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

From "Anywhere, Anytime, Anyone"
to
"The Right Information at the Right Time, in the Right Place, in the Right Way to the Right Person"

Gerhard Fischer
Center for LifeLong Learning & Design (L³D) (http://www.cs.colorado.edu/~l3d/)
Department of Computer Science and Institute of Cognitive Science
University of Colorado, Boulder

Presentation, "International Workshop Series on RFID —
Information Sharing and Privacy, Tokyo, November 2004

Overview

♣ The Center for Lifelong Learning and Design (L3D)

♣ Basic Message

♣ Examples:
- **Privacy** (Movie Clip from ABC)
- L3D's **CLever Project** (multimedia presentation)

♣ Conceptual Frameworks
- Information Access and Information Delivery
- Gift-Wrapping and Techno-Determinism
- Meta-Design

♣ Example: Envisionment and Discovery Collaboratory

♣ Conclusions

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 (collaborative knowledge construction)

♣ **individual ◊ social (distributed cognition, social creativity)**
  - knowledge in the head ◊ knowledge in the world
  - access ◊ informed participation

♣ **generic ◊ specific ("universe of one")**
  - design ◊ meta-design (adaptive, adaptable, situated)
  - general ◊ customization, personalization

♣ **desktop ◊ ubiquitous computing** (going small, large, everywhere)

♣ **"gift-wrapping" and "techno-determinism" with new media ◊ co-evolution** of new media, new theories about working, learning, and collaborating

Thanks

♣ **Shin'ichi Konomi**

♣ **all members of L3D**

♣ **our sponsors:**
  - National Science Foundation
  - Coleman Institute for Cognitive Disabilities
  - Software Research Associates (SRA), Tokyo, Japan

The Basic Message

♣ RFID technologies offer **opportunities** and **risks**

♣ **risks:**

- privacy

- **information overload:** anywhere, anytime, anyone, push technologies, information delivery, …

♣ **opportunities:**

- new levels of distributed intelligence

- *"the right information at the right time, in the right place, in the right way to the right person"*

The Challenge — RFID Research: Beyond Technology

♣ social context

♣ ethical issues (privacy)

♣ high impact

♣ new divisions of labor

♣ redefinition of the unique human role in socio-technical environments

♣ questions: magnitude of a change
  - oral ◊ literal society
  - printing press
  - digital media
  - World Wide Web (WWW)
  - **RFID????**

The **Right Information** at the **Right Time**, in the **Right Place**, in the **Right Way** to the **Right Person**

♣ right **information**: relevant to the task at hand ◊ task modeling

♣ right **time**: intrusiveness (pull versus push)

♣ right **place:** location-aware cell phone (noisy environment versus movie theatre), smart tour guides

♣ right **way**: multimodal presentation (textual, visual, auditory, tactile)

♣ right **person**: taking background knowledge and interests of specific users into account ◊ user modeling, "who do I ask and who do I tell"

Finding the Limiting Resource in Design

Herbert Simon (Nobel Prize Winner) in "Sciences of the Artificial"

♣ claims

- a design representation suitable to a world in which the scarce factor is information may be exactly the wrong one for a world in which the scarce factor is attention

- the critical component in information sharing is not information per se, but *human attention*

- "What information consumes is rather obvious: it consumes the **attention** of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate efficiently among the overabundance of information sources that might consume it."
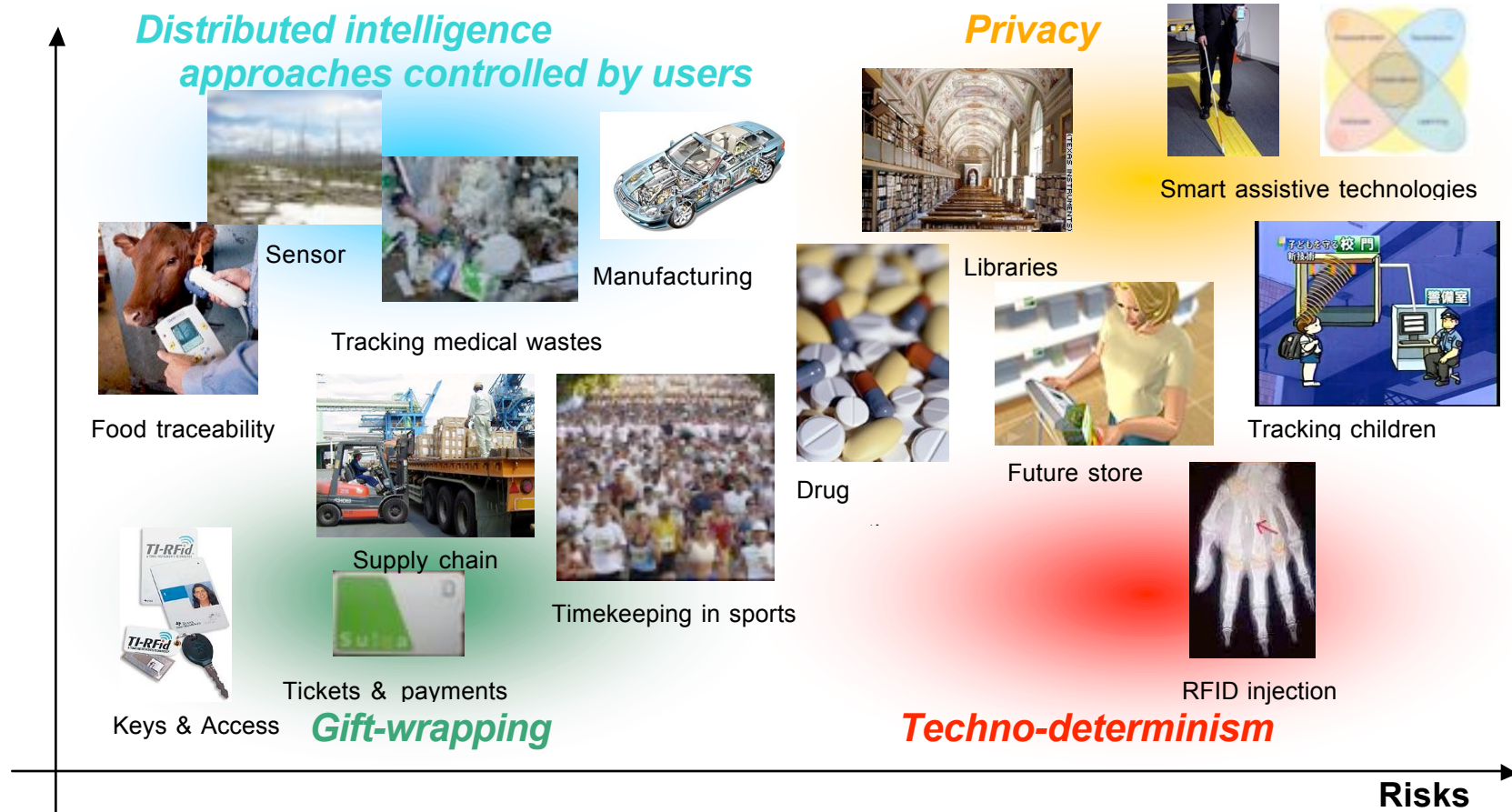
example:

- some crisis in the world ◊ many messages to the State Department

- printing capacity was identified at the limiting factor ◊ buy high speed printers

- the real bottleneck: time and attention of the human decision makers who had to use the incoming information ◊ the real challenge: filters, intelligent summarizing, …

Trade-Offs between Risks and Opportunities
(provided by new technologies such as RFID, GPS, ..)

