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 and Social Creativity

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Presentation, IEMC 2007, Austin

Acknowledgements

- **organizers of IEMC 2007:** thanks for providing me with this opportunity

- **my collaborators at the Center for LifeLong Learning & Design (L3D):** colleagues, former and current PhD students, Undergraduate Research Apprentices, visitors, ….

Overview

- The Center for Lifelong Learning and Design (L^3D)
- Basic Message
- Creativity and Design
- Elements of a Conceptual Framework
- Socio-Technical Environments (Examples)
- Implications
- Conclusions

The Center for Lifelong Learning and Design (L^3D)

http://l3d.cs.colorado.edu/

- **global objective: to do basic research on real problems**

- **examples of conceptual frameworks:**
  - transcending the unaided, individual human mind → distributed intelligence, **social creativity**, learning on demand
  - making all voices heard → design, **meta-design**, social knowledge construction, Web 2.0 technologies

- **examples of specific socio-technical environments**
  - Envisionment and Discovery Collabaoratory
  - Google-SketchUp + 3D Warehouse + Google Earth

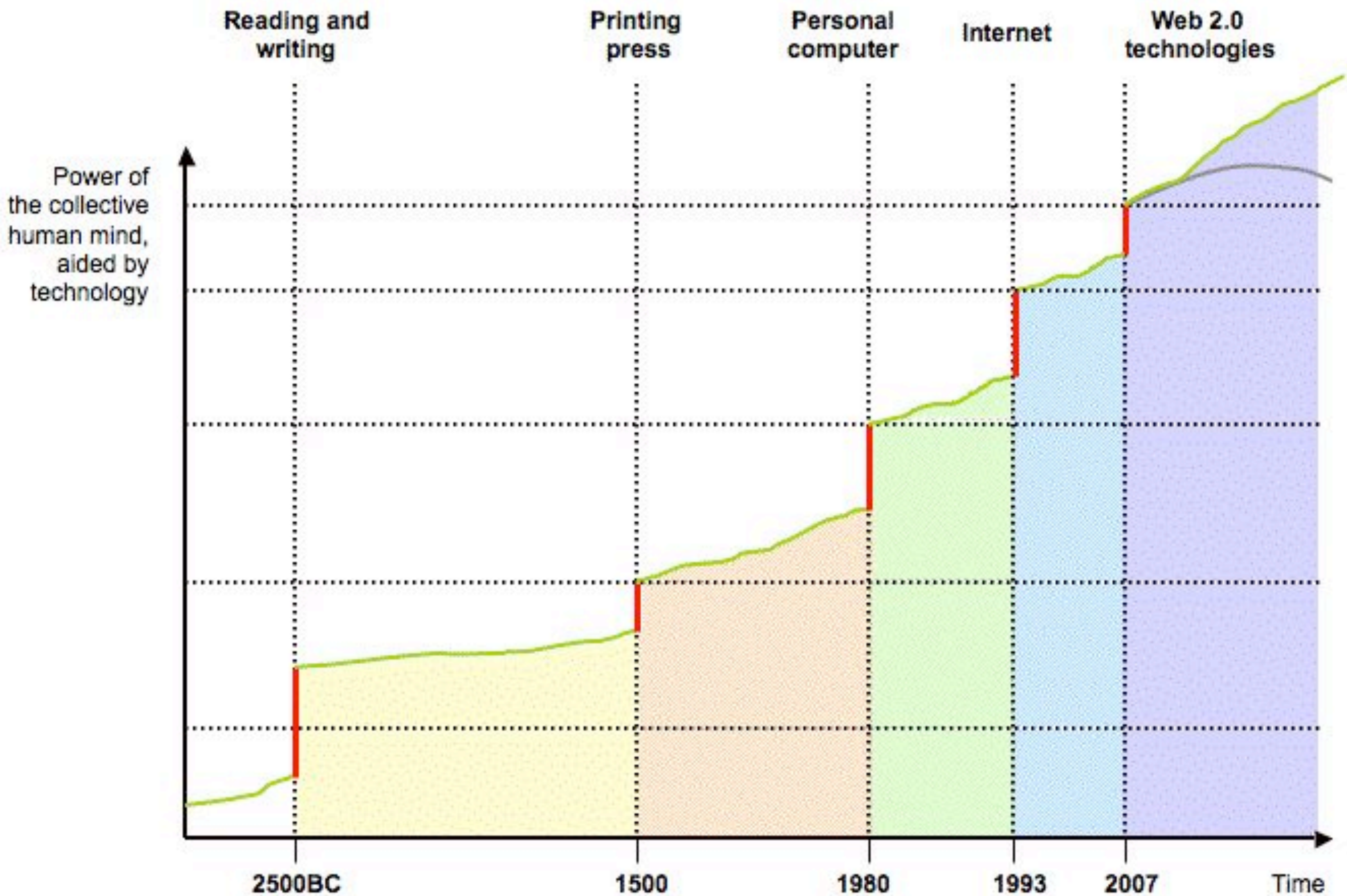
The Basic Message

- the **complexity** and **uniqueness** of design problems transcend the unaided, individual human mind → they require **meta-design** and **social creativity**

- explore innovative conceptual frameworks as **opportunities** to bring humans and media together to achieve new levels of **creativity** supported by **socio-technical environments**

The Larger Context

Beyond the Unaided, Individual Human Mind



Why Now?


National Science Foundation
INVESTING IN AMERICA'S FUTURE
STRATEGIC PLAN
FY 2006-2011

National Science Foundation

- ***5 year strategic plan: terms and concepts***

- collaboration	17
- creativity	6
- innovation	26
- exploration	11
- discovery	27
- STEM	9

- ***new programs:***
  - Science of Design (2005)
  - CreativeIT (2007)
  - Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (2007)

Design,
Collaborative Design
and
Meta-Design

Design and Collaborative Design

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

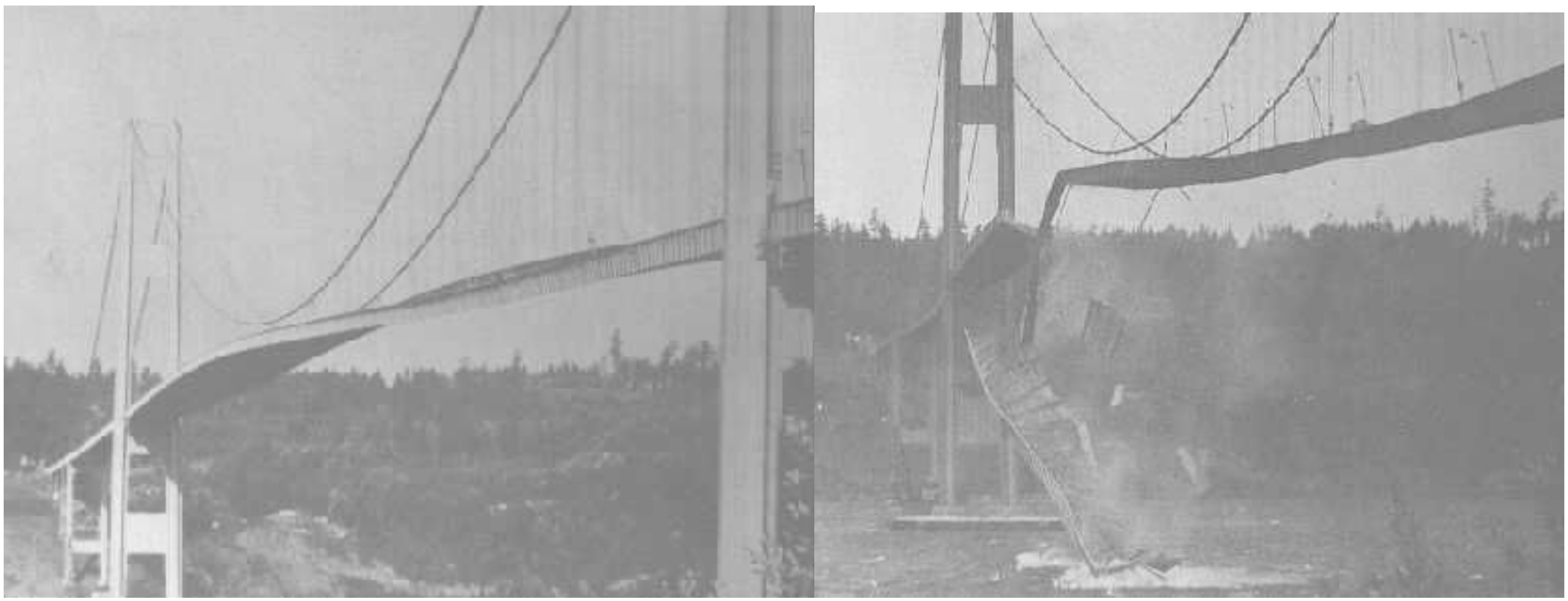
- the need for **collaborative design** because design problems are
  - **complex** → requiring **social creativity** in which stakeholders from different disciplines have to **collaborate**
  - **ill-defined** → requiring the **integration of problem framing and problem solving**
  - **have no (single) answer** → **argumentation support, consideration of trade-offs**
  - **unique ("a universe of one")** → requiring **learning when no one knows the answer**

