University of Colorado at Boulder

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

Social Creativity

Gerhard Fischer
Center for LifeLong Learning & Design (L^3D), Department of Computer Science and Institute of Cognitive Science, University of Colorado, Boulder

University of Milan, February 2012

Overview

- Creativity
- Social Creativity — Transcending the Individual Human Mind
- Distances and Diversity
- Communities of Practice and Communities of Interest
- Examples

The Grand Challenge for the Future of Computer Science: Beyond Productivity: Innovation and Creativity

- challenge for the 21st century: "**work smarter, not harder**"
- explore collaborative efforts between **information technologies (IT)** and **creative practices (CP;** fine arts, movie making) → artists and technologists should find common ground
- **objective-1 (IT → CP):** how can IT provide new tools and media for artists and designers that enable new types of work?
- **objective-2 (CP → IT):** how can CP raise important challenges for IT (new tools, new representations)?
- **objective-3 (IT + CP):** how can a successful collaboration of IT and CP be established?

Creativity: Four Essential Attributes

- **originality** means people having unique ideas 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

Historical versus Psychological Creativity

- ***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 —The "Wrong" Image?

"The Thinker" by Auguste Rodin

Human Creativity = f{Medium}

- Neil Postman, “Amusing Ourselves to Death” **:**
  “you cannot use smoke signals to do philosophy. Its form excludes the content”

- **claim:** we cannot use most current computer systems to be creative

- **challenge:** design of socio-technical environments supporting creativity by allowing us
  - to think previously **unthinkable thoughts**
  - to do previously **undoable actions**, and
  - to explore previously **unfeasible questions**

Research in Creativity

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

- **workshop** supported by the National Science Foundation, June 2005
  http://www.cs.umd.edu/hcil/CST/

- **conference** "Creativity & Cognition", June 2007
  http://www.cs.umd.edu/hcil/CC2007/

- **research program** "CreativeIT: Creativity and IT"; National Science Foundation (2007)

CreativeIT

Developing the Synergies between Research in Creativity and Computer and Information Science and Engineering

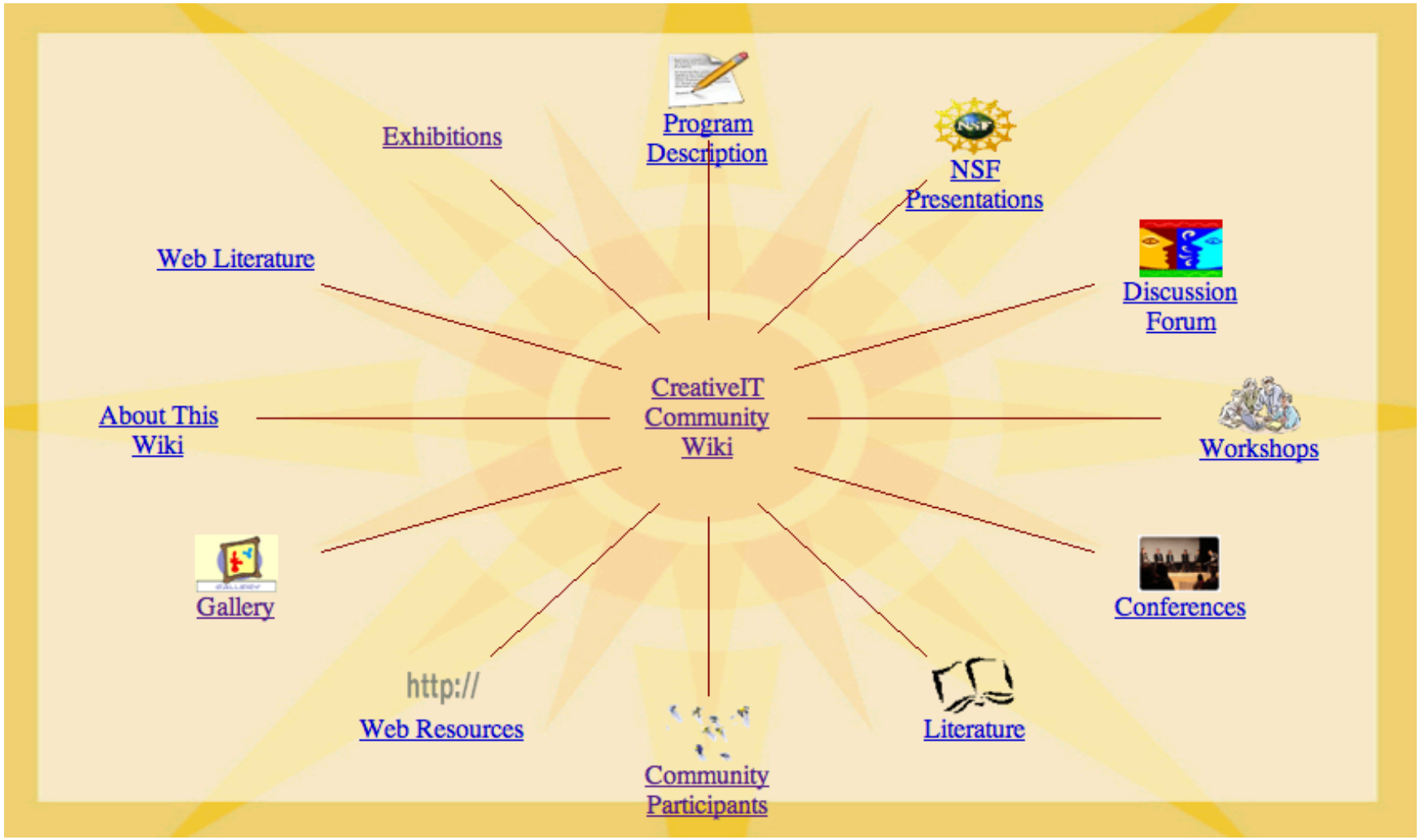
http://www.nsf.gov/pubs/2007/nsf07562/nsf07562.htm

- **program description:**
  - information technology is playing an increasing role in extending the capability of human creative thinking and problem solving
  - creative uses of information technology are leading to new areas of research and innovation

- **research areas:**
  - understanding creative cognition and computation
  - creativity to stimulate breakthroughs in science and engineering
  - educational approaches that encourage creativity
  - supporting creativity with information technology

A Wiki about the CreativeIT Program — Invitation to Participate

http://swiki.cs.colorado.edu:3232/CreativeIT



Democratizing Creativity — with Cultures of Participation and Meta-Design

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

Economic Implications

- **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?