Opportunities

Distributed intelligence approaches controlled by users

Privacy

Sensor

Manufacturing

Tracking medical wastes

Food traceability

Libraries

Smart assistive technologies

Drug

Future store

Tracking children

Supply chain

Timekeeping in sports

RFID injection

Tickets & payments

Keys & Access

Gift-wrapping

Techno-determinism

Risks

Opportunities
(provided by new technologies such as RFID, GPS, ..)

Consumer benefits

Security and piece of mind

Convenience and efficiency

Business benefits

Reduced costs

Increased profits

Social benefits

Environmental conservation

Universal usability

Risks
(provided by new technologies such as RFID, GPS, ..)

Consumer risks

Privacy violation

Health risks (stress; RF signals can
affect pacemakers etc.)

Business risks

Failure of RFID systems

More lawsuits and product return

Social risks

"Big Brother"

Job loss

Example-1: Privacy Issues (ABC Movie Clip)

♣ **example:** newspaper story *"Man accused of using GPS to track ex-lover"*
- cellular phone with GPS and motion sensor
- man faces up to six years in prison if convicted

♣ **Personal Privacy Assistants (see contribution by Shin'ichi Konomi)**
- boundary control rather than isolation
- Personal Privacy Assistants provide users with feedback and control
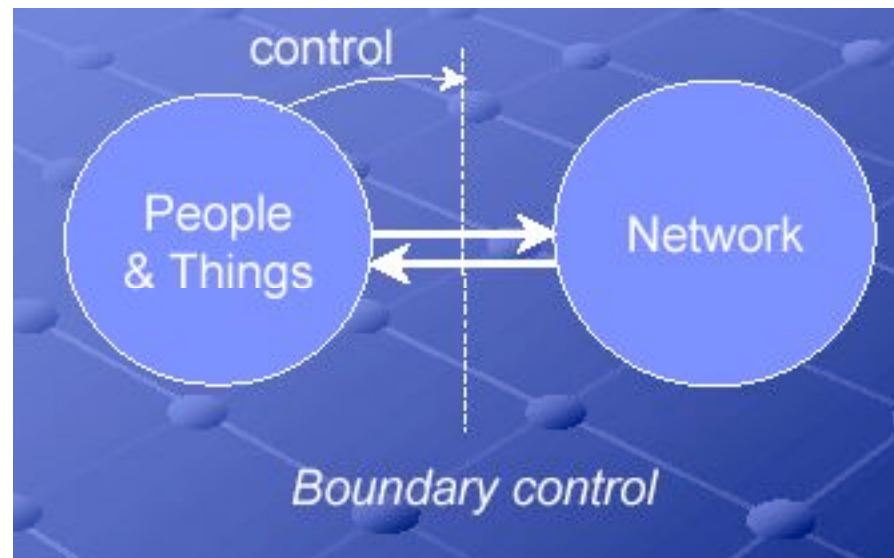
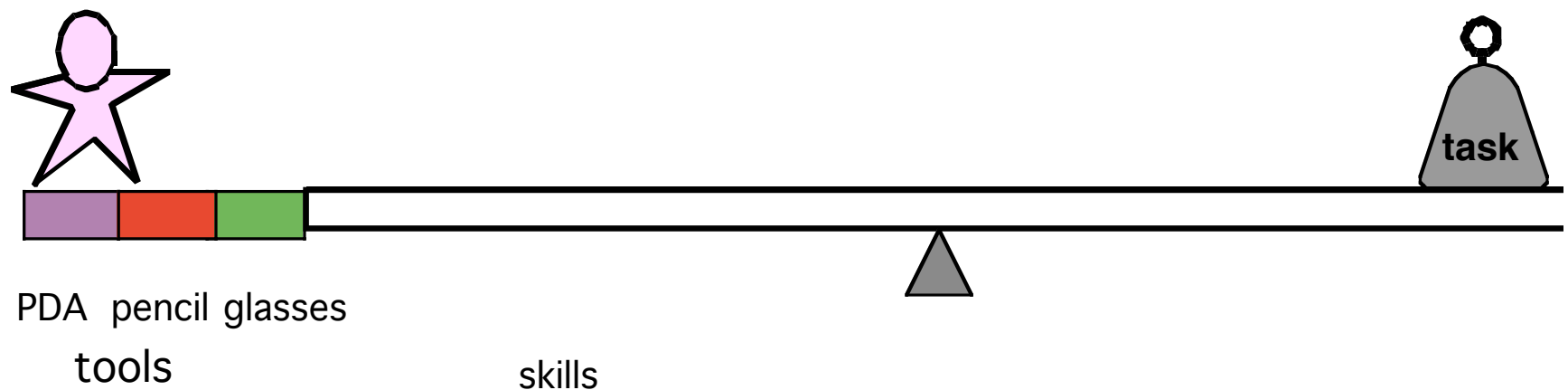# Example-2: The CLever Project —Enriching the Life of People with Disabilities

	"**CLever:** Cognitive Levers — Helping People Help Themselves"