A Success Example of Design / Creativity in Architecture

Another Success Example of Design / Creativity in Architecture

To Engineer is Human

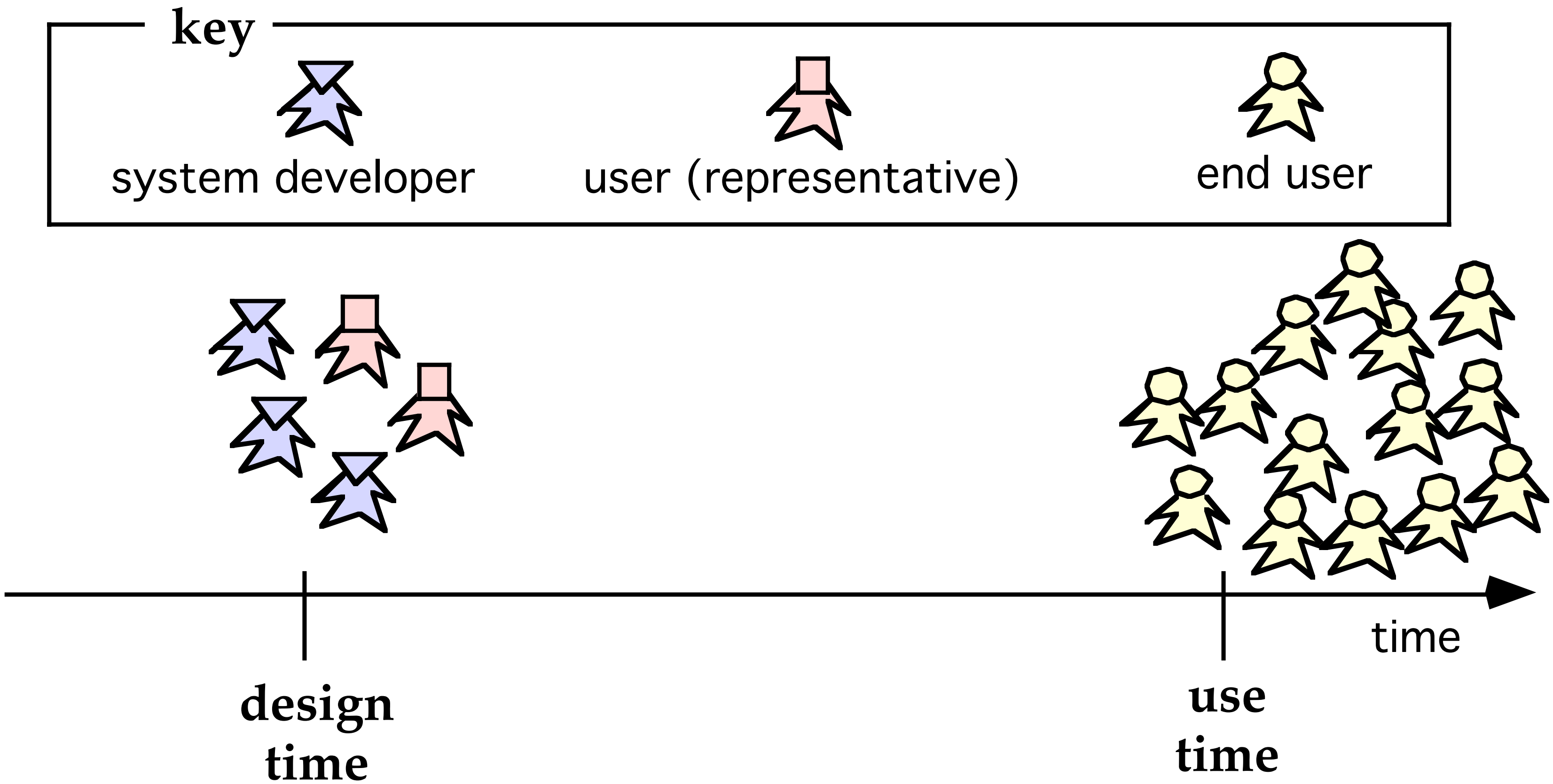
<<more info: Petroski, H. (1985) To Engineer Is Human: The Role of Failure in Successful Design, St. Martin's Press, New York>>



Meta-Design = Design for Designers

- **meta-design explores:**
  - the invention and design of a culture in which participants can **express themselves** and engage in personally meaningful activities
- **meta-design requires**
  - designers giving up some **control** at design time
  - **active contributors** (and not just passive consumers) at use time
- **meta-design raises research problems of fundamental importance** including
  - new **design methodologies**
  - a new understanding of **collaboration, motivation, innovation and creativity**
  - the design of innovative **socio-technical environments**
- provides a theoretical framework for **Web 2.0 technologies**

Design Time and Use Time



world-as-imagined
prediction
planning

world-as-experienced
reality
situated action

Meta-Design: A Framework for Effective, Large Scale, Distributed, Collaborative Efforts

- **social production** → Benkler, Y. (2006) "*The Wealth of Networks: How Social Production Transforms Markets and Freedom*"

- **democratizing innovation** → von Hippel, E. (2005) "*Democratizing Innovation*"

- **mass collaboration** → Tapscott, D and Williams, A. (2006): *"Wikinomics: How Mass Collaboration Changes Everything"*

- **integration of consumer and producer roles** → Fischer, G. (2002) *"Beyond 'Couch Potatoes': From Consumers to Designers and Active Contributors"*

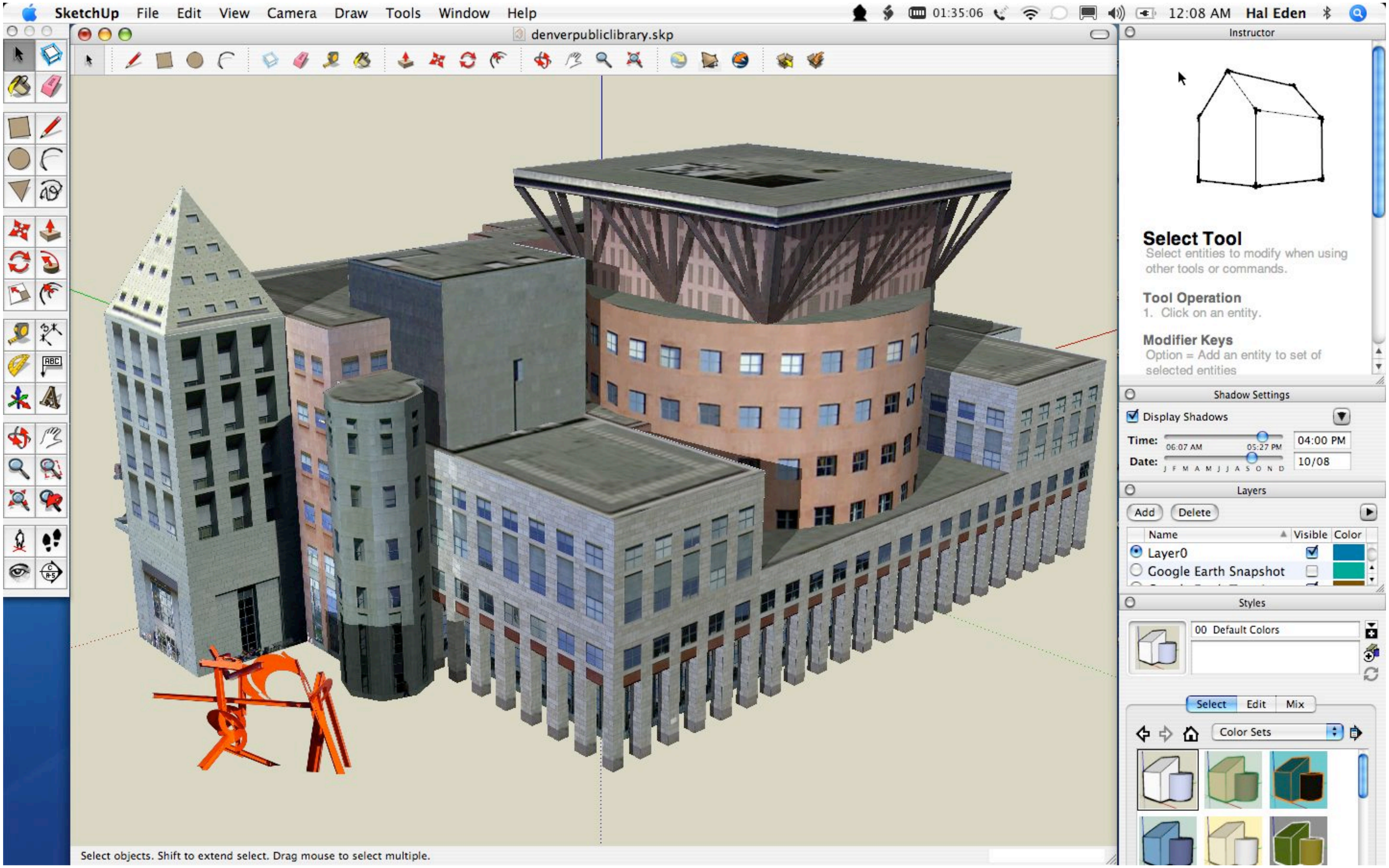
What Do Meta-Designers Do?