Individual Creativity

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

- **individual creativity**
  - grounded in the unique perspective that an individual brings to bear in a specific problem
  - results from the life experience, culture, education, and background knowledge of an individual

- individual creativity has **limits**
  - in today's society, the Leonardesque aspiration to have people who are competent in all of science fails because the individual human mind is limited ("symmetry of ignorance")
  - *"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)

Individual Creativity

- **fundamental beliefs:**
  - breakdowns as a source for creativity (“critiquing”)
  - reflection-in-action (“making argumentation serve design”)

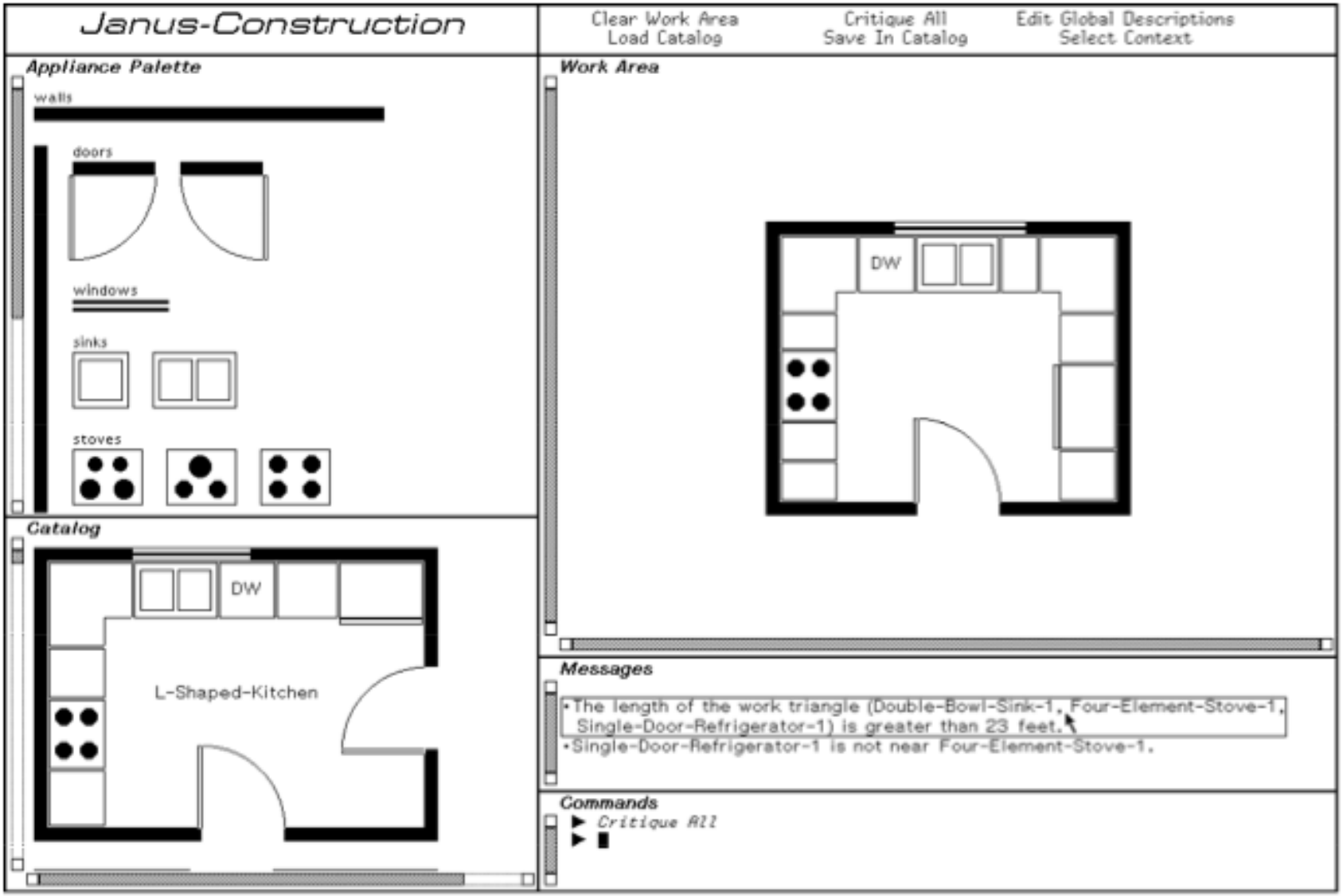
- **our work:**
  - critiquing (increase the back-talk of the artifacts under construction)
  - learning on demand
  - domain-oriented design environments (DODEs) = creativity enhancing environments
  - empower skilled domain workers by bringing task to the front with the support of human problem-domain interaction
  - make information relevant to the task at hand

Domain-Oriented Design Environments (DODEs)

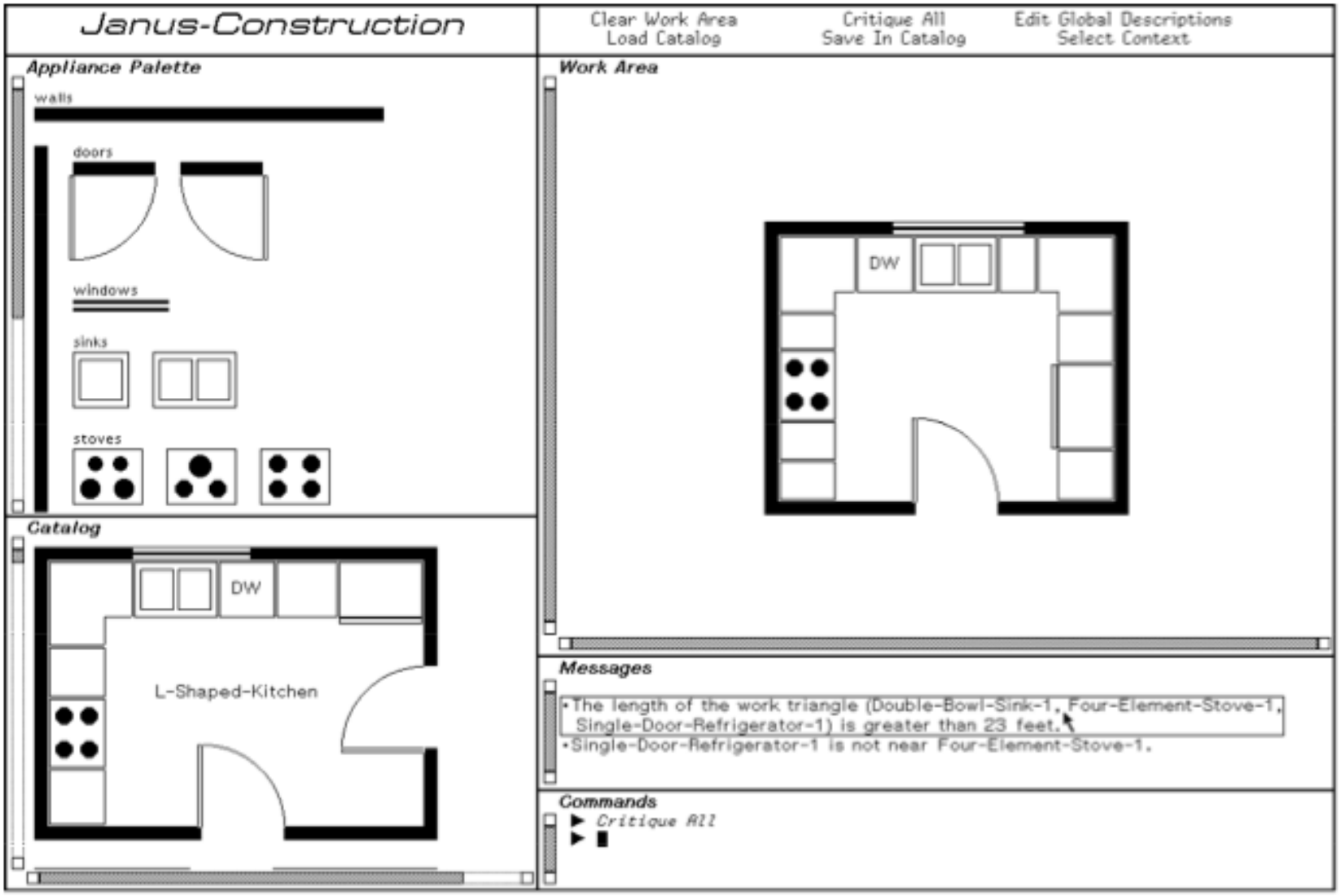
- support reflective practitioners in specific domains by bringing tasks to the forefront

