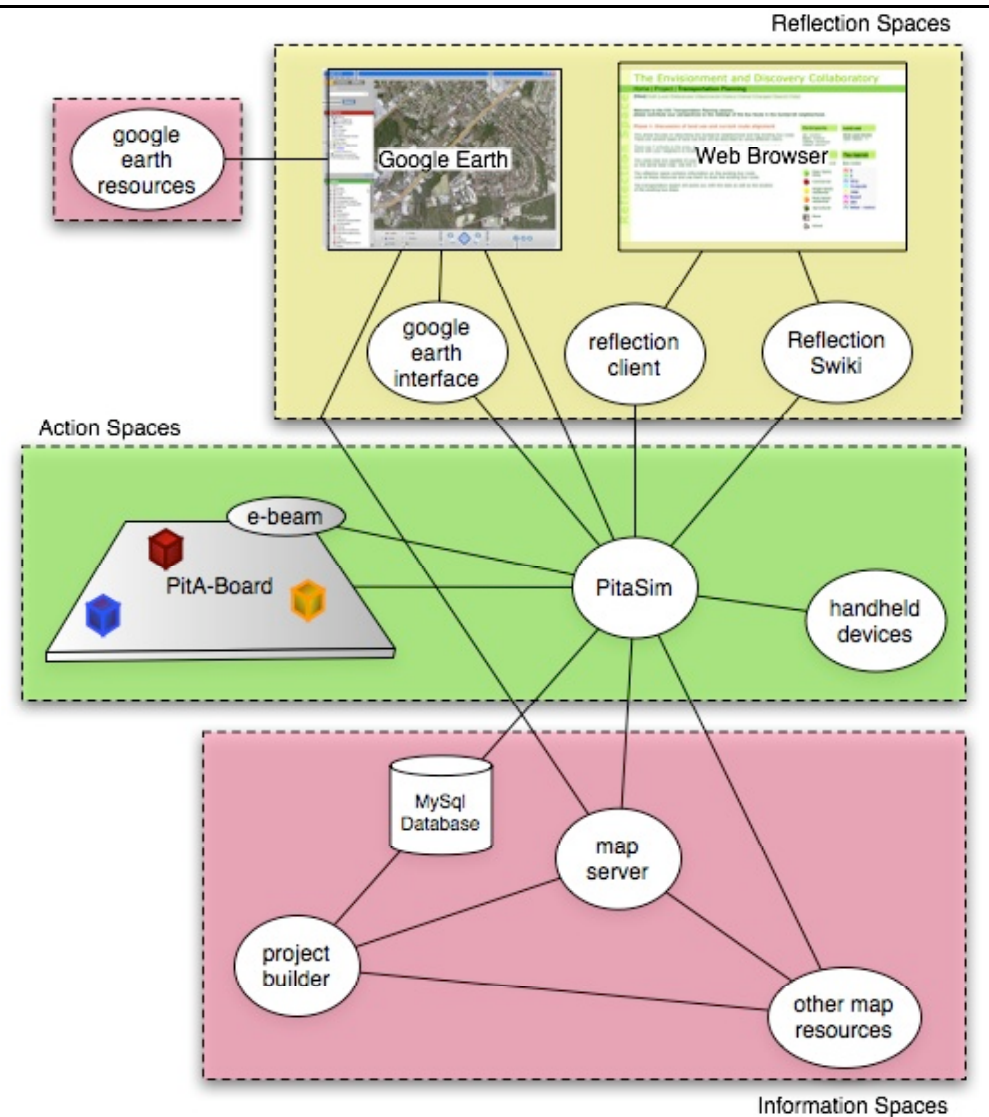
Integrating the EDC with Google Earth

# The EDC Architecture

reflection space

action space

information sources

Creativity Support with the EDC

- access → **informed participation**

- design → **meta-design**

- individual creativity→ **social creativity**

- communities of practice → **communities of interest**

- **computing beyond the desktop:** computationally enhanced physical objects, parallel interactions, context awareness, ….