♣ supported by the Coleman Institute, August 2000 – July 2005
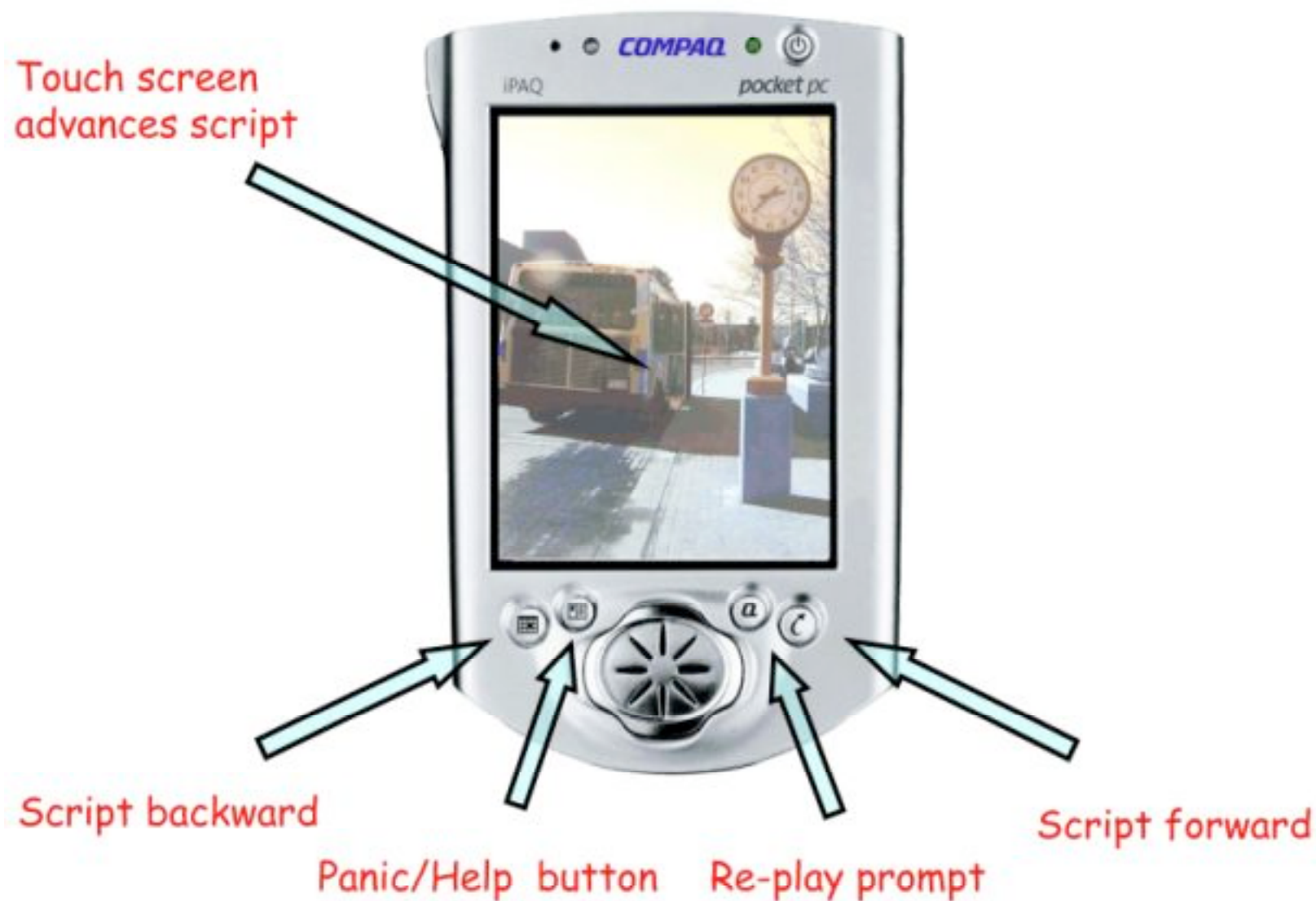♣ http://www.cs.colorado.edu/~l3d/clever/index.html

Cognitive Levers (CLever) — Helping People Help Themselves

♣ **theoretical framework: distributed intelligence** ◊ empowering humans
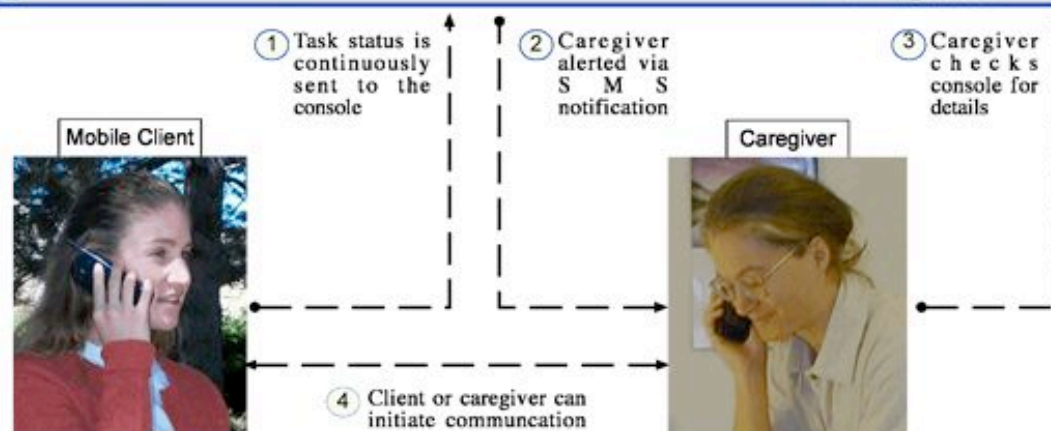   with cognitive disabilities with media and technology