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

- they **underdesign**
  - by creating **contexts** and **content creation** tools rather than content
  - by creating **technical** and **social** conditions for broad participation in design activities
  - by supporting '**hackability**' and '**remixability**'

- **examples for meta-design:** exploiting the power of mass collaboration with Web 2.0 Technologies
  - Wikis
  - **Google-SketchUp + 3D Warehouse + Google Earth**
  - Second Life
  - Open source

SketchUp – a 3D Modeling Environment for Content Creation



3D Warehouse: a Web 2.0 Environment

http://sketchup.google.com/3dwarehouse/

- **features:**
  - search, share, and store 3D models created in SketchUp
  - models include: buildings, houses, bridges, sculptures, cars, people, pets, …
  - download the 3D models to be modified in SketchUp
  - if the model has a location on earth → download it and view it in Google Earth
  - share 3D models by uploading them from SketchUp

- **challenges:**
  - what will motivate people to participate?
  - participation requires to learn SketchUp → create learning environments for SketchUp

3D Warehouse

Tsim Sha Tsui Clock Tower
by Google
(1 rating)
Tsim Sha Tsui Clock Tower,...
View in Google Earth

1500 Walnut Street
by Google
This building located at 1500...
View in Google Earth

Marriott Marquis
by Google
This Hotel in Atlanta rises...
View in Google Earth

Milwaukee Art Museum
by Google
(6 ratings)
The history of the Milwaukee...
View in Google Earth

Figueroa at Wilshire
by Google
Albert C. Martin and...
View in Google Earth

CPL Harold Washington Library Center
by Google
(6 ratings)
This monumental building,...
View in Google Earth

Hearst Residence (Hearst Castle)
by Google
(2 ratings)
San Francisco architect Julia...
View in Google Earth

CitySpire Center
by Google
(2 ratings)
Designed by Murphy/Jahn, Inc....
View in Google Earth

CU Boulder in 3D

Downtown Denver in 3D

Creativity and Social Creativity

Why is Creativity Needed?
—
Learning When No One Knows the Answer

- **design problems are unique** → learning from the past is not enough

- **sources for new knowledge**:
  - conceptual collisions
  - epistemological pluralism: diversity in how we think; e.g.: formal thinking versus bricolage
  - distributed intelligence
  - symmetry of ignorance
  - emergence

Creativity —The "Wrong" Image?

"The Thinker" by Auguste Rodin

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**

- **individual:**
  - 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

- **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 joint thinking, passionate conversations, and shared struggles

Social Creativity

- complex design problems are systemic problems; *they seldom fall within the boundaries of one specific domain* → they require the participation and contributions of several stakeholders with various backgrounds

- *“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”*
  — Mihaly Csikszentmihályi

- *“Invention is a social process: it rests on the accumulation of many minor improvements, not the heroic efforts of a few geniuses”* — Karl Marx

Distances in Social Creativity: Limitations or Opportunities?

- **spatial dimension:** shared location → shared concerns; *success model:* open source communities

- **temporal dimension:** learning from the past; *success model:* reuse and redesign

- **conceptual dimension**: exploiting symmetry of ignorance, conceptual collisions, epistemological pluralism and breakdowns as sources for innovation; success models: Communities of Practice (CoPs) and Communities of Interest (CoIs)

- **technological dimension:** a new understanding of ***distributing intelligence*** and the identification of basic skills in the 21st century

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)

- **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 different cultures

- **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” (such as LPP in CoP) but **“integrating diversity and making all voices heard”**

Creativity and Innovation — Hot Topics

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

- 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.

- Bennis, W., & Biederman, P. W. (1997) *Organizing Genius: The Secrets of Creative Collaboration,* Perseus Books, Cambridge, MA.

- 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 Computer Support for Creativity,* 63(4-5), pp. 482-512.

CreativeIT

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

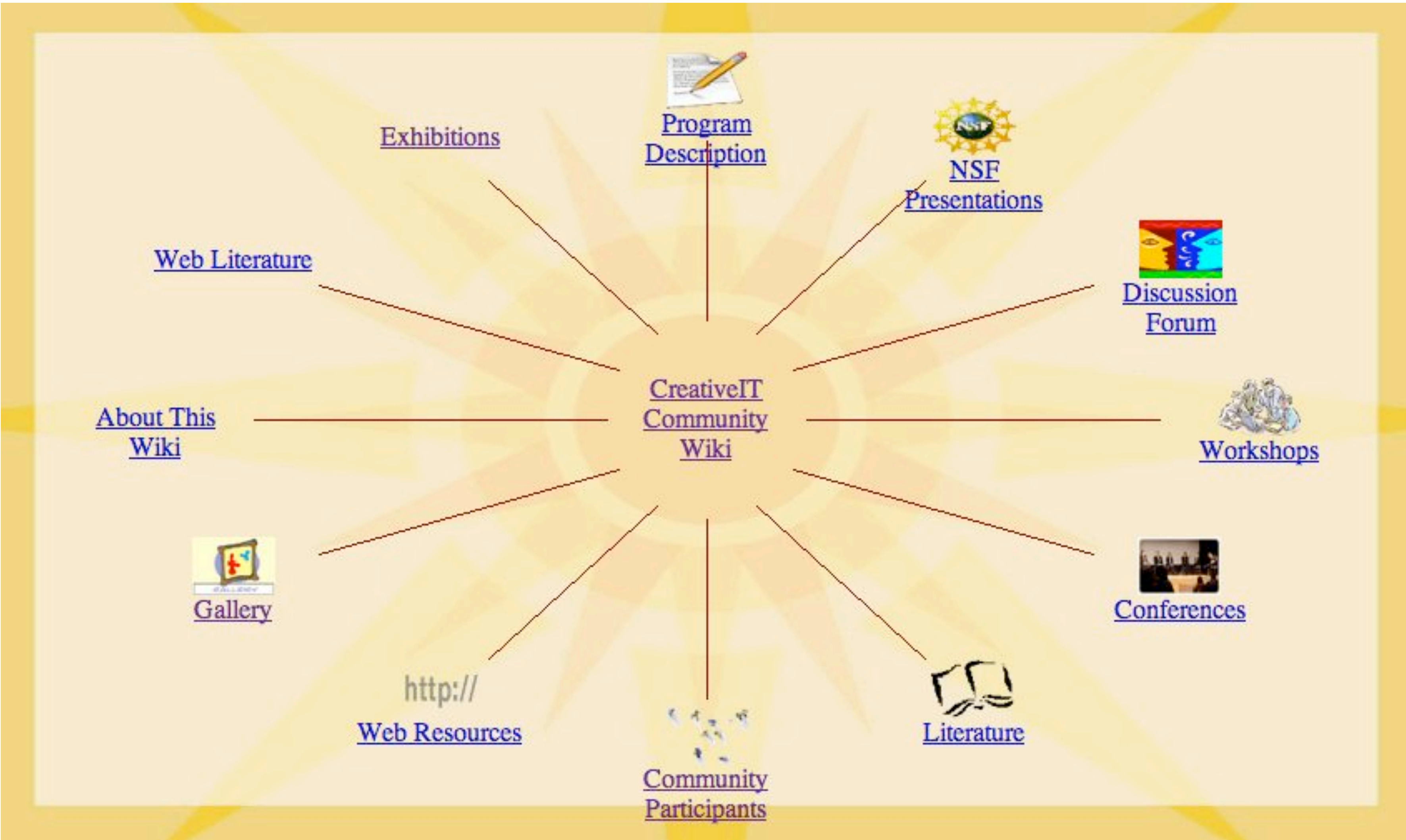
http://www.nsf.gov/pubs/2007/nsf07562/nsf07562.htm