Caretta: A EDC Extension at the University of Tokyo

LCD projector

PDA

simulation and database server

sensing board
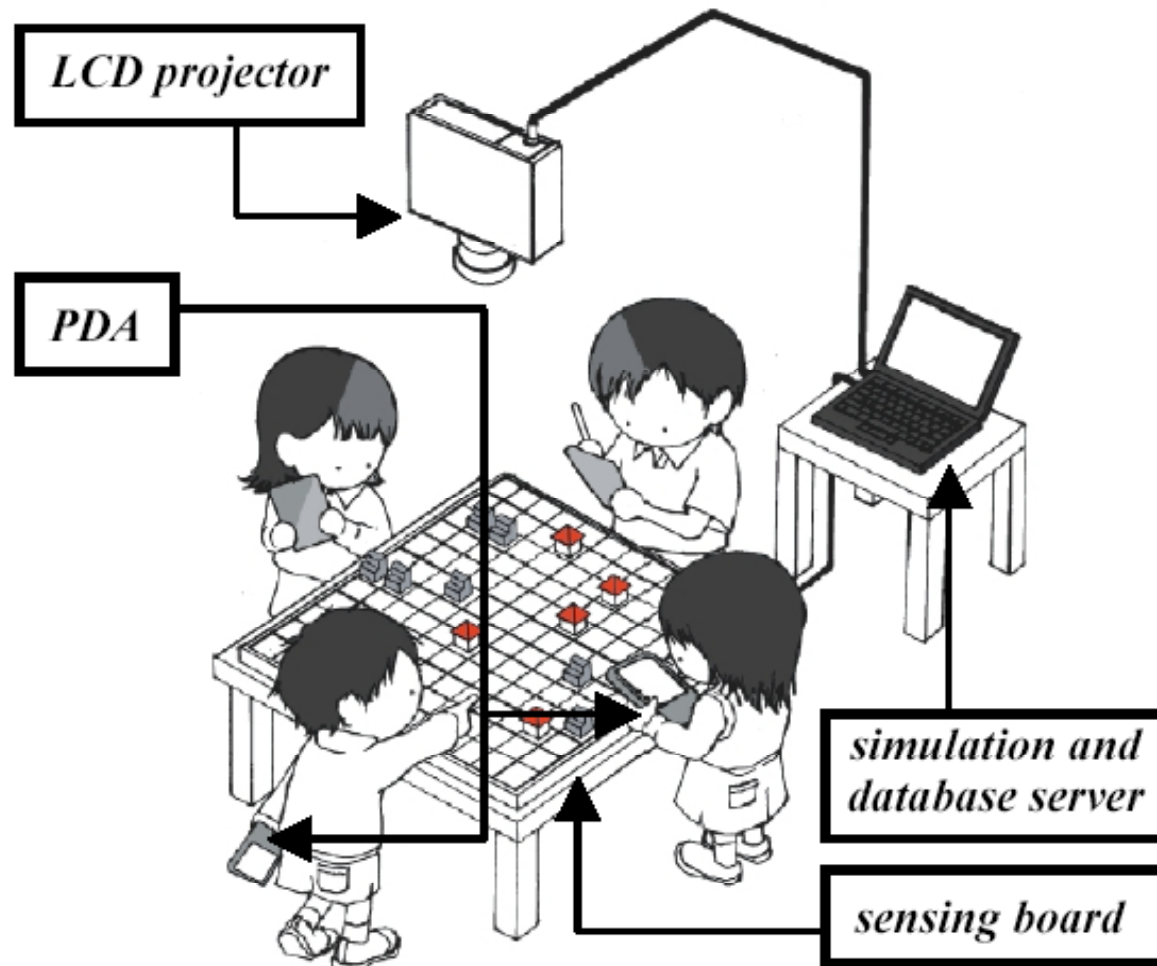
Caretta: Integrating Individual and Social Creativity

- **objective**: the smooth integration of individual and social creativity; individual creativity drives social creativity, and social creativity triggers further individual creativity

- technological support for **individual creativity**: Personal Digital Assistants (PDAs)

- technological support for **social creativity**: SensingBoard

- **more information:** Fischer, G., Giaccardi, E., Eden, H., Sugimoto, M., & Ye, Y. (2005) "Beyond Binary Choices: Integrating Individual and Social Creativity"

Implications

- fish-scale model

- reflective communities

- producers and consumers

Beyond the Individual Human Mind: Fish-Scale Model

source: Campbell, D. T. (2005) "Ethnocentrism of Disciplines and the Fish-Scale Model of Omniscience." In S. J. Derry, C. D. Schunn, & M. A. Gernsbacher (Eds.), *Interdisciplinary Collaboration — An Emerging Cognitive Science,* Lawrence Erlbaum, Mahwah, NJ, pp. 3-21.