♣ *"Give me a lever long enough and I can move the world"*

PDA pencil glasses

tools

skills

MAPS: Memory Aiding Prompting System

Touch screen advances script

Script backward

Panic/Help button

Re-play prompt

Script forward

Lifeline: monitor and support clients with wireless prompting systems

Mobile architecture

data servers

wireless networks

mobile internet

internet backbone

mobility agents

transportation systems

mobile users

support communities

17
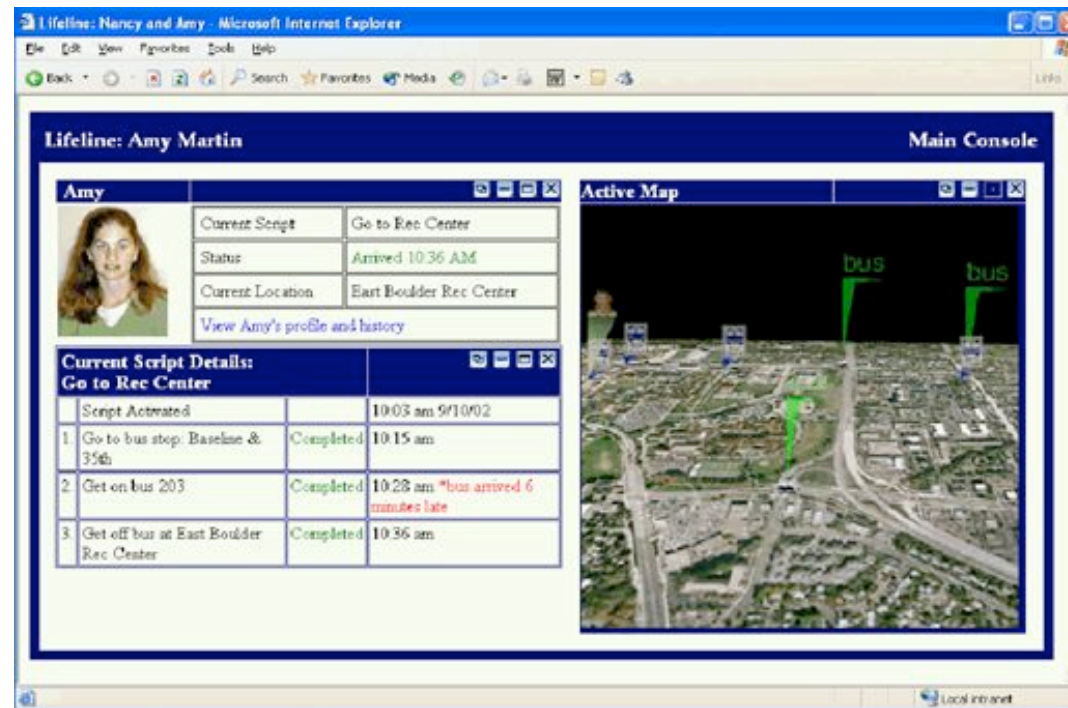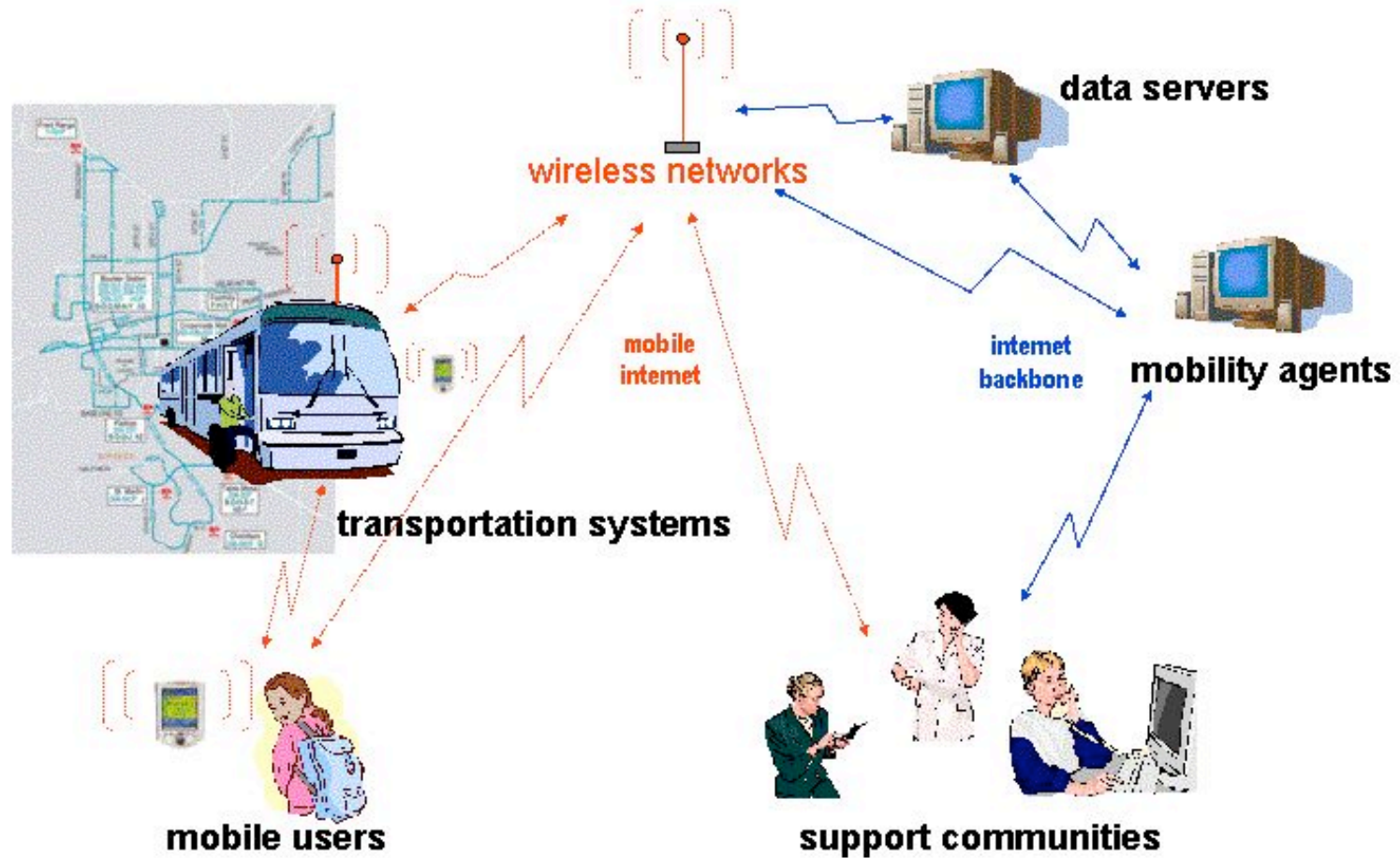
The Story Shown on the **Videotape**

♣ **specific:** a woman with cognitive disabilities (memory problems, no capacity for planning and remembering) and her mother

♣ **general:** the scenario shows socio-technical environments to help people with

- cognitive disabilities

- elderly people (e.g., with Alzheimer)

- out-of-town visitors

- foreigners

- everyone

♣ many people **can not use** current public transportation systems

♣ innovative technologies to **"simplify"** their use

- personal device such as personal digital assistants (PDAs),

- mobile phones,

- global positioning systems (GPS),

- web-based collaboration tools

Selected CLever Projects

♣ **Web2gether: Online Community Environment** — supporting the members of a community (not only information management)

♣ **TEA: The Evaluation Assistant** — matching the needs of individuals to specific technologies

♣ **MAPS: Memory Aiding Prompting Systems** — creating new "knowledge" (scripts) by end-users who have no interest or technical knowledge

♣ **Mobility-for-All: Human Centered Public Transportation Systems** — from "anywhere, anytime, anyone" ⇒ right information, right person, right time, right way (exploiting the power of ubiquitous, wireless technologies)

♣ **Lifeline: Remote Monitoring** — reuse of the technological infrastructure for a different purpose

Conceptual Frameworks

♣ shift from purely **computational worlds inside the computer** (such as domain-oriented design environments) ◊ **augmented reality, pervasive computing** (a partial mapping / representation of the external world needs to be created inside a computational environment)

♣ Information Access and Information Delivery

♣ Gift-Wrapping and Techno-Determinism

♣ Meta-Design

Information Sharing:
Access ("Pull") and / or Delivery ("Push")

	access ("pull")	delivery ("push")
examples	browsing, search engines, bookmarks, passive help systems	Microsoft's "Tip of the Day", broadcast systems, critiquing, active help systems, agent-based systems
strengths	non-intrusive, user controlled	serendipity, creating awareness for relevant information, rule-enforcement
weaknesses	task relevant knowledge may remain hidden because users can not specify it in a query	intrusiveness, too much decontextualized information
major system design challenges	supporting users in expressing queries, better indexing and searching algorithms	context awareness (intent recognition, task models, user models, relevance to the task-at-hand)

Decontextualized Information Delivery:
Example: Tip of the Day ("Did You Know")

♣ the **Assistant of Microsoft Office** provides tips on how to use features or keyboard shortcuts more effectively

- – When a yellow light bulb appears next to the Assistant, click the light bulb to see a tip