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

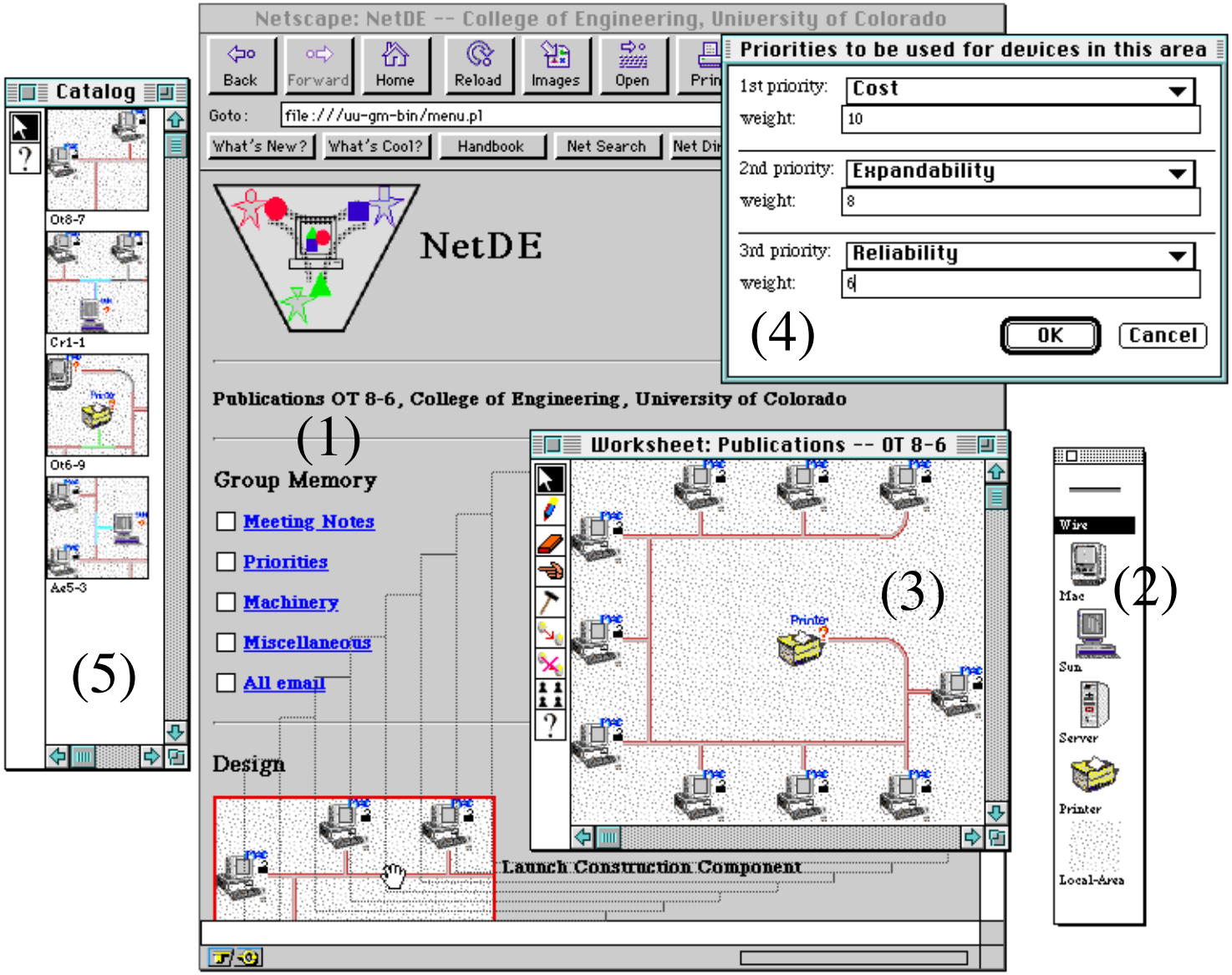
A DODE for Kitchen Design: Construction



A DODE for Kitchen Design: Argumentation



A DODE for Computer Network Design



Creativity oriented Assessment / Evaluation Issues in DODEs

- do critics enhance or hinder creativity (e.g., Fosbury Flop)? — Stravinsky: *"without constraints, there can be no creativity"*
- differences in performance, quality, and creativeness as a function of critics, catalog, simulation component?
- trade-offs between critiquing (breakdowns occur) versus constraint (breakdowns are prevented)
- trade-offs between different intervention strategies (active versus passive)
- does "making information relevant to the task at hand" prevent serendipity?
- under which conditions will designers challenge or extend the knowledge represented in the system?

Social Creativity

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

- **social creativity: requires designers not consumers** — domain professionals, discretionary users, and competent practitioners worry about tasks and are motivated to contribute and to create good products

- **requires externalizations/oeuvres to serve as boundary objects**
  (see Bruner, J. (1996) "The Culture of Education", Harvard University Press, Cambridge, MA)

- individual **versus** social creativity → individual **and** social creativity
  - not a binary choice
  - explore the relationship between the individual and the social (e.g., autonomy ←→ collective goals)