- the key to address complex problems is
  - **not** in *"Leonardos who are competent in all sciences"* or in "educating the *intellectual superhuman"* who knows everything
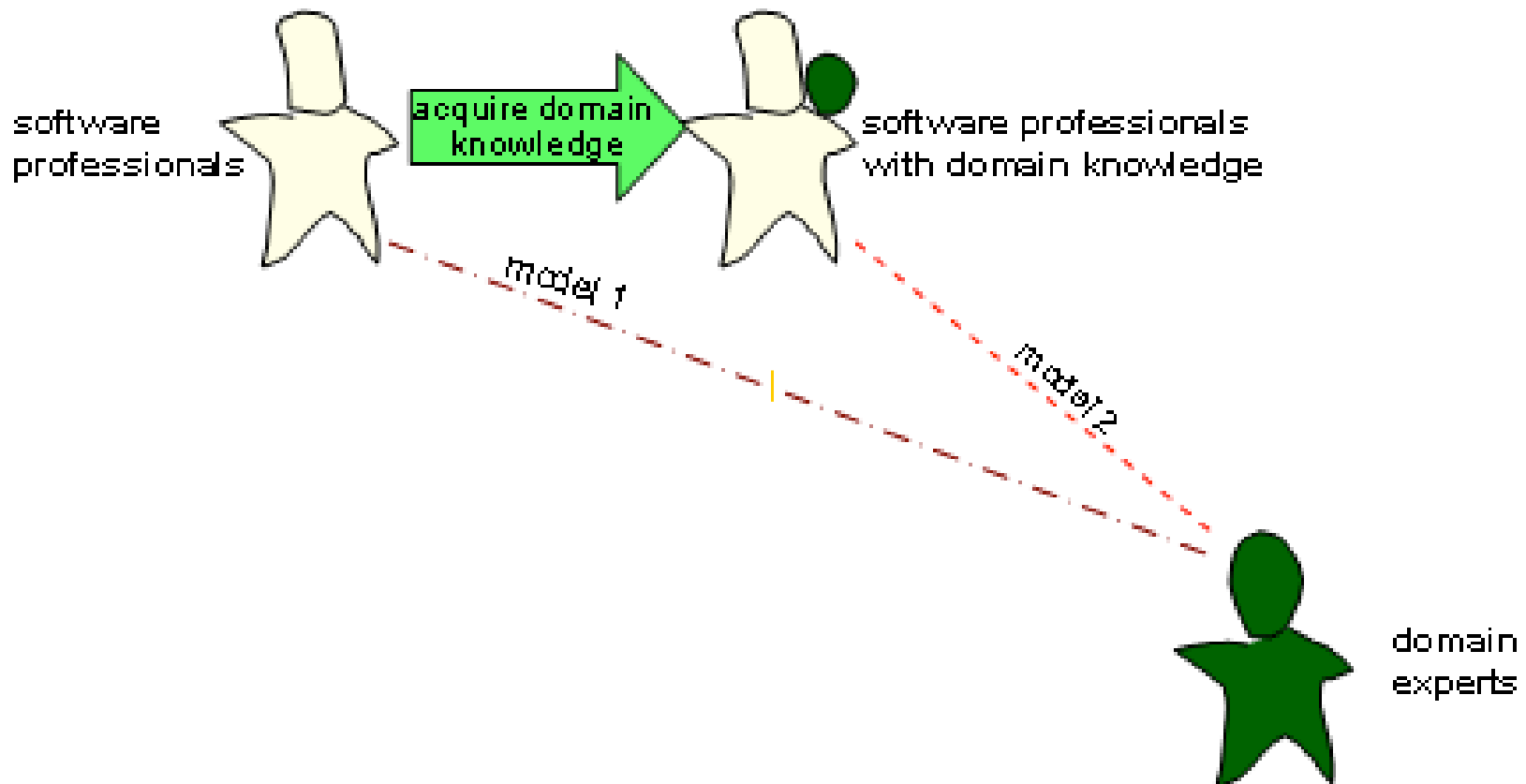 - but to achieve *"**collective comprehensiveness through overlapping patterns of unique narrowness**"*
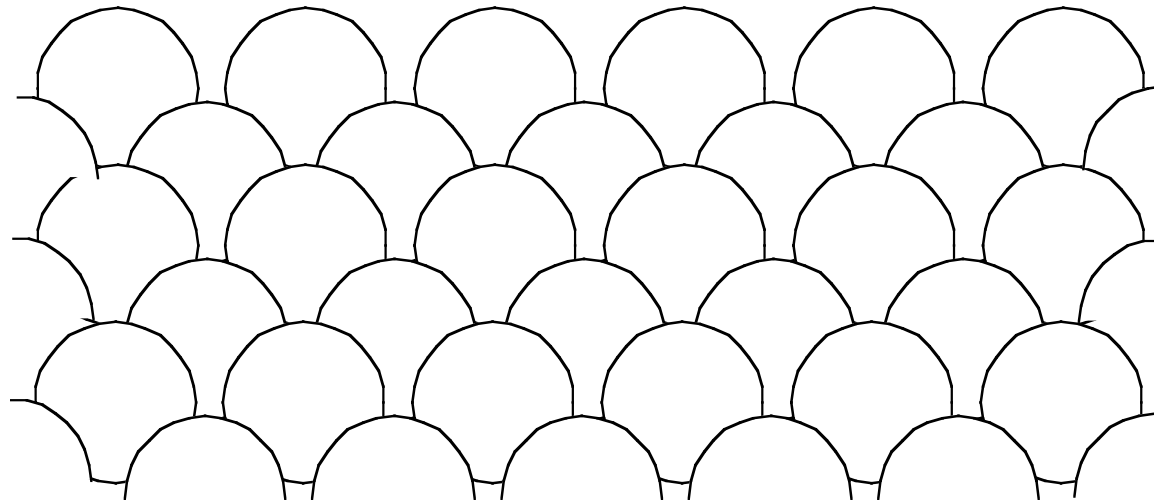
From Reflective Practitioners to Reflective Communities