- – user can turn on or off showing the Tip of the Day

♣ idea behind it: to incrementally learn **High-Functionality Applications**
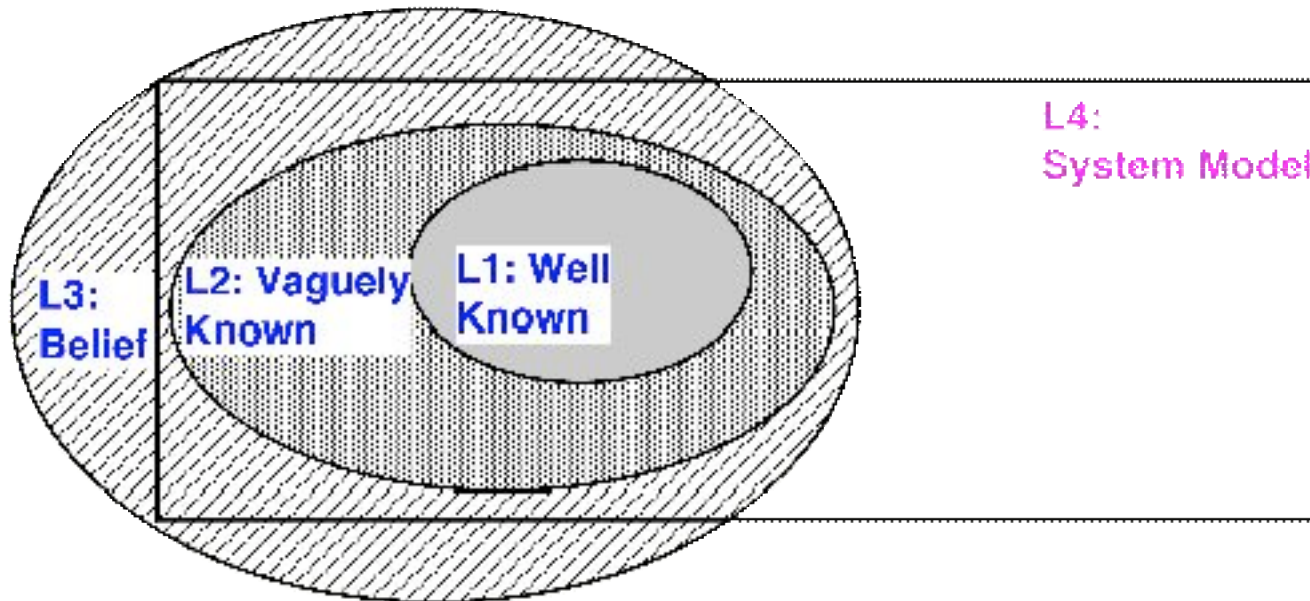
Contextualized Information Delivery — Example: Codebroker

**Yunwen Ye (more info at: http://www.cs.colorado.edu/~yunwen)**

♣ **thousands of components,** no programmer knows all of them, constantly evolving

♣ information access does **not support programmers** who do not actively search for reusable components

♣ **delivers personalized components** based on task and user modeling techniques