- **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

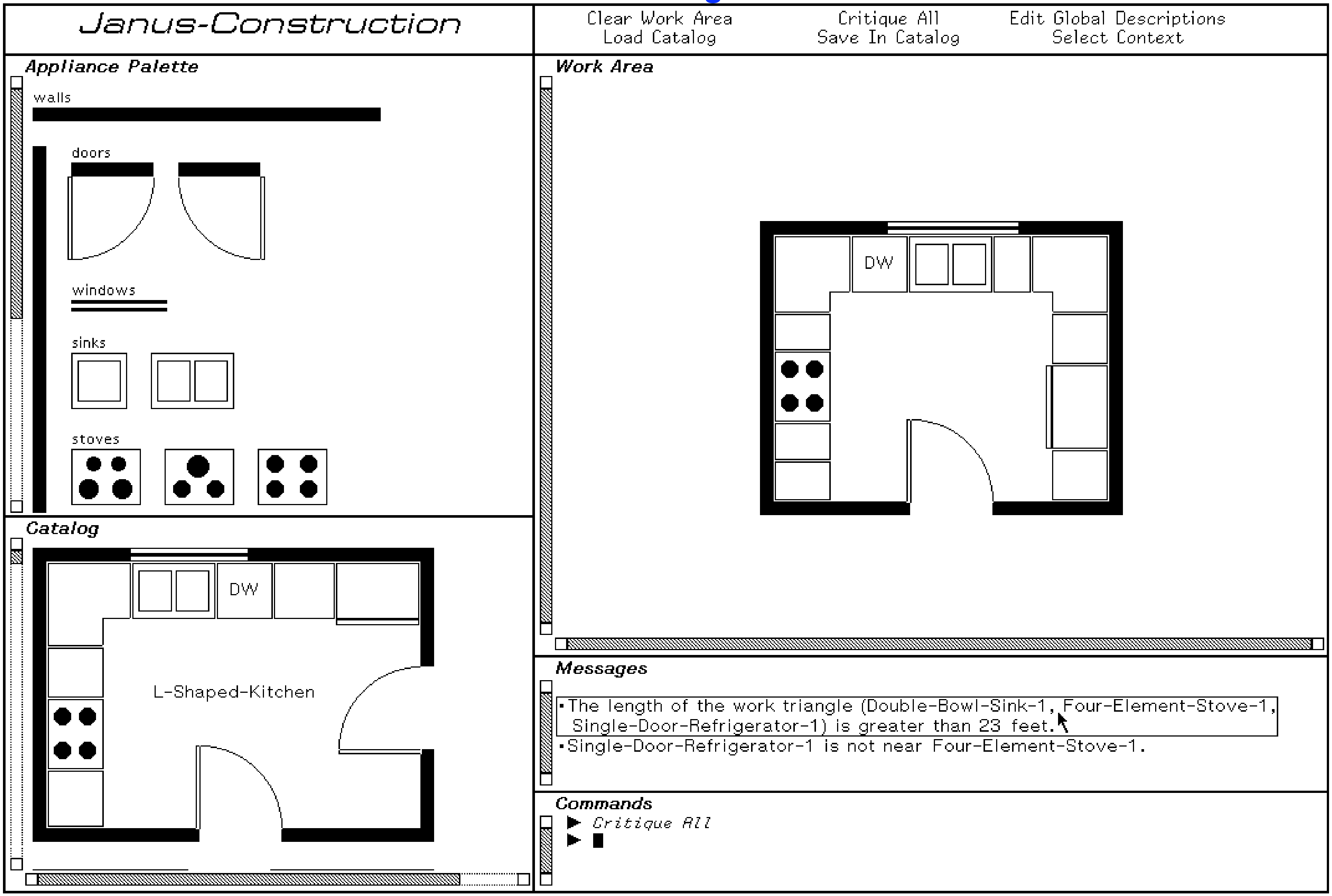


Examples

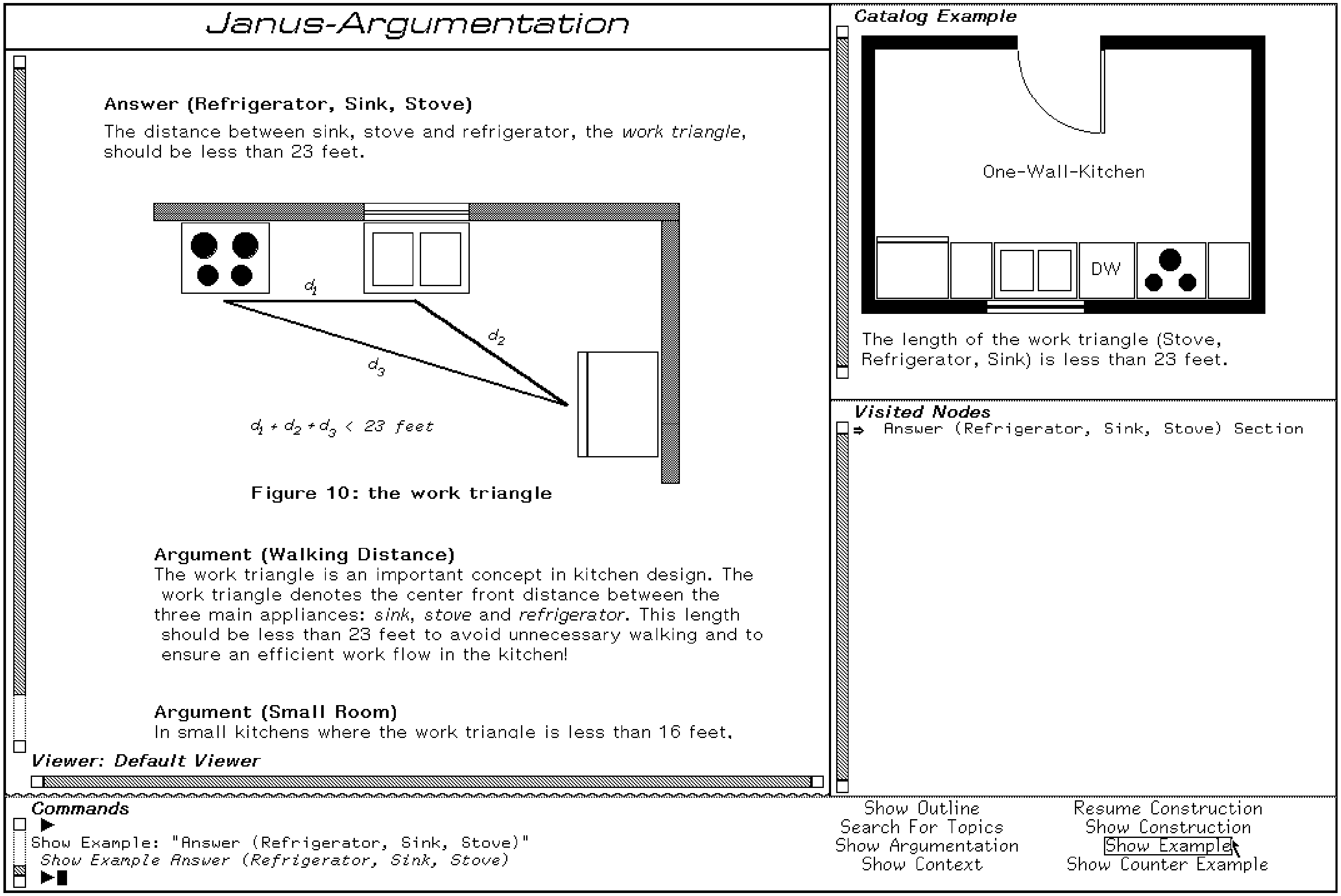
- **domain-oriented design environments (DODEs)** (including critiquing systems) — focused on individual creativity in design

- **Envisionment and Discovery Collaboratory** — focused on social creativity in design

A DODE for Kitchen Design: Construction



A DODE for Kitchen Design: Argumentation



The Envisionment and Discovery Collaboratory (EDC)

- **the EDC supports:**
  - collaborative design (e.g. in: urban planning, emergency management)
  - **social creativity** → learning when no one knows the answer — allowing all stakeholders to act as informed participants and active contributors (→ a Web 2.0 environment)
  - **meta-design** → a version of SimCity in which content is generated by users

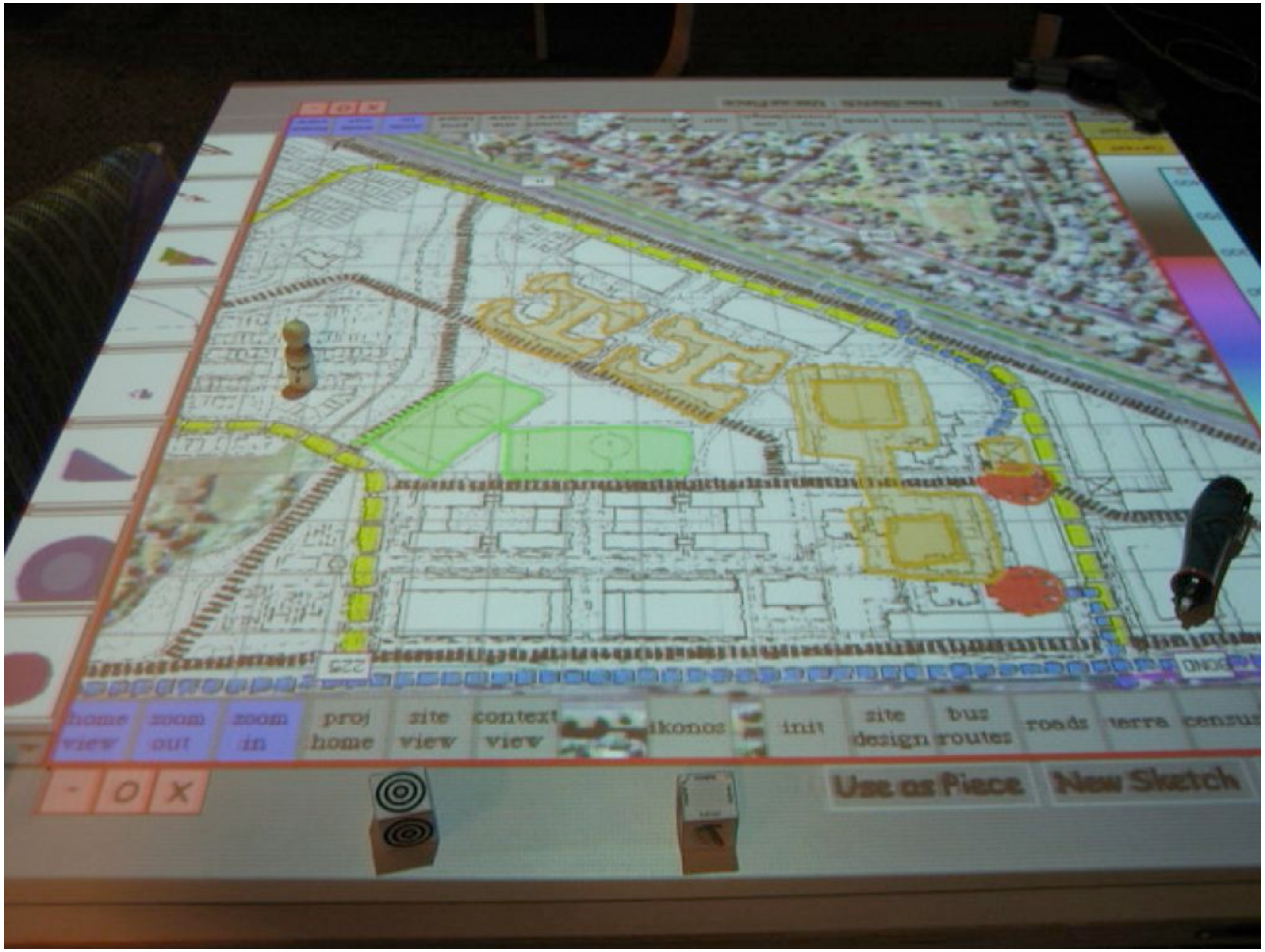
- **the innovative technologies in the EDC:**
  - table-top
  - computationally enriched physical objects
  - visualization reflection-in-action