Symmetry of Ignorance

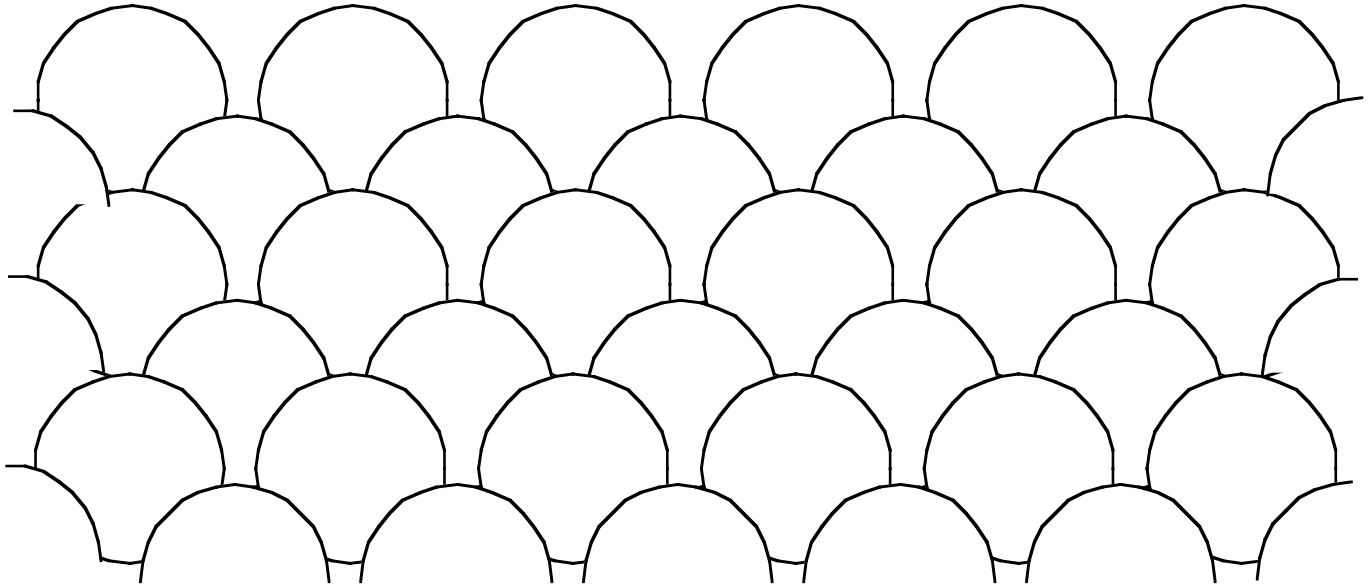
- **the Renaissance scholar does not exist anymore** — the individual human mind is limited ("the great individual" → "the great group")

- **distinct domain of human knowledge exist** → of critical importance: mutual appreciation, efforts to understand each other, increase in socially shared cognition and practice (source: Snow, C. P. (1993) "The Two Cultures", Cambridge University Press, Cambridge, UK)

- **create "boundary objects" / "bridge objects"** → shared objects
  - to "talk about" and to "think with"
  - to coordinate the perspectives of various constituencies for some purpose

The Fish-Scale Model for Social Creativity

- "collective comprehensiveness through overlapping patterns of unique narrowness"
  → Campbell, D. T. (1969) "Ethnocentrism of Disciplines and the Fish-Scale Model of Omniscience."



Evidence and Arguments for Social Creativity

- "none of us is as smart as all of us" → Bennis, W. & Biederman, P. W. (1997) Organizing Genius: The Secrets of Creative Collaboration

- "Linux was the first project to make a conscious and successful effort to use the entire world as a talent pool" → Raymond, E. S. & Young, B. (2001) The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary, O'Reilly & Associates, Sebastopol, CA.

Distances and Diversity — Limitations or Opportunities for Social Creativity?

- distribution creates **distances** → these distances are not only **spatial**, but also **temporal**, **conceptual**, and **technological**

- explore these distances as **opportunities** to bring humans and media together to achieve new levels of social creativity based on distributed intelligence

Overview of Distances

Dimension	Rationale	Addressed by	Media / Technologies	Challenges
spatial	participants are unable to meet face-to-face; low local density of people sharing interests	computer-mediated communication	e-mail, chat rooms, video conferences, local knowledge in global societies	achieve common ground; involve large communities *("the talent pool of the whole world")*;
temporal	design and use time: who is the beneficiary and who has to do the work?	long-term, indirect communication; meta-design	group memories, organizational memories	build on the work of the giants before us; design rationale, reflexive CSCW

Overview of Distances — Continued

Dimension	Rationale	Addressed by	Media / Technologies	Challenges
conceptual within domains	shared understanding	communities of practice (CoPs), legitimate peripheral participation (LPP)	domain-oriented design environments (DODEs)	innovation; avoid group-think
conceptual between domains	make all voices heard	communities of interest (CoIs); boundary objects	Envisionment and Discovery Collaboratory	common ground; different ontologies; integration of diversity
technological	things are available; complement human abilities	distributed cognition, socio-technical environments; meta-design	agents, critics, simulations	formalization; human-problem-domain interaction; digital fluency

Distance: Spatial Dimension

- 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, thereby **exploiting local knowledge**

- success model: **open source communities** — see analysis of open source communities as success models (→ Scharff, E. (2002) *Open Source Software, a Conceptual Framework for Collaborative Artifact and Knowledge Construction*, Ph.D. Dissertation, University of Colorado at Boulder.)

- transcending the barrier of spatial distribution is of particular importance in **locally sparse populations** → see CLever project: "Cognitive Levers: Helping People Help Themselves" — dePaula, R. (2004) *The Construction of Usefulness: How Users and Context Create Meaning with a Social Networking System*, Ph.D. Dissertation, University of Colorado at Boulder.

- but: **distance matters** (→ Olson, G. M., & Olson, J. S. (2001) "Distance Matters." In J. M. Carroll (Ed.), *Human-Computer Interaction in the New Millennium,* ACM Press, NY, pp. 397-417.)

Distance: Temporal Dimension

- 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"* (Simon)
  - see: Ye, Y. (2001) Supporting Component-Based Software Development with Active Component Repository Systems, Ph.D. Dissertation, University of Colorado at Boulder.

Distance — Conceptual Dimension

Communities of Practice and Communities of Interest

- ***Communities of Practice (CoPs)***, defined as groups of people who share a professional practice and a professional interest (Lave, Wenger)

- ***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 and designs artifacts (Envisionment and Discovery Collaboratory)

- **for details see:**

  Fischer, G. (2001) "Communities of Interest: Learning through the Interaction of Multiple Knowledge Systems," 24th Annual Information Systems Research Seminar In Scandinavia (IRIS'24), pp. 1-14.
  [http://www.cs.colorado.edu/~gerhard/papers/iris24.pdf]