♣ programmers are **consumers and contributors**

Information Delivery in Large Software Reuse Repositories
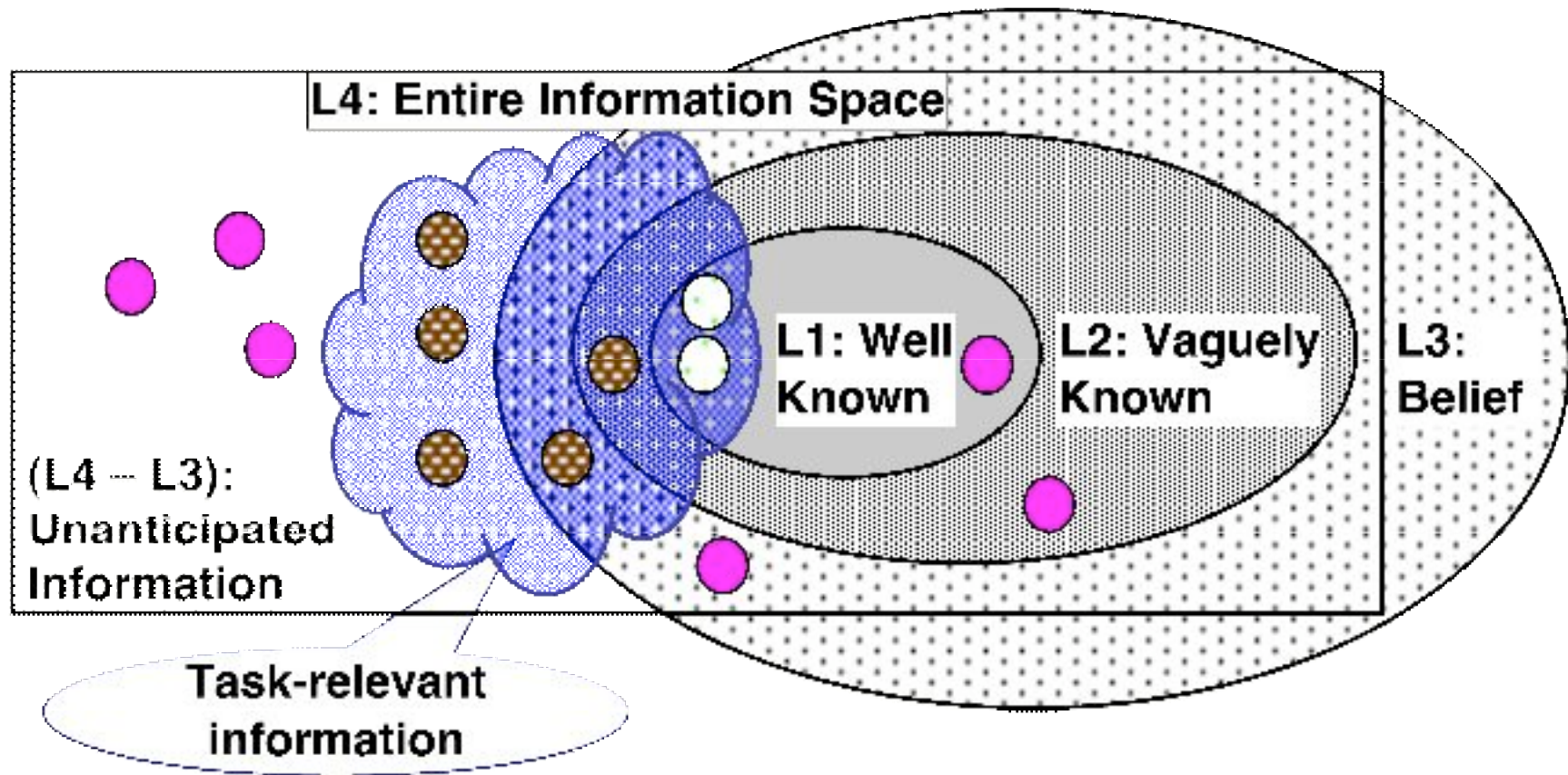
Gift-Wrapping: Adding Technology to Existing Practice
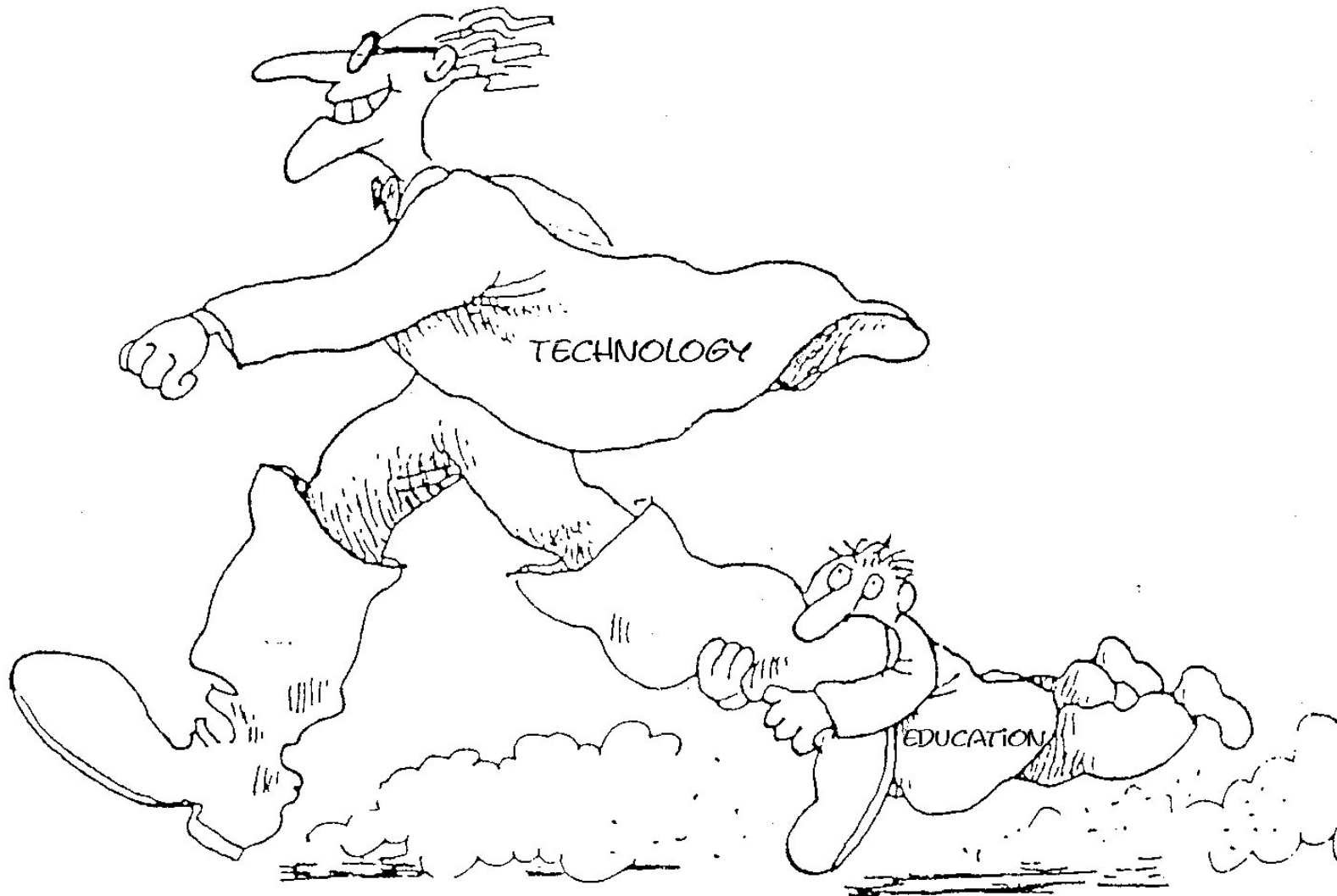
"There is nothing so useless as doing efficiently that which should not be done at all." — **Peter Drucker**
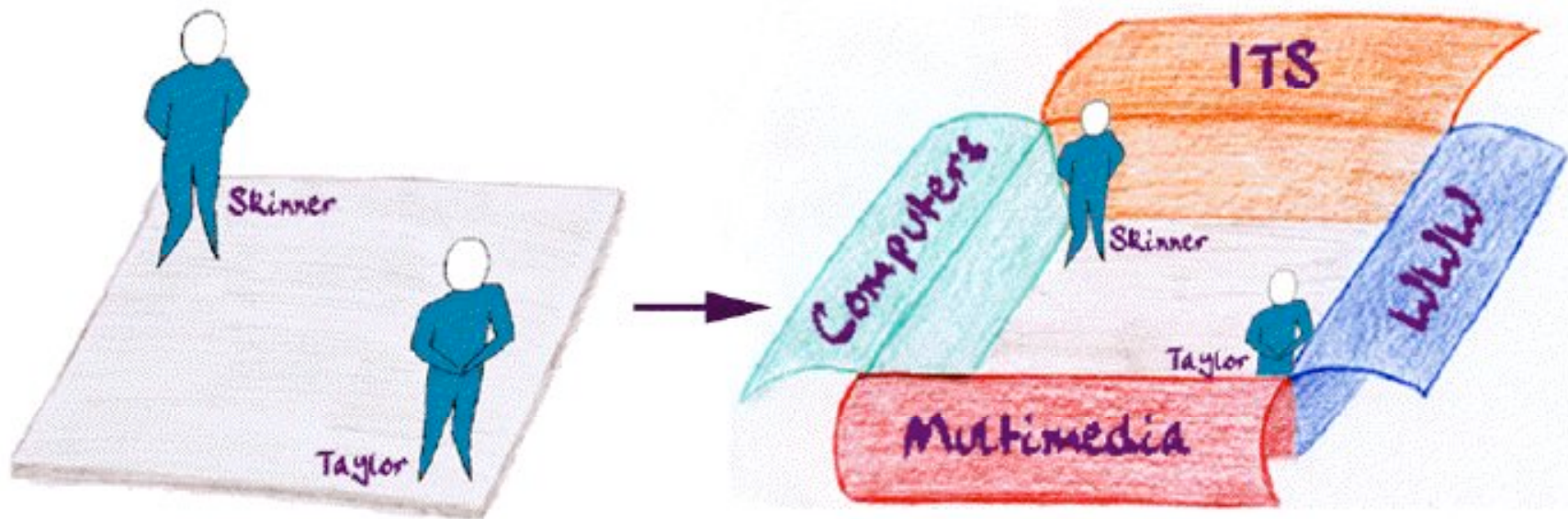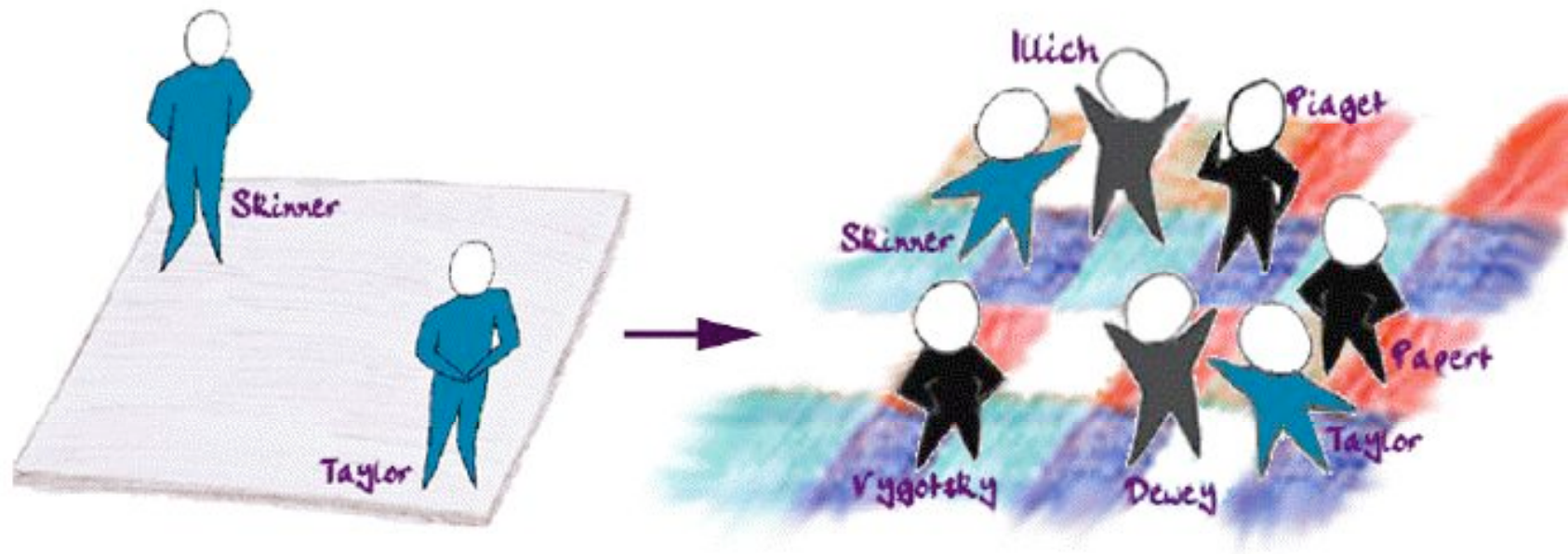