The Envisionment and Discovery Collaboratory

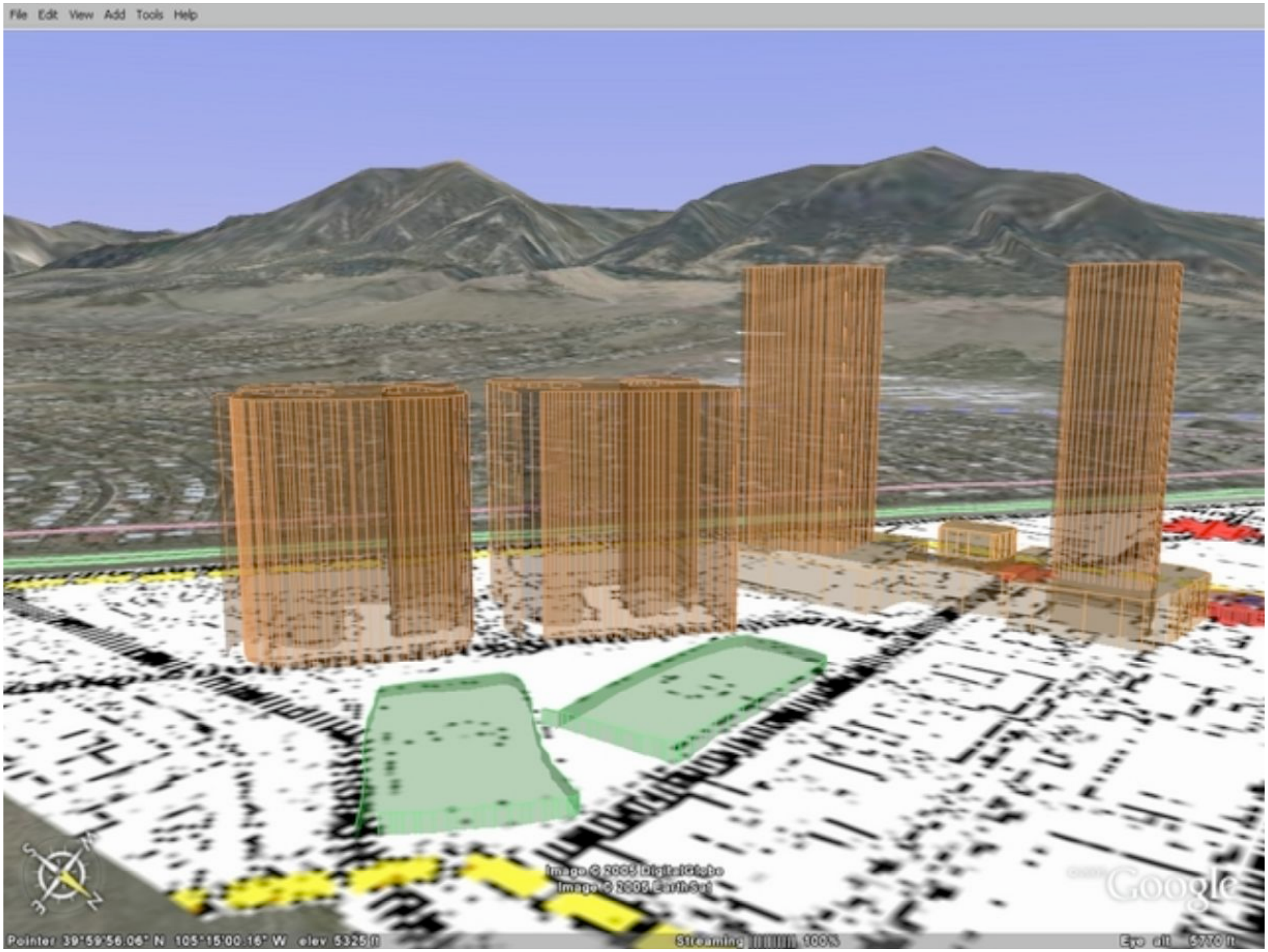
Face-to-Face Collaboration around the EDC Action Space