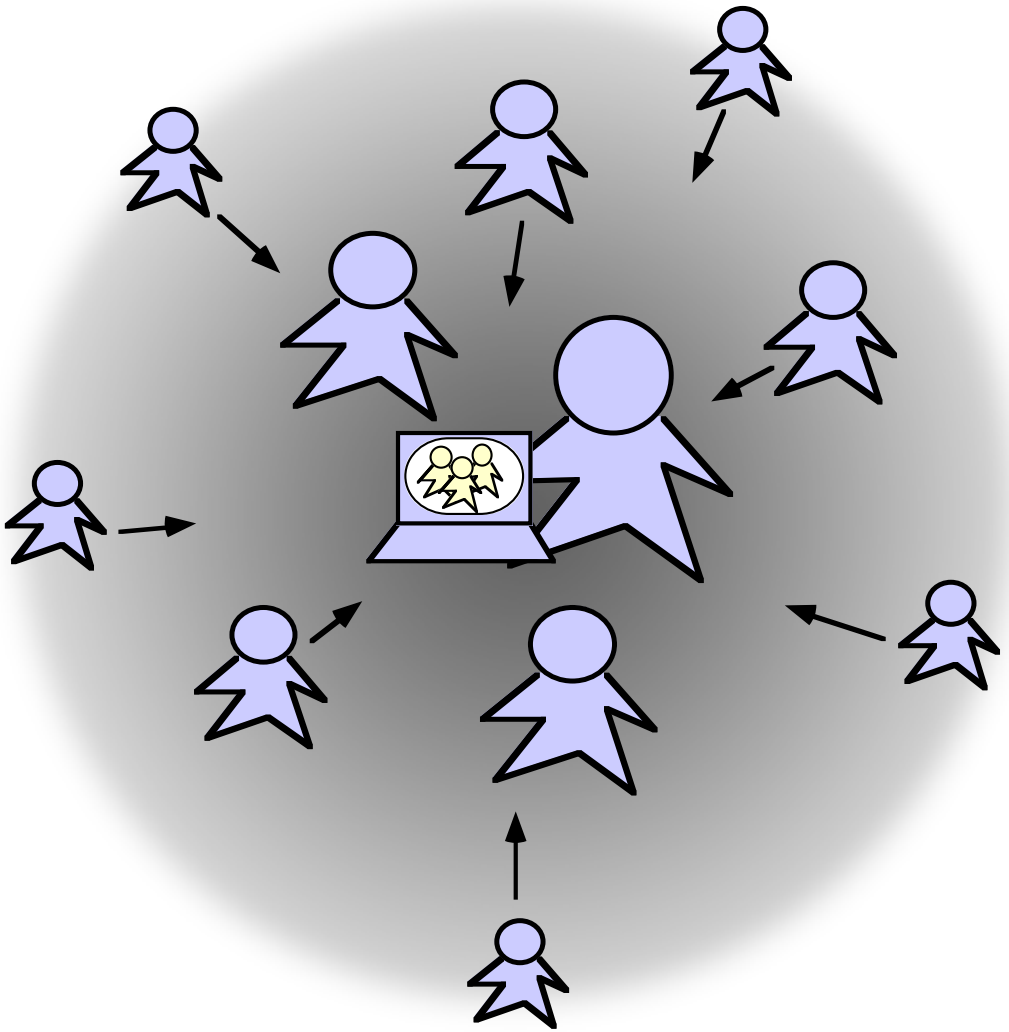
Communities of Practice (CoPs)

—

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, voice dialog systems designers ……
- **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, …..)