source: Schön, D. A. (1983) *The Reflective Practitioner: How Professionals Think in Action,* Basic Books, New York.
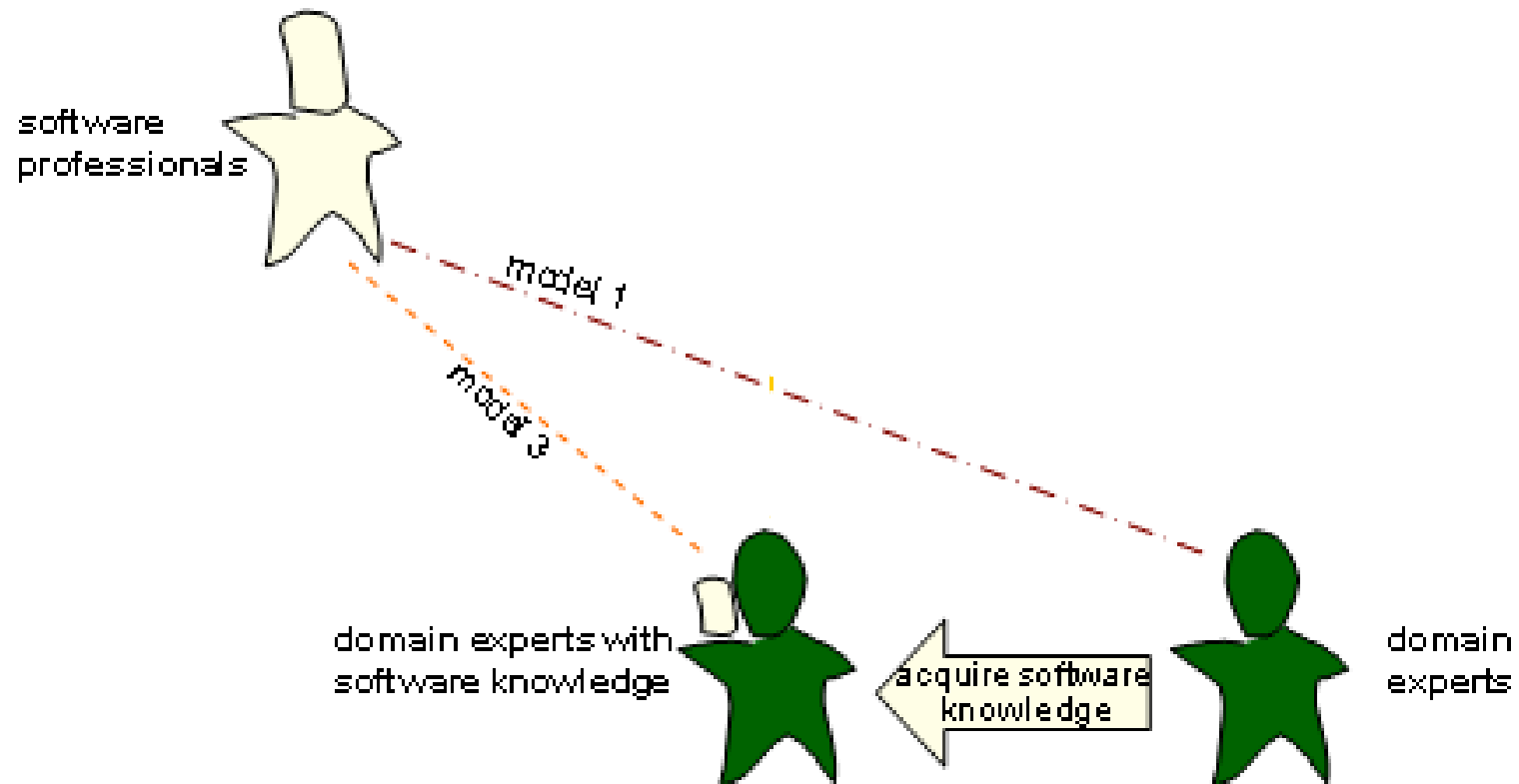