Boulder City Council and University of Colorado Regents

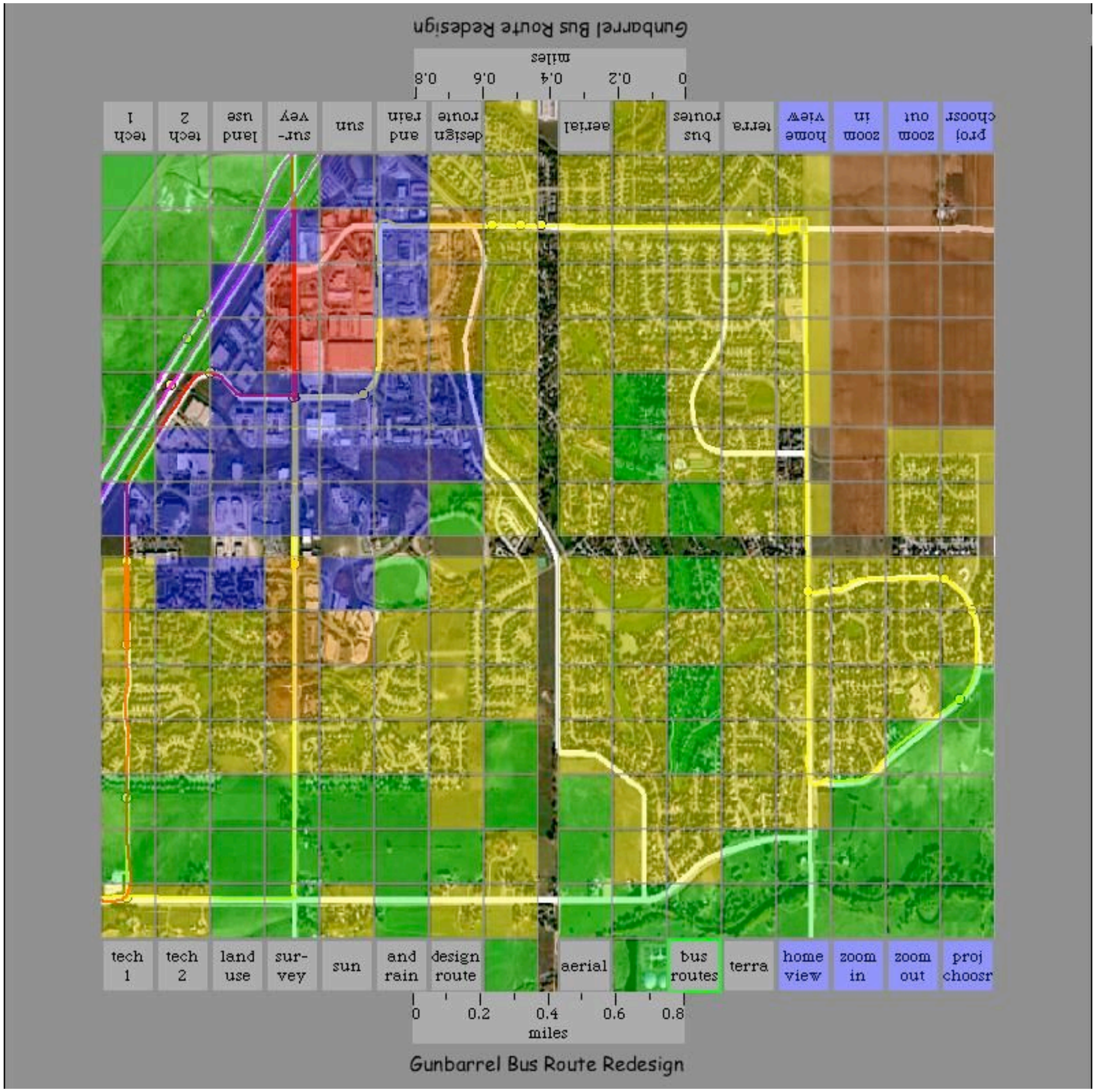
Sketching Support in the EDC



Buildings Sketched into a Google-Earth Client



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

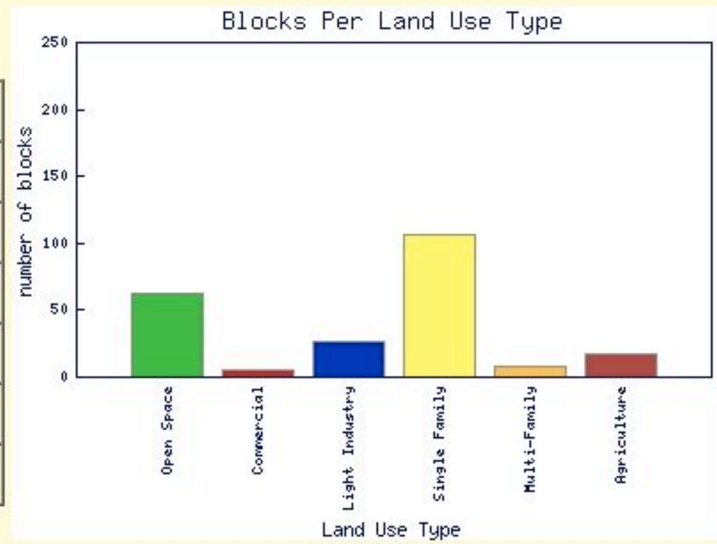
EDC Home | Project Home |

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

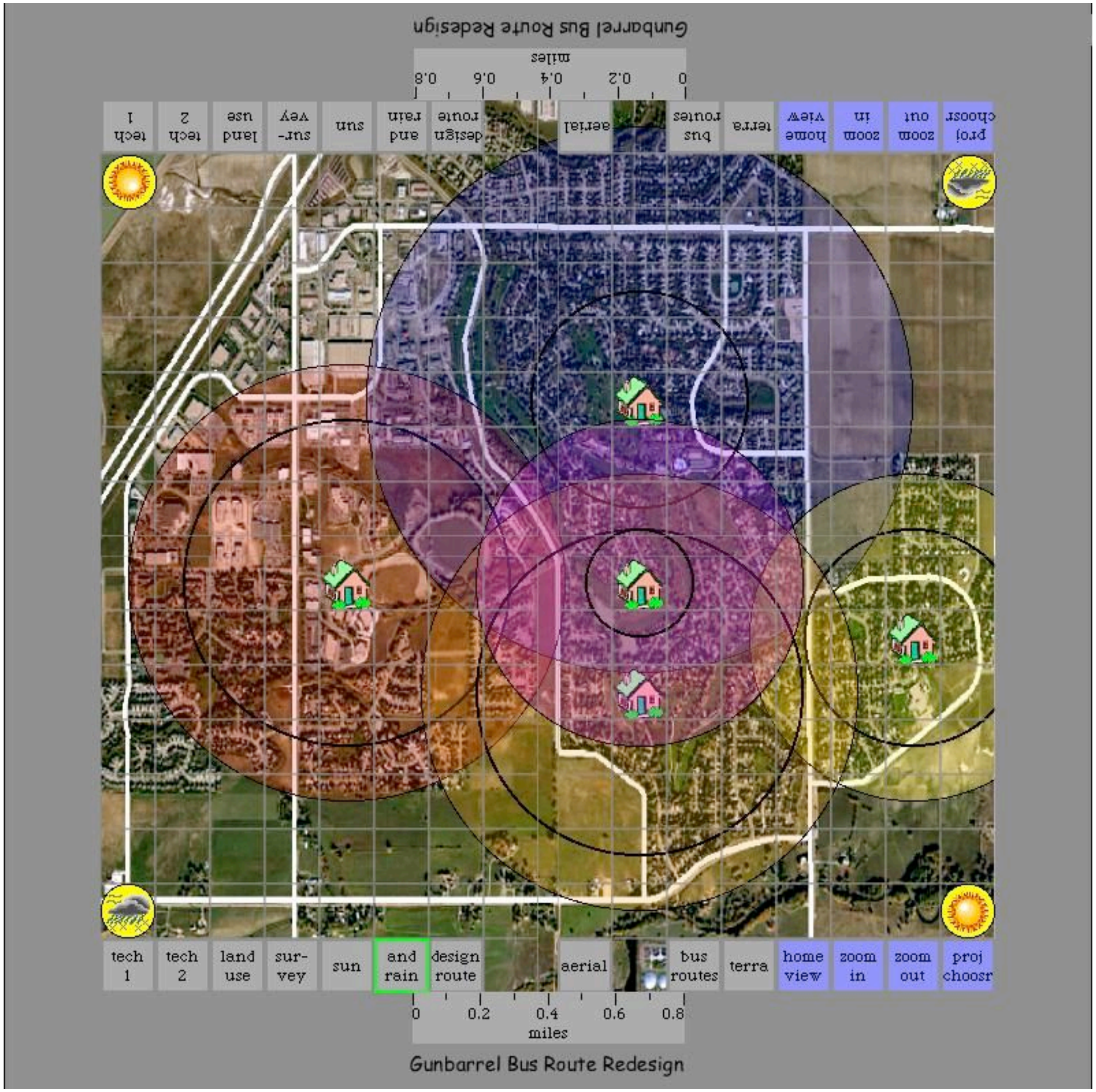
Reflection Space

Land Use Table

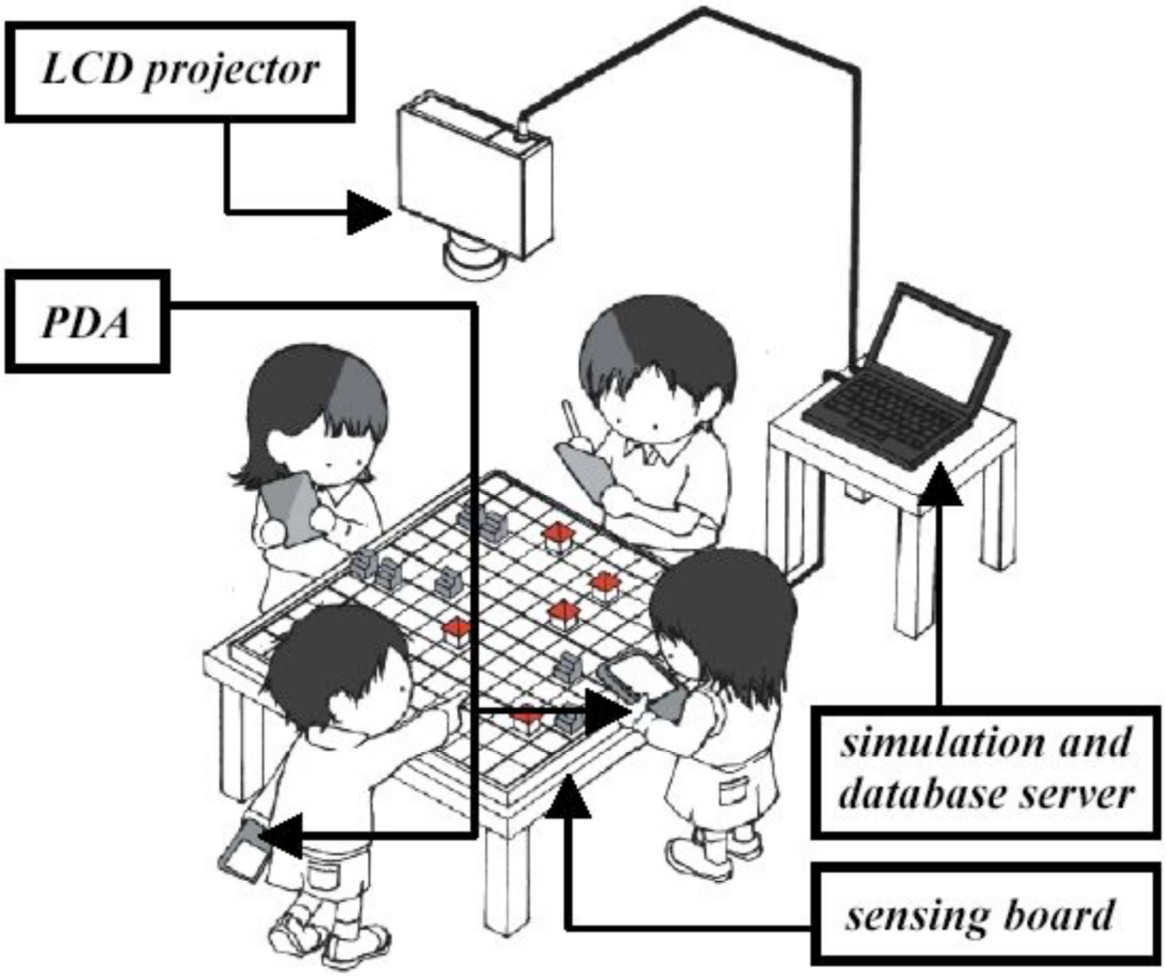
Land Use Type	# of Blocks
Open Space	62
Commercial	5
Light Industry	27
Single Family	107
Multi-Family	8
Agriculture	17



Emerging Insight: Illustrating Multiple Walking Distances



Integrating Individual and Social Creativity: Caretta



Challenges

- creativity and education
- transdisciplinary collaboration
- creativity and outsourcing

Panic-Driven Educational Reform in the USA

- **panic #1: USSR first in space → emphasis of STEM (Science, Technology, Education, Mathematics) disciplines**
  - this is an area where many other countries do extremely well

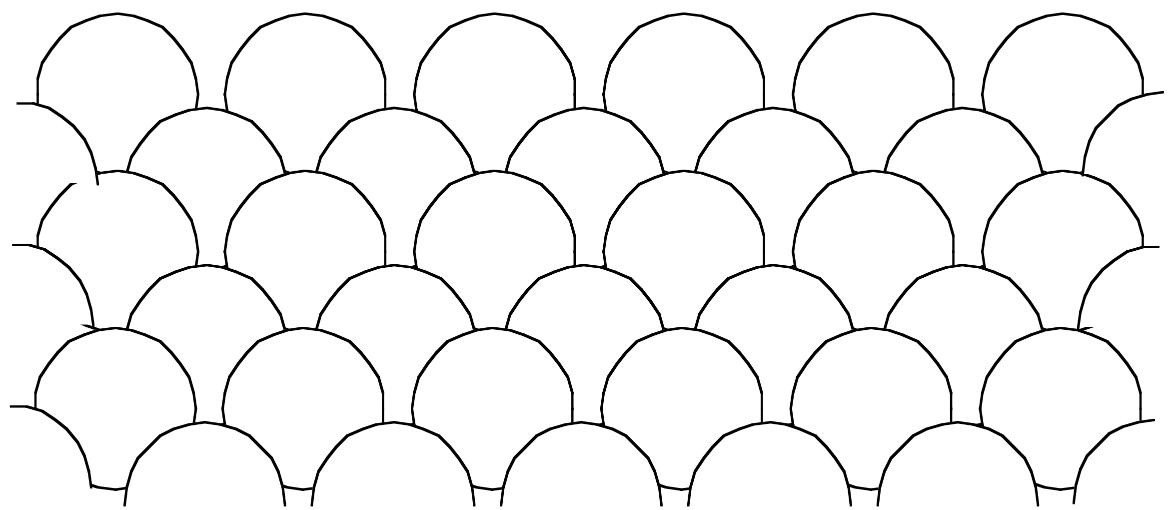
- **panic #2: US lagging in test scores → high-stake testing**
  - this is an area where many other countries do extremely well