Community of Practice

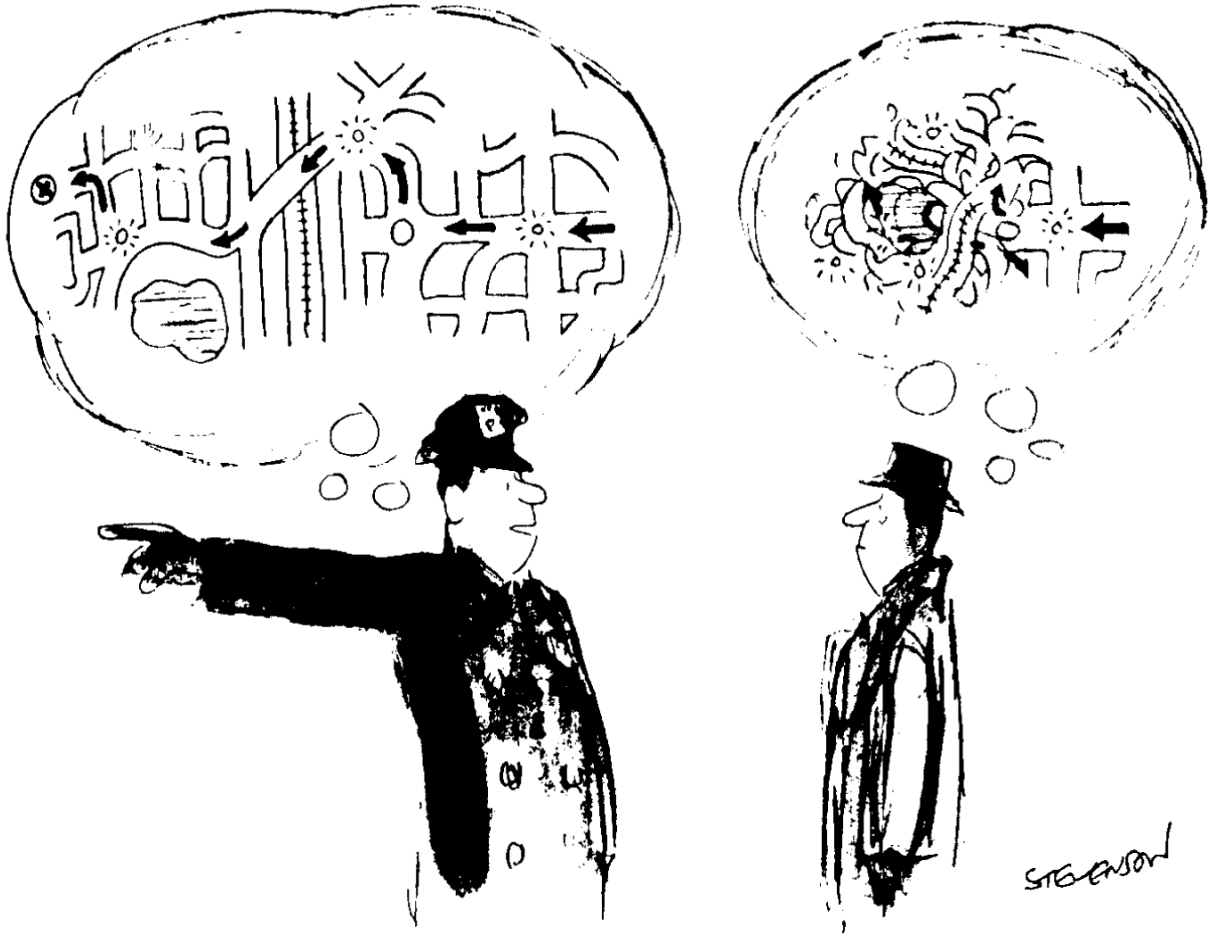


Communities of Interest (CoIs):
Heterogeneous Design Communities

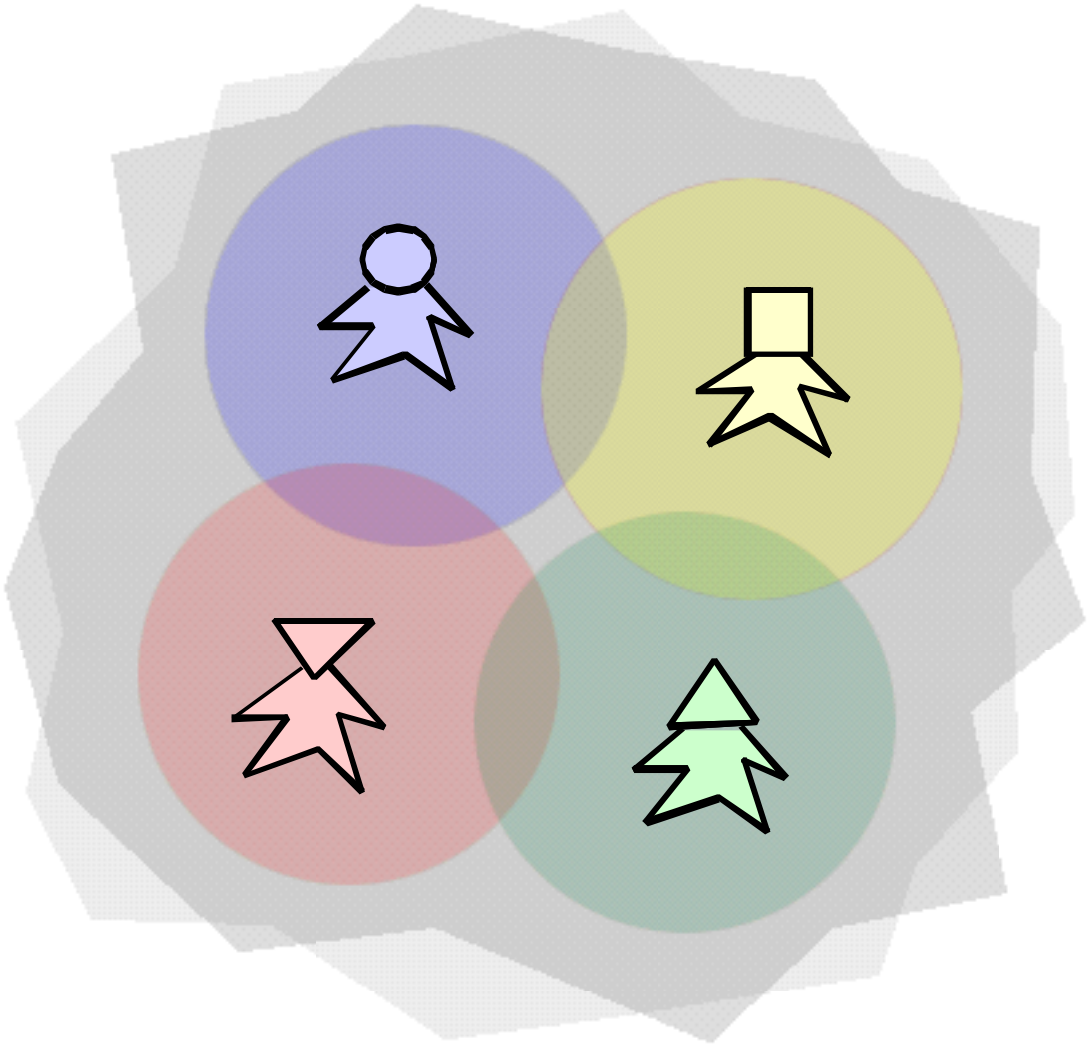
"Innovations come from outside the city wall."— Kouichi Kishida

- **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 a common ground
  - building a shared understanding of the task at hand (which often does not exist up-front, but is evolved incrementally and collaboratively and emerges in people's mind and in external artifacts)
  - learning to communicate with others who have a different perspective
  - primary goal: not **"moving toward a center" (CoP)** but **"integrating diversity"**

Communication Problems in Cols



CoPs and CoIs



Software Developers and Software Users
—
A Community of Interest (CoI)

- *"system requirements are not so much analytically specified as they are collaboratively evolved through an iterative process of consultation between end-users and software developers"*
  — Computer Science Technology Board (1990) "Scaling Up: A Research Agenda for Software Engineering," *Communications of the ACM,* 33(3), pp. 281-293.

- *"System development is difficult not because of the complexity of technical problems, but because of the social interaction when users and system developers learn to create, develop and express their ideas and visions"*
  — Greenbaum, J., & Kyng, M. (Eds.) (1991) Design at Work: Cooperative Design of Computer Systems, Lawrence Erlbaum Associates, Inc., Hillsdale, NJ.)

Differentiating CoPs and CoIs

Dimensions	CoPs	CoIs
nature of problems	different tasks in the same domain	common task across multiple domains
knowledge development	refinement of one knowledge system; new ideas coming from within the practice	synthesis and mutual learning through the integration of multiple knowledge systems
major objectives	codified knowledge, domain coverage	shared understanding, making all voices heard
weaknesses	group-think	lack of a shared understanding
strengths	shared ontologies	social creativity; diversity; making all voices heard
people	beginners and experts; apprentices and masters	stakeholders (owners of problems) from different domains
learning	legitimate peripheral participation	informed participation

Bridge Objects / Boundary Objects

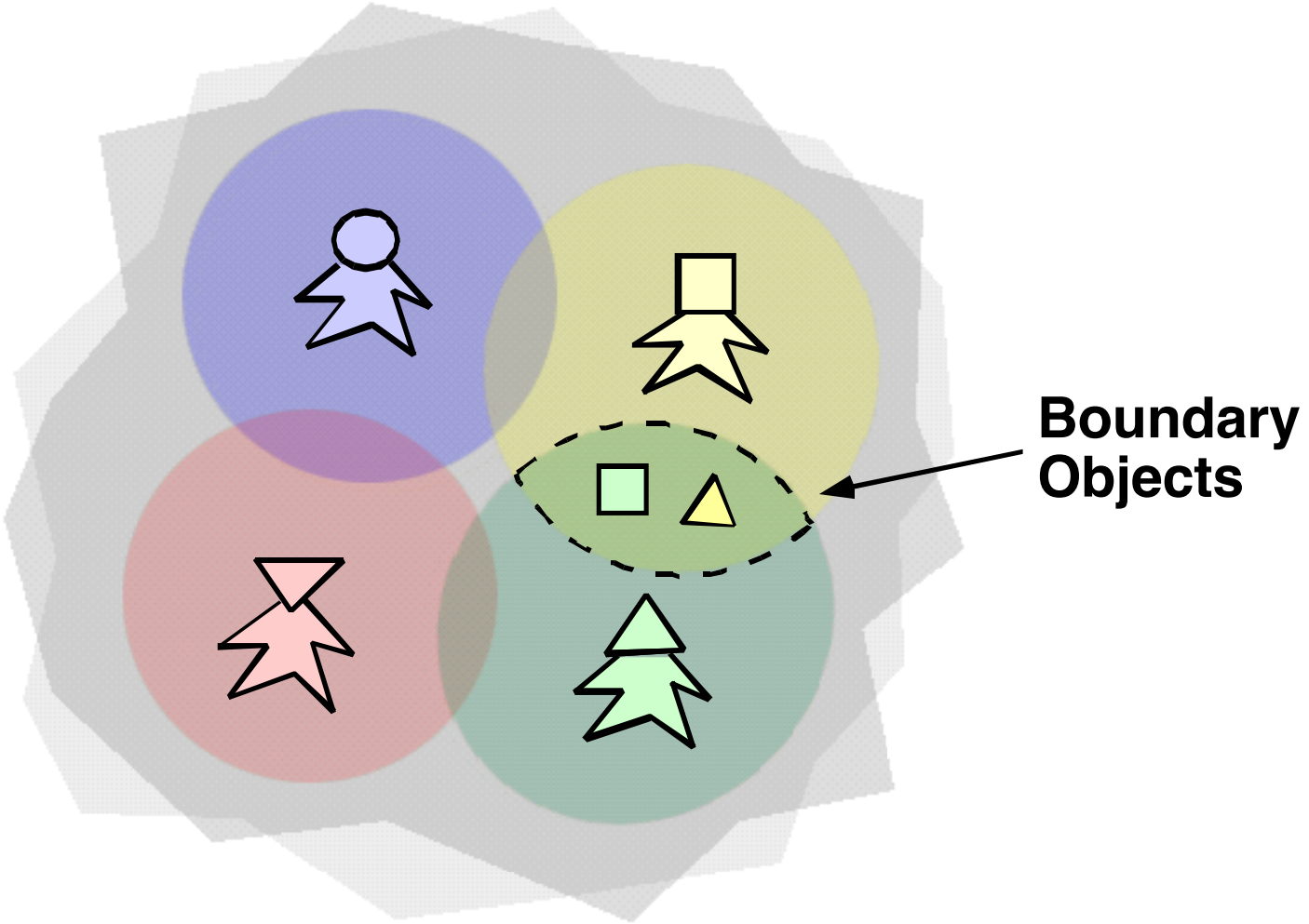
"If a lion could speak would we understand him?" — Wittgenstein