Large Conceptual Distance — Limited Common Ground
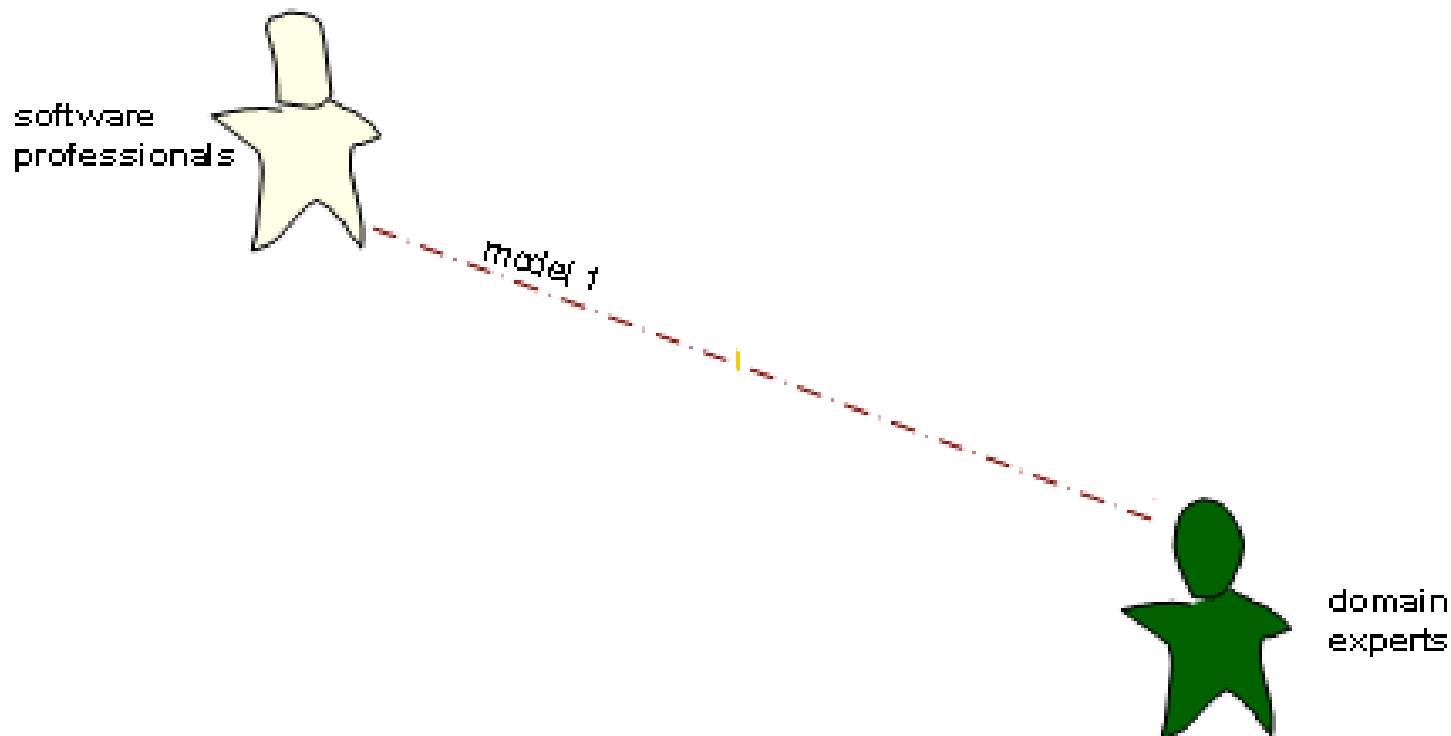
Software Professionals Acquiring Domain Knowledge