- **panic #3: outsourcing of knowledge work → education for creativity, imagination, and innovation, thinking outside of the box, unique solutions**
  - question: which country does well in this area?
  - question: is #2 and #3 somewhat incompatible

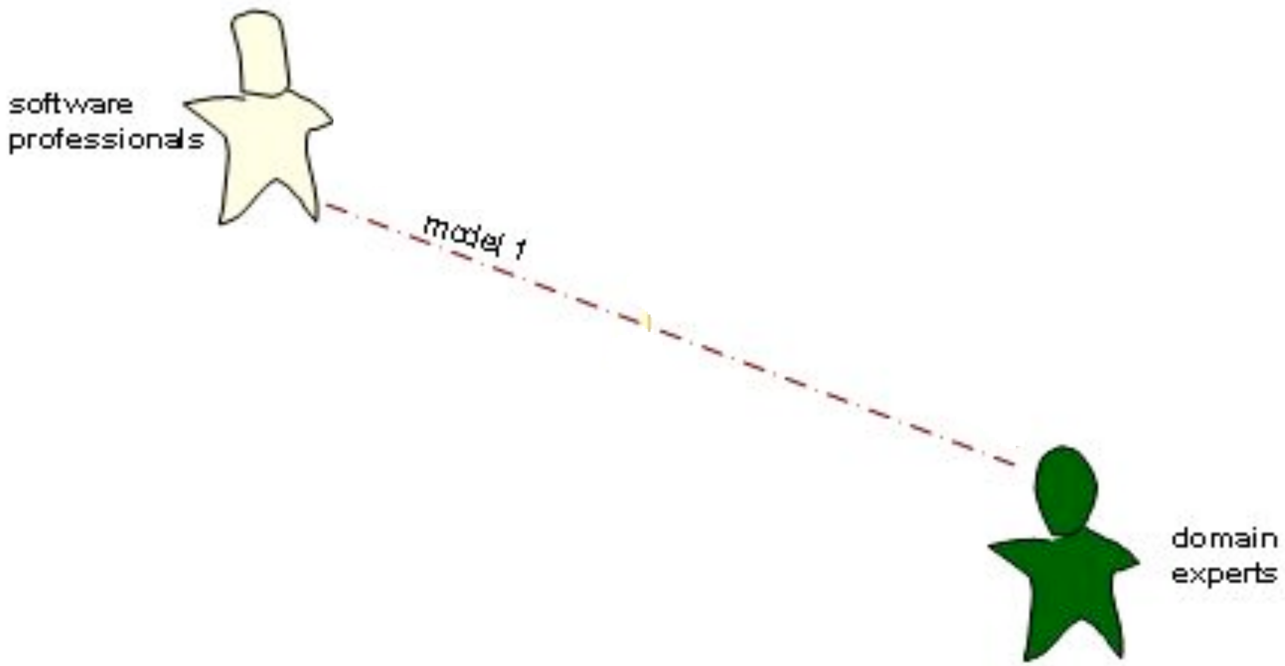
- **panic #4: complex problems transcending the unaided, individual human mind, symmetry of ignorance → reflective communities, distributed intelligence, meta-design, social creativity**

Reflective Practitioners → Reflective Communities

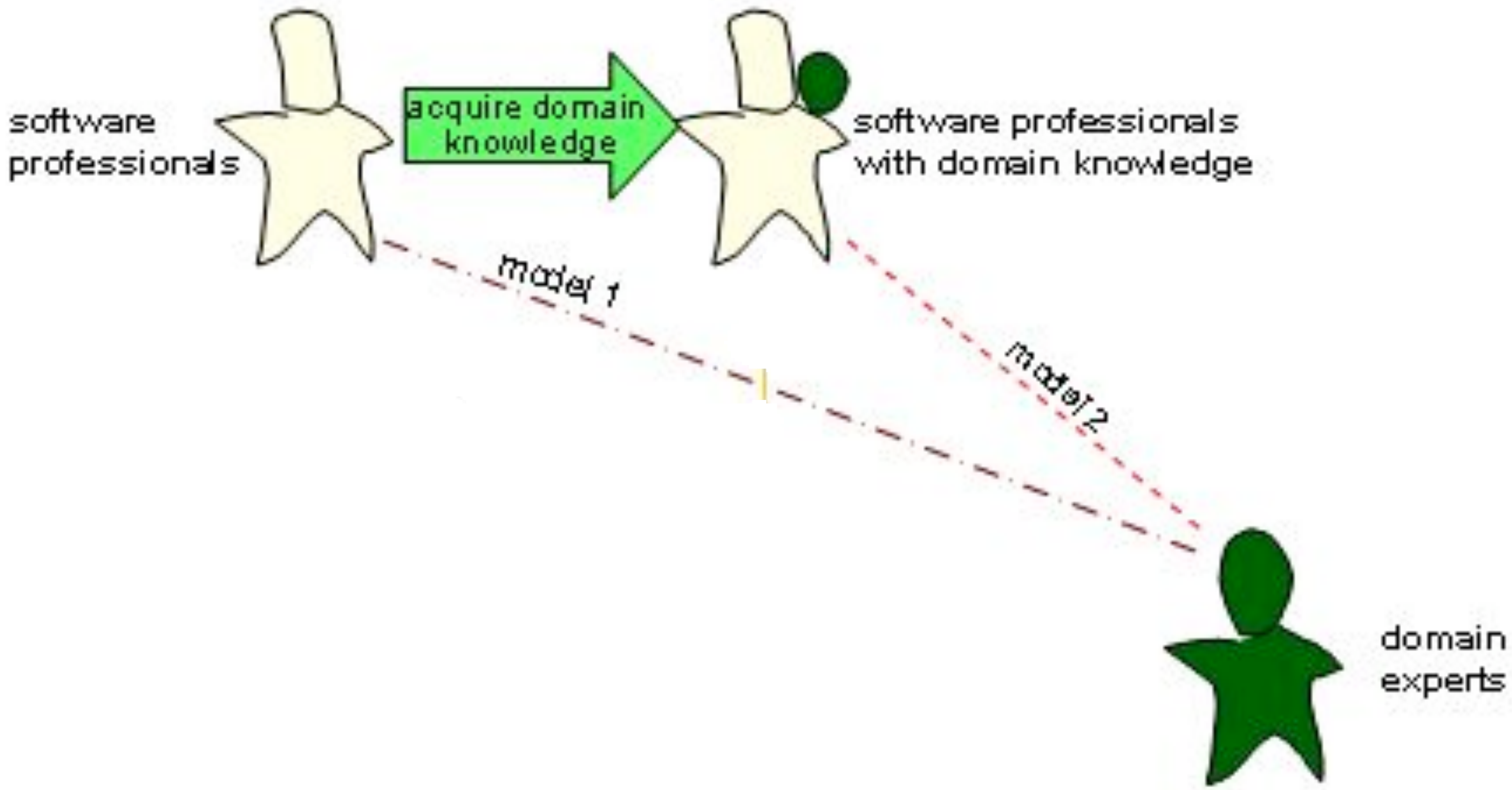
- the key to address complex problems is
  - **not** in *"Leonardos who are competent in all sciences"* or in "educating the *intellectual superhuman"* who knows everything
  - but to achieve ***"collective comprehensiveness through overlapping patterns of unique narrowness"*** → Fish-Scale Model by Campbell