- **boundary objects serve**
  - to communicate and coordinate the perspectives of CoPs brought together for some purpose leading to the formation of a CoI
  - the interaction between users and (computational) environments

- perform a **brokering role** involving translation, coordination and alignment between the perspectives of different CoPs

- **examples:**
  - boundary objects can bridge the gap between situation models and system models
  - prototypes serve as boundary objects between developers and users in participatory system design
  - examples: vocabulary problems, help system, software reuse, McGuckin hardware store, …

Cols: Social Creativity and Boundary Objects



Distance "Technological Dimension"

- **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
  - human problem-domain interaction
  - end-user development and meta-design
  - pervasive and ubiquitous computing
  - digital fluency to make domain experts independent of high-tech scribes

Example: The Envisionment and Discovery Collaboratory

Land Use in the Action Space

Summary View of Land Use Generated in the Reflection Space

watcher for land use table

http://swiki:3232/Reflection/24

Apple eBay Yahoo! welcome to apple rockies gis ▾ News (1344) ▾ college ▾ cisco ▾ cars ▾ google earth ▾ CPR spar cable

The Envisionment and Discovery Collaboratory

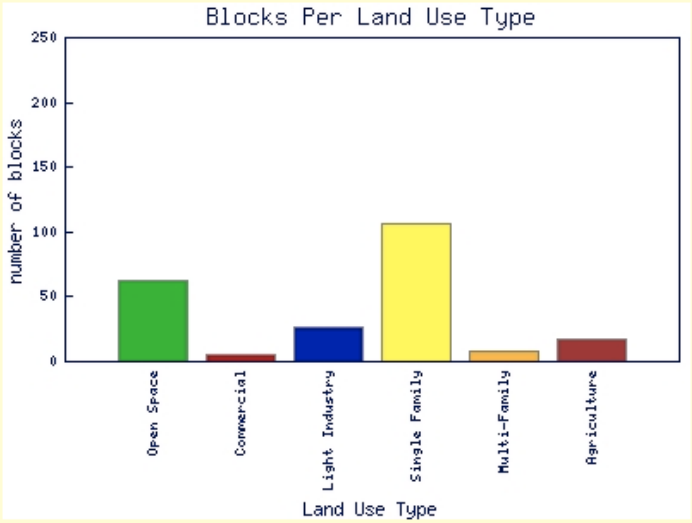
EDC Home | Project Home |

[View] [Edit] [Print] [Lock] [References] [Attachments] [History] [Home] [Changes] [Search] [Help]

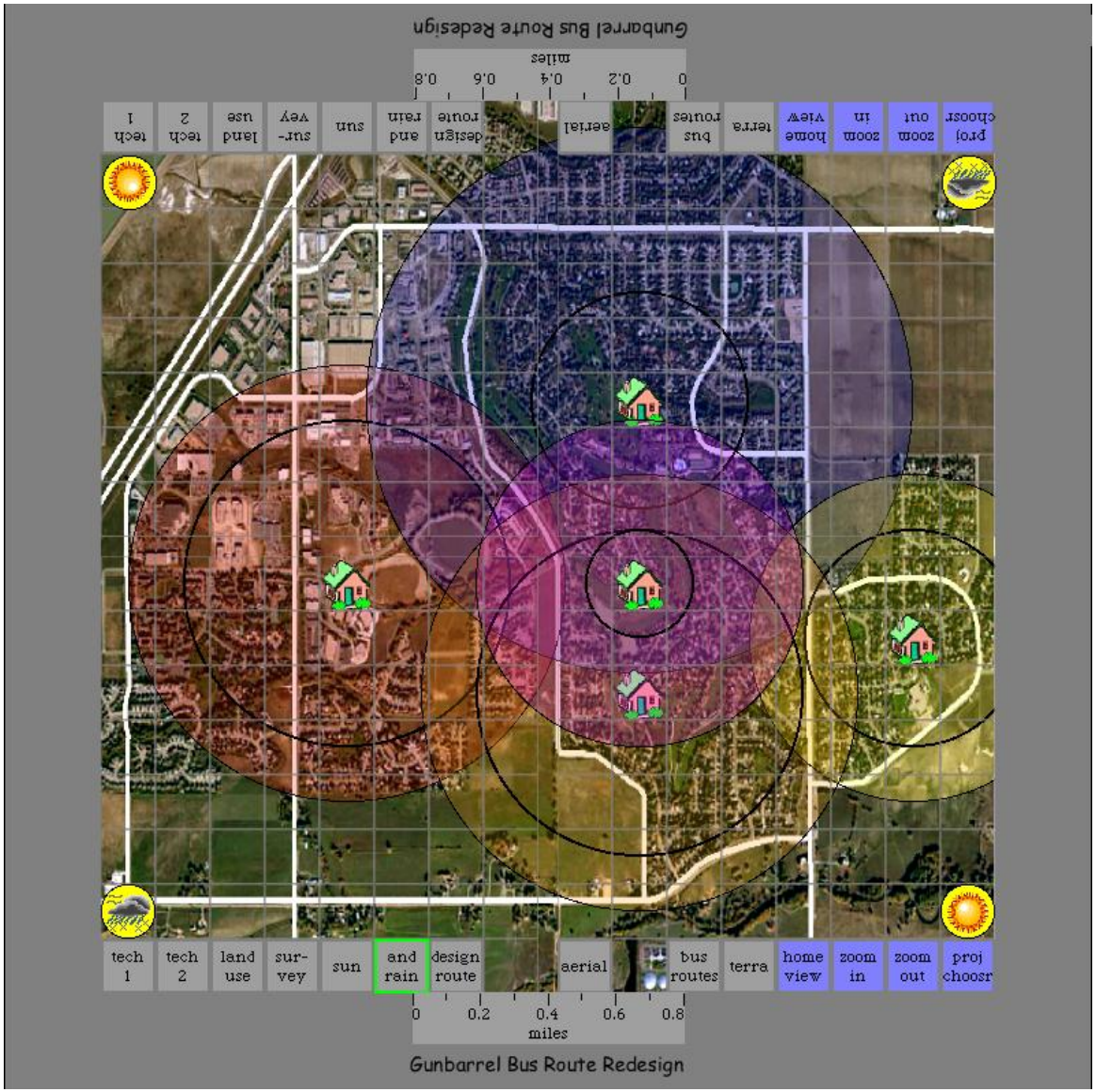
Reflection Space

Land Use Table

Land Use Type	# of Blocks
Open Space	62
Commercial	5
Light Industry	27
Single Family	107
Multi-Family	8
Agriculture	17

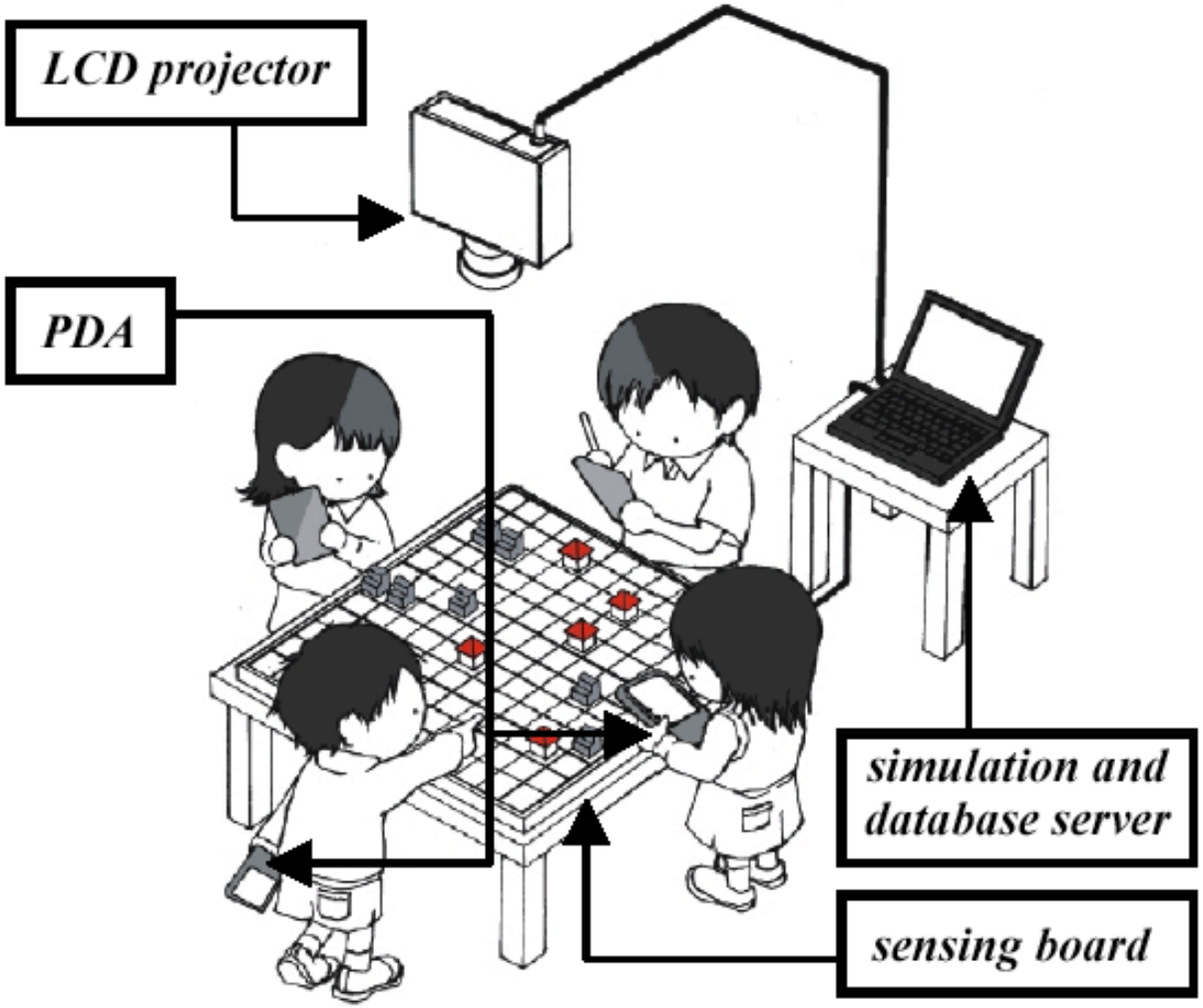


Emerging Insight: Illustrating Multiple Walking Distances



Caretta: Integrating Individual and Social Creativity

(Masanori Sugimoto, University of Tokyo)



Assessment of Social Creativity

- **what will make people want to engage in social creativity?**
  - requires: culture change, new mindsets, new reward systems
  - organizational rewards
  - social capital

- **"collaborative systems will not work in a non-collaborative society"**
  - a student's observation in one of our classes using technologies to enhance peer-to-peer learning, sharing of information, self-evaluation, etc.
  - collaboration should not be considered as cheating

Cultures of Participation + Meta-Design + Social Creativity

—

Some Integrating Remarks

- **The Past and The Future**

Theme	Past	Future
focus of interest	algorithm	complex system
relevant theories	physics, mathematics	biology
design methodology	building from scratch	reuse, redesign, adaptation, evolution

- **claims/challenges:**
  - (many) software systems must evolve (they cannot be completely designed prior to use)
  - (many) software systems must evolve at the hands of the users
  - (many) software systems must be designed for evolution

Problems of Complex (Computer) System Design

- problems in semantically rich domains → **thin spread of application knowledge**
- modeling a changing world → **changing and conflicting requirements**
- symmetry of ignorance → **communication and coordination problems**

Answers to Problems of System Design

- problems in semantically rich domains → thin spread of application knowledge — **domain-orientation, end-user development**
- modeling a (changing) world → changing and conflicting requirements — **evolution, meta-design**
- symmetry of ignorance → communication and coordination problems — **cultures of participation**

Conclusions

- challenge for the 21st century: "**work smarter, not harder**"

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

- **innovative socio-technical environments supporting**:
  - consumer cultures → **cultures of participation**
  - design → **meta-design**
  - unaided, individual human mind → **social creativity**