software
professionals

acquire domain
knowledge

software professionals
with domain knowledge

model 1

model 2

domain
experts

Domain Experts Acquiring Media Knowledge

software
professionals

model 1

media 2

domain experts with
software knowledge

acquire software
knowledge

domain
experts

Reflective Communities

software
professionals

acquire domain knowledge

software professionals
with domain knowledge

model 1

model 4

model 3

model 2

domain experts with
software knowledge

acquire software knowledge

domain
experts
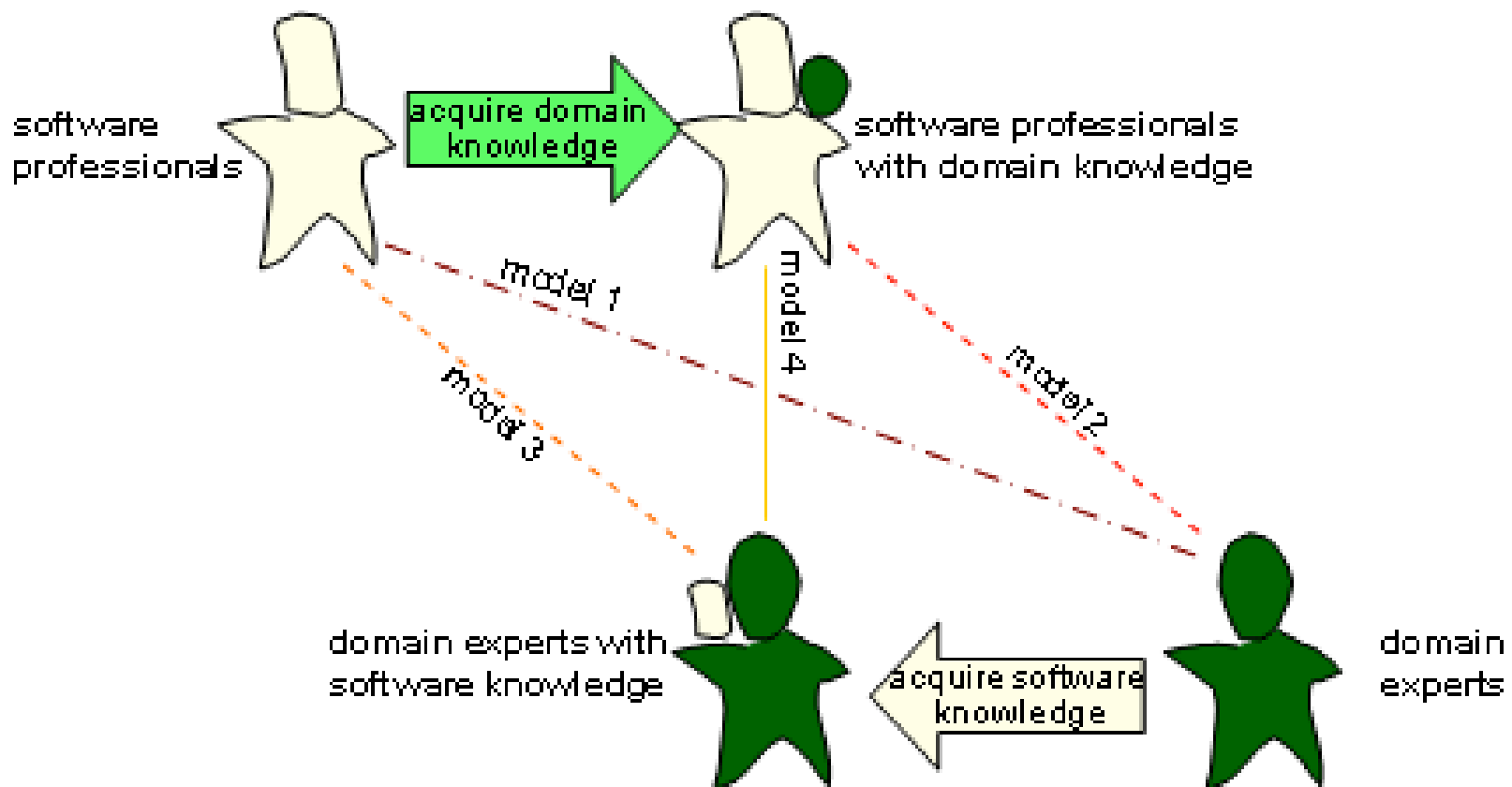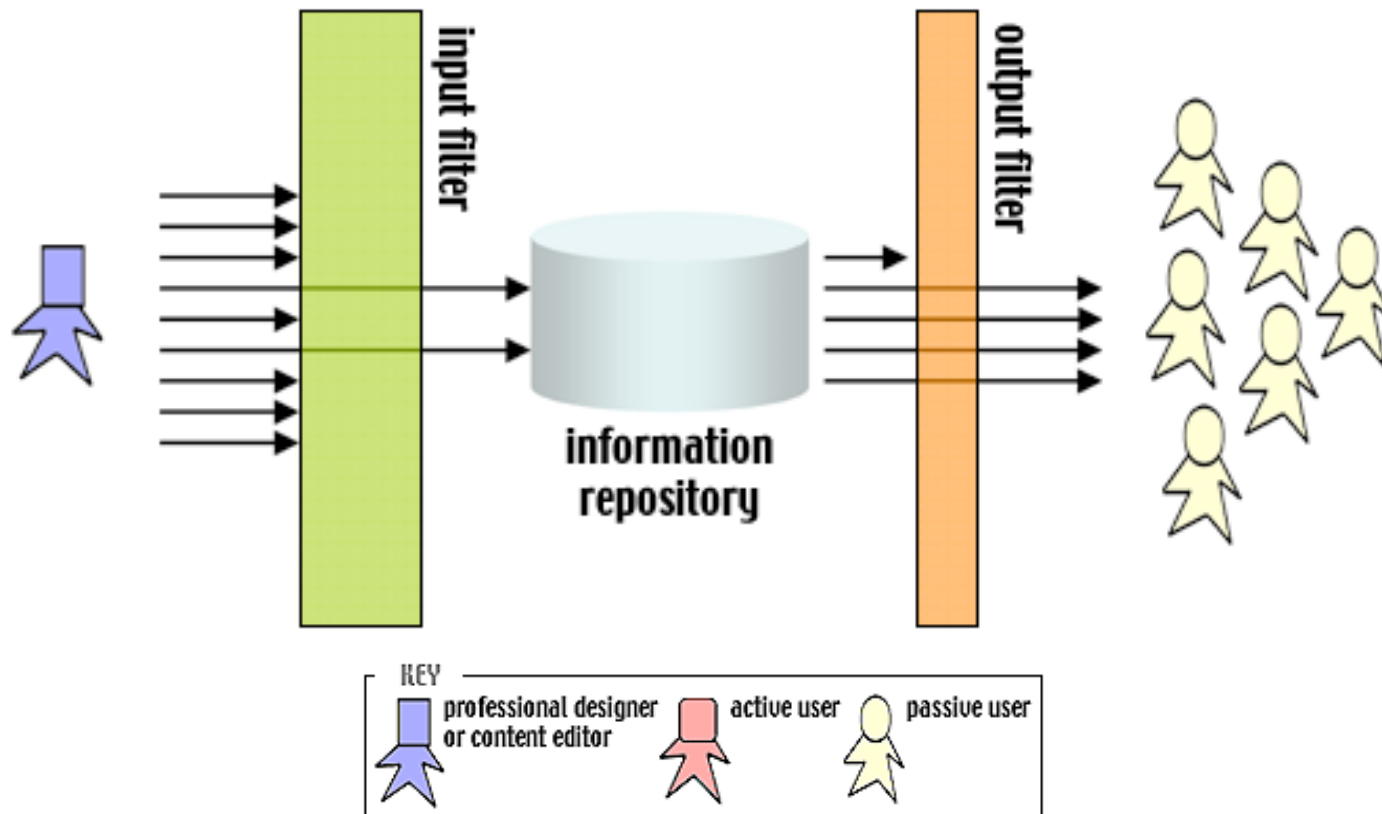
Producer/Consumer Models in a Consumer Culture ("Access")

- Strong Input Filters, Small Information Repositories, Weak Output Filters
- Limitation: Making All Voices Heard

Producer/Consumer Models in Design Culture ("Informed Participation")

- Weak Input Filters, Large Information Repositories, Strong Output Filters
- Limitation: Trust and Reliability of Information
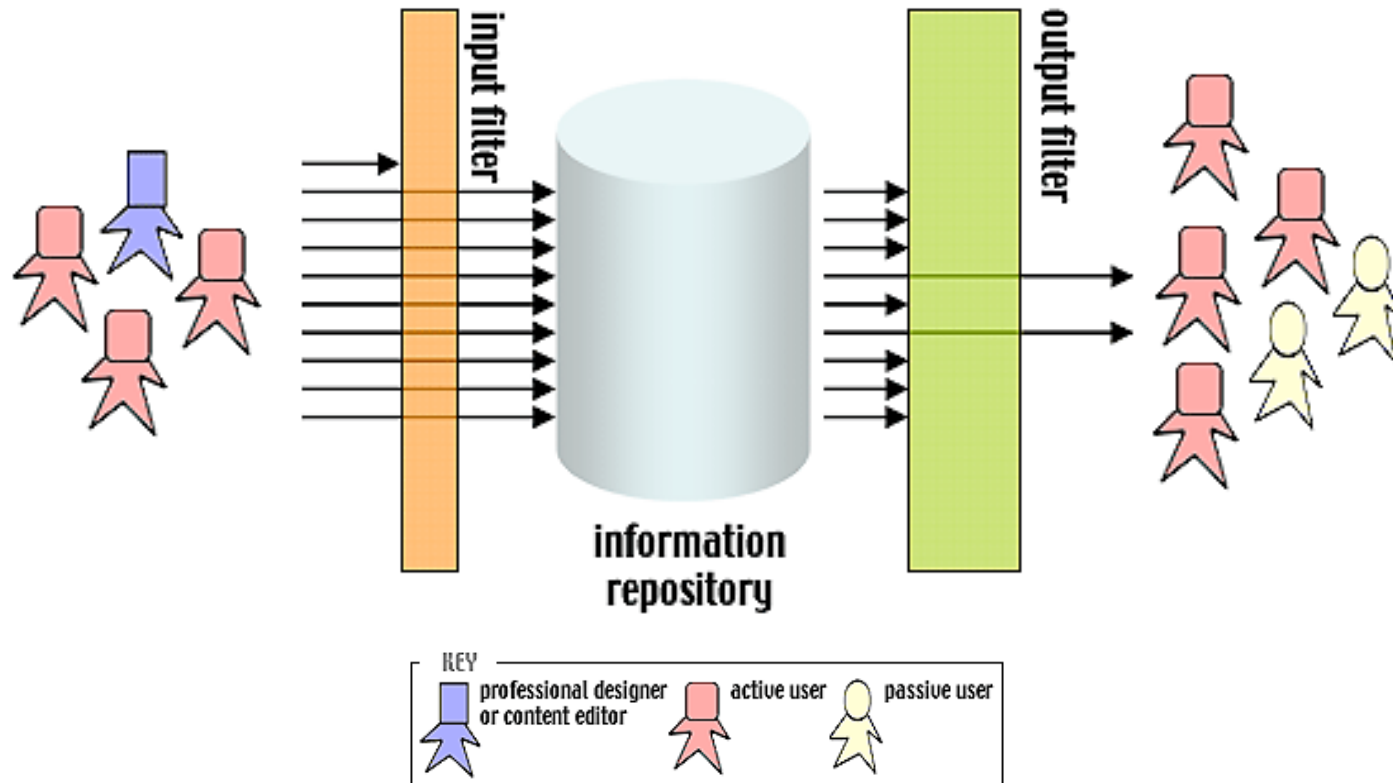
Conclusions

- the complexity of problems transcends the individual human mind, requiring not only individual but also social creativity

- **socio-technical environments in support of individual and social creativity**:
    - unaided, individual human mind → media-augmented social creativity to make all voices heard and integrate diversity

    - exploit distances in communities as sources of creativity → spatial, temporal, conceptual, and technological distances

    - design → meta-design

    - communities of practice → communities of interest

    - reflective practitioners → reflective communities

Some L3D Publications about Creativity

- Fischer, G., Giaccardi, E., Eden, H., Sugimoto, M., & Ye, Y. (2005) "Beyond Binary Choices: Integrating Individual and Social Creativity," International Journal of Human-Computer Studies (IJHCS) Special Issue on Creativity (eds: Linda Candy and Ernest Edmond), p. (in press). http://l3d.cs.colorado.edu/~gerhard/papers/ind-social-creativity-05.pdf

- Fischer, G., & Giaccardi, E. (2005) "Meta-Design: A Framework for the Future of End User Development." In H. Lieberman, F. Paternò, & V. Wulf (Eds.), *End User Development* Kluwer Academic Publishers, Dordrecht, The Netherlands, p. (in press). http://l3d.cs.colorado.edu/~gerhard/papers/EUD-meta-design-online.pdf

- Fischer, G. (2005) "Distances and Diversity: Sources for Social Creativity," *Proceedings of Creativity & Cognition*, London, April, pp. 128-136. http://l3d.cs.colorado.edu/~gerhard/papers/creativity-cognition-2005.pdf

- Giaccardi, E., & Fischer, G. (2005) "Creativity and Evolution: A Metadesign Perspective." In Proceedings of the European Academy of Design (EAD-6) Conference, Bremen, Germany, 29-31 March, http://l3d.cs.colorado.edu/~gerhard/papers/ead06.pdf

- Fischer, G., & Ostwald, J. (2005) "Knowledge Communication In Design Communities." In R. Bromme, F. Hesse, & H. Spada (Eds.), *Barriers and Biases in Computer-Mediated Knowledge Communication,* Springer, New York, NY, pp 213 - 242. http://l3d.cs.colorado.edu/~gerhard/papers/fi_ost-final.pdf