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 (L3D), 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**

- **workshop** supported by the National Science Foundation, June 2005
  

- **conference** “Creativity & Cognition”, June 2007
  

- **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


- **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


- 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

(1) NetDE

(2) Priorities to be used for devices in this area

1st priority: Lost
weight: 10

2nd priority: Expandability
weight: 5

3rd priority: Reliability
weight: 5

(3) Worksheet: Publications -- OT 8-6

(4) Publications OT 8-6, College of Engineering, University of Colorado

(5) Group Memory

- Meeting Notes
- Priorities
- Machinery
- Miscellaneous
- All email
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

- 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” \(\rightarrow\) “the great group”)

- distinct domain of human knowledge exist \(\rightarrow\) 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” \(\rightarrow\) 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”
  
Evidence and Arguments for Social Creativity


- “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

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

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


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)

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 (Cols)**, 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:**
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 (Cols): Heterogeneous Design Communities

“Innovations come from outside the city wall.”—Kouichi Kishida

- **Cols** = bring different CoPs together to solve a problem
- **membership** in Cols 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 Cols
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”

- “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”
## Differentiating CoPs and CoIs

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

**The Envisionment and Discovery Collaboratory**

**EDC Home | Project Home |**

#### Land Use Table

<table>
<thead>
<tr>
<th>Land Use Type</th>
<th># of Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Space</td>
<td>62</td>
</tr>
<tr>
<td>Commercial</td>
<td>5</td>
</tr>
<tr>
<td>Light Industry</td>
<td>27</td>
</tr>
<tr>
<td>Single Family</td>
<td>107</td>
</tr>
<tr>
<td>Multi-Family</td>
<td>8</td>
</tr>
<tr>
<td>Agriculture</td>
<td>17</td>
</tr>
</tbody>
</table>

![Blocks Per Land Use Type](chart.png)

*Gerhard Fischer*

*University of Milan, February 2012*
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

<table>
<thead>
<tr>
<th>Theme</th>
<th>Past</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>focus of interest</td>
<td>algorithm</td>
<td>complex system</td>
</tr>
<tr>
<td>relevant theories</td>
<td>physics, mathematics</td>
<td>biology</td>
</tr>
<tr>
<td>design methodology</td>
<td>building from scratch</td>
<td>reuse, redesign, adaptation, evolution</td>
</tr>
</tbody>
</table>

- 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 $\Rightarrow$ thin spread of application knowledge — *domain-orientation*, *end-user development*

- modeling a (changing) world $\Rightarrow$ changing and conflicting requirements — *evolution*, *meta-design*

- symmetry of ignorance $\Rightarrow$ 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