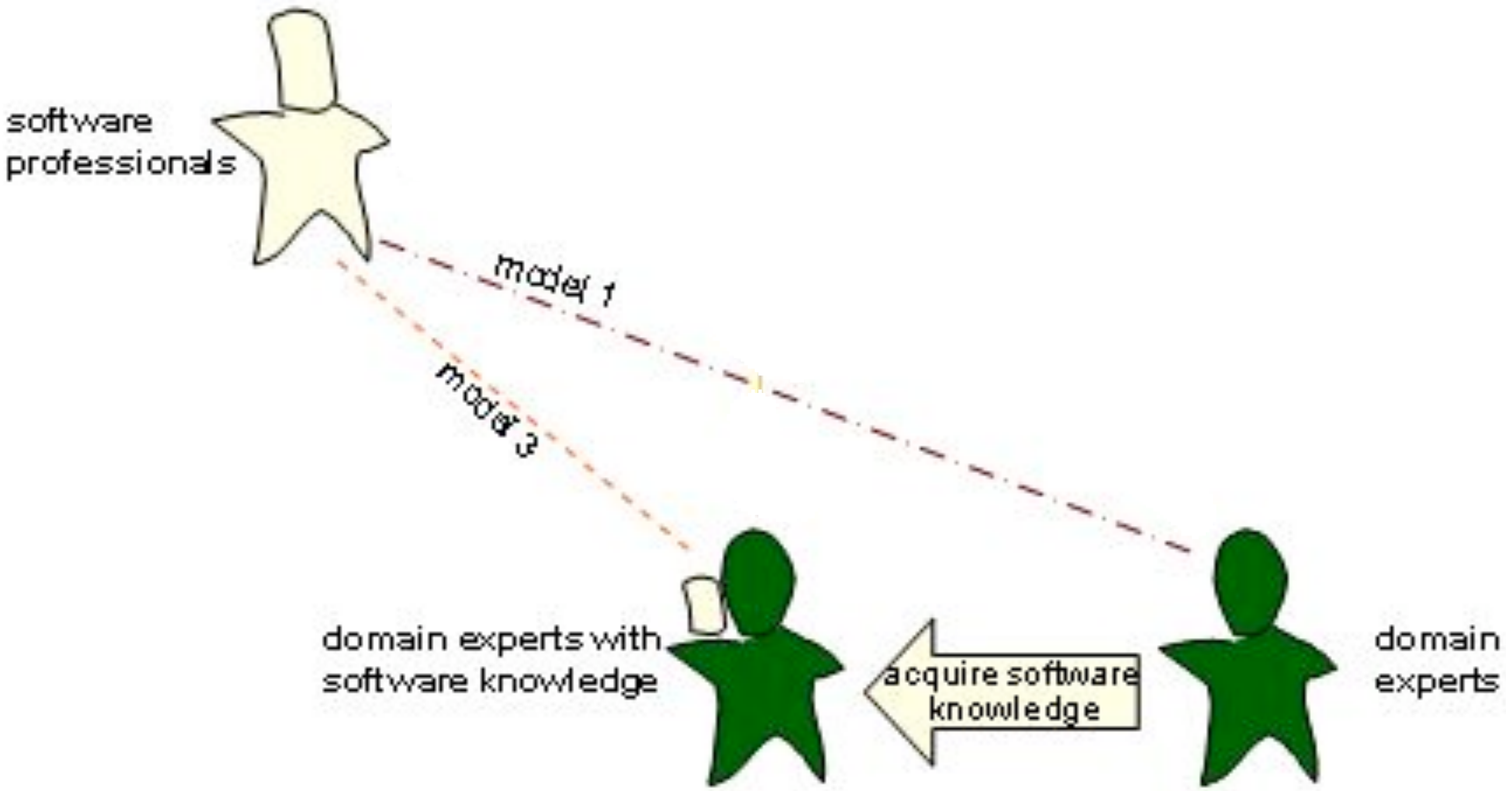
Large Conceptual Distance — Limited Common Ground



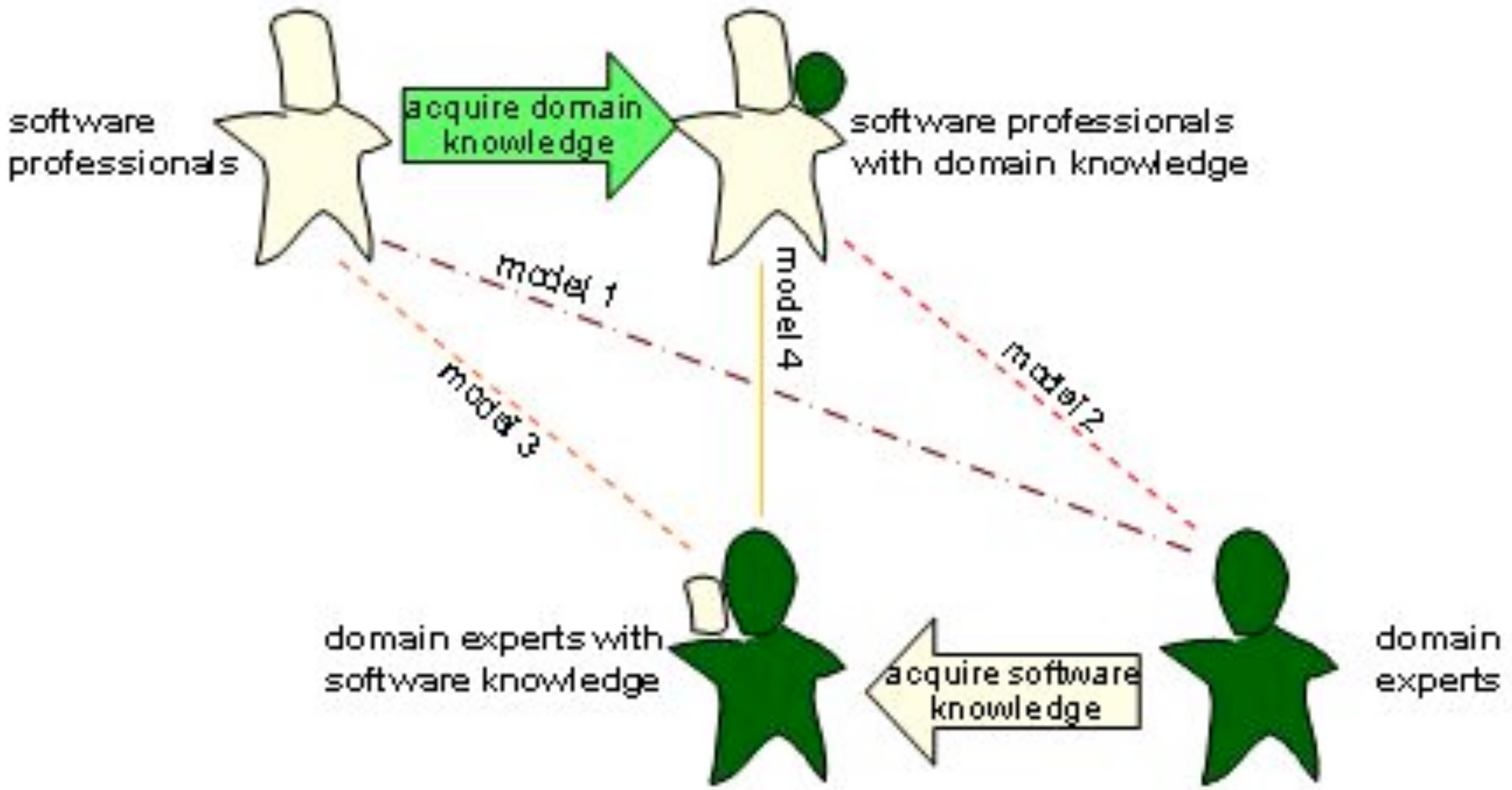
Software Professionals Acquiring Domain Knowledge



Domain Experts Acquiring Media Knowledge



From Reflective Practitioners to Reflective Communities



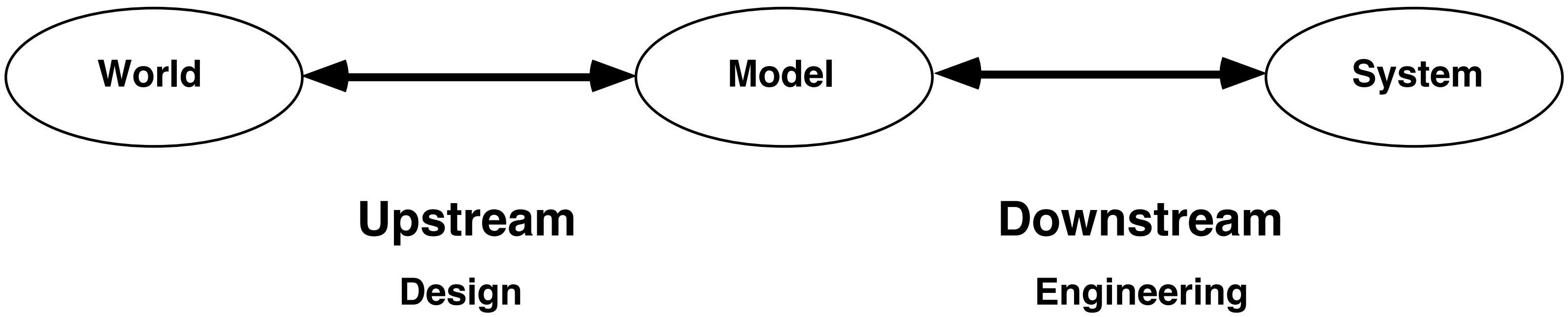
Why Should Computer Science be Interested in Creativity?

- **National Science Foundation**
  - Creativity Support Tools Workshop (June 2005)
  - new programs with the Computer Science Directorate:
    - **Science of Design Program**
    - new **Creativity Program**: The Synergy of Creativity with Research in Computer and Information Science and Engineering
    - **American Competitiveness** in the Future Globalized Economy

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

- **Globalization and Offshoring of Software**
  - Aspray, W., Mayadas, F., & Vardi, M. Y. (2006) Globalization and Offshoring of Software - A Report of the ACM Job Migration Task Force, Available at http://www1.acm.org/globalizationreport/

Software Design: Upstream and Downstream Activities



- **upstream: world → model / specification**
  - ill-defined problem
  - integration of problem framing and problem solving
  - collaboration and communication between different stakeholders
  - failure leads to ***design disasters*** (wrong problem is solved)

- **downstream: model / specification → implementation / system**
  - well-defined problem
  - dealing with difficult technical problems
  - creating reliable code
  - failure leads to ***implementation disasters*** (wrong solution to the right problem)

Current Computer Science Education and Outsourcing

	upstream activities	downstream activities
themes	creative work, communication, collaboration, context, integration of problem framing and problem solving, fuzzy requirements, customer satisfaction	programming, programming languages, compilers, rule-based behavior (tax returns),….
emphasis in current CS programs	X	XXXXX
future jobs (not being outsourced)	XXXXX	X

Conclusions

- **the basic message**
  - the complexity and uniqueness of design problems transcend the unaided, individual human mind → they require meta-design and social creativity

- **socio-technical environments in support of meta-design and social creativity**:
  - design → meta-design
  - unaided, individual human mind → media-augmented social creativity to make all voices heard and integrate diversity
  - communities of practice → communities of interest
  - reflective practitioners → reflective communities