current practice (e.g., education)   current practice wrapped in technology

Techno-Determinism

Learning and Media: Rethinking, Reinventing, and Redesign Theory and Practice

current practice

computer-supported and computer–mediated practice of the future

Examples of Gift-Wrapping

♣ using the **World Wide Web for "new" approaches in education:** posting slides on a website rather than handing them out as paper copies

    – this is worthwhile and has advantages (e.g., ease of updates)

    – but: it leaves the underlying processes unchanged

♣ **in RFID:** using tags in smart stores to eliminate the scanning process at check-out

Meta-Design

♣ **meta-design =** how to create new media at design time *("world-as-imagined")* that allow users to act as designers and be creative at use time *("world-as-experienced")*

♣ **why meta-design?**

– deal with a changing world

– address and overcome problems of closed systems

– transcend "consumer mindsets"

♣ **impact of meta-design**

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

- can be extended to: "if we can provide someone with the knowledge, the know-how, and the tools for making a fishing rod, we can feed the whole community"

Design Time and Use Time

key

system developer

user (representative)

end user

design time

use time

time

world-as-imagined
prediction
planning

world-as-experienced
reality
situated action
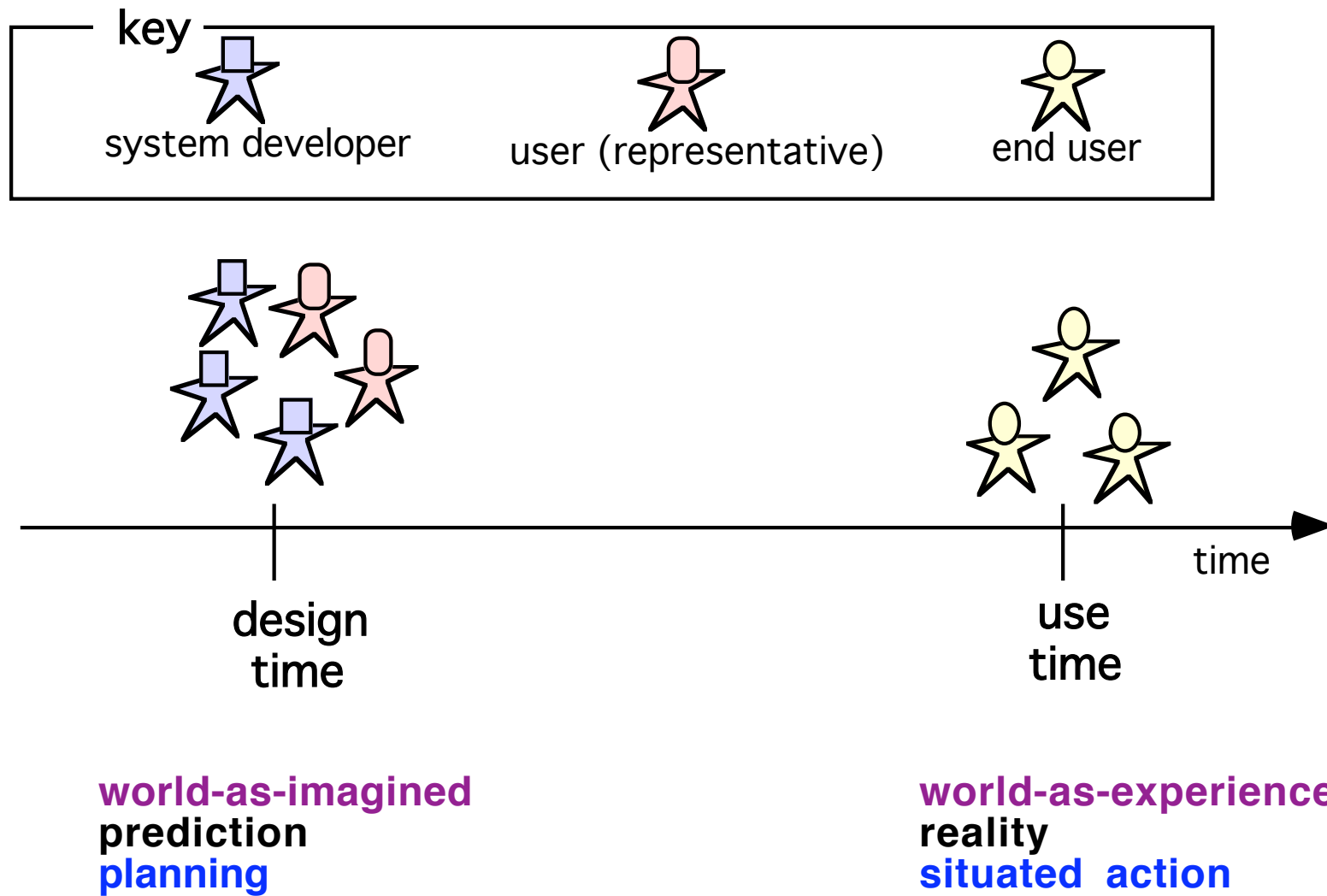
Computational Media
—
Extending Design Opportunities at Use Time

♣ **print media:**
- a fixed context for use time is decided at design time
- all interpretation needs to be done by humans

♣ **computational media**:
- presentations at use time can take advantage of contextual factors only known at use time (about tasks, users, social systems,.....)
- examples: specification sheets and usage data, supporting dynamic forms, dynamic websites, user and task specific maps and traffic schedules....

♣ **evolving the existing systems**: users (acting as designers) can transcend at use time the boundaries of the systems as developed at design time

The Envisionment and Discovery Collaboratory

http://www.cs.colorado.edu/~l3d/systems/EDC (including demo)

♣ **creating shared understanding** in the context of collaborative design

♣ **integration of physical and computational environments**

♣ **specific major application:** urban planning ◊ build an end-user modifiable version of Simcity (**meta-design approach**)

Non-Computational Collaborative Environments

Collaboration with many Stakeholders on the Desktop

Smartboards: Computation and Collaboration Beyond the Desktop

PiTaBoard: Parallel Interaction and Computational Objects

PiTaBoard: Parallel Interaction and Computational Objects

Realities based on Assessment Studies

♣ **RFID: new technology is necessary, but not sufficient** ◊ change of work practices, mindsets and reward structures is necessary

♣ **motivation for a group is different than for an individual**
- "who is the beneficiary and who has to do the work?"
- **utility = value / effort** ◊ can the EDC or RFID technologies change this equation?

♣ **EDC: engage skilled professionals in realistic work situations**
- requires useful and usable systems (not just demo systems)
- prerequisite for evolutionary growth

Utility = Value / Effort

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

♣ **decrease in effort:**
  - exploit data provided computational mechanisms
  - extending meta-design to design for design communities

Future Directions

♣ **technical:**

- more **resources** (e.g., weather information in CLever/Mobility-for-All environment)

- more **integration**: e.g., use personal devices in the context of the EDC

- use objects and interaction histories as **indices** into large information spaces
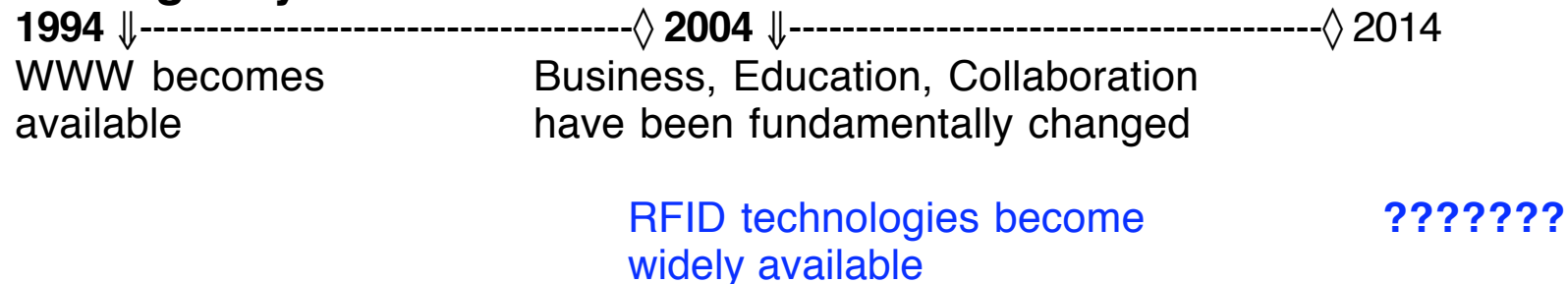
♣ **theoretical:**

- integrate individual and **social creativity**

- integrate planning and situated action ◊ **meta-design**

- extend **distributed intelligence** framework

- design with **human attention** as the fundamental limiting resource

♣ **social:**

- **privacy** and **security**

Innovating Innovation

♣ **looking 10 years in the future**

1994 ⇓-----------------------------------◊ **2004** ⇓------------------------------------◊ 2014

WWW becomes   Business, Education, Collaboration
available   have been fundamentally changed

RFID technologies become   **???????**
widely available

♣ **innovating innovation** (John Seely Brown)

- our ideas of innovation have gone stale ◊ be innovative in the area of **innovation itself**

- will RFID technologies be a **"disruptive innovation"** (= something that actually changes social practices: the way we live, work and learn ◊ beyond "gift-wrapping")

♣ **challenges associated with disruptive innovation:**

- it is not technology per se that matters, but **technology-in-use**

- **shift the discourse**: from a concern about who has **access** to new information technologies ◊ who will have the **knowledge** to design, create, invent, and use the technologies enhancing human lives

Summary — The Basic Message Again

♣ the biggest problem in the field of RFID is an

imagination crisis

of exciting things to do, of balancing the trade-offs between risks and opportunities, ...

♣ it is **not a technology crisis**

More Information

http://l3d.cs.colorado.edu/~gerhard/papers.html

♣ context awareness in augmented reality environments

- Fischer, G., Arias, E., Carmien, S., Eden, H., Gorman, A., Konomi, S. i., & Sullivan, J. (2004) "Supporting Collaboration and Distributed Cognition in Context-Aware Pervasive Computing Environments" (Paper Presented at the 2004 Meeting of the Human Computer Interaction Consortium "Computing Off The Desktop"), Available at http://www.cs.colorado.edu/~gerhard/papers/hcic2004.pdf.

- Arias, E. G., Eden, H., & Fischer, G. (1997) "Enhancing Communication, Facilitating Shared Understanding, and Creating Better Artifacts by Integrating Physical and Computational Media for Design." In Proceedings of Designing Interactive Systems (DIS '97), ACM, Amsterdam, The Netherlands, pp. 1-12. Available at: http://www.acm.org/pubs/articles/proceedings/chi/263552/p1-arias/p1-arias.pdf.

♣ meta-design:

- Fischer, G., Giaccardi, E., Ye, Y., Sutcliffe, A. G., & Mehandjiev, N. (2004) "Meta-Design: A Manifesto for End-User Development," Communications of the ACM, 47(9), pp. 33-37. http://www.cs.colorado.edu/~gerhard/papers/CACM-meta-design.pdf

- Fischer, G., & Giaccardi, E. (2004) "Meta-Design: A Framework for the Future of End User Development." In H. Lieberman, F. Paternò, & V. Wulf (Eds.), End User Development —. (in press). http://www.cs.colorado.edu/~gerhard/papers/EUD-meta-design-online.pdf

More Information

♣ gift-wrapping

- Fischer, G. (1998) "Making Learning a Part of Life—Beyond the 'Gift-Wrapping' Approach of Technology." In P. Alheit, & E. Kammler (Eds.), Lifelong Learning and Its Impact on Social and Regional Development, Donat Verlag, Bremen, pp. 435-462.
  http://www.cs.colorado.edu/~gerhard/papers/giftwrapping-98.pdf

♣ Clever Project and Mobility-for-All

- Carmien, S., Dawe, M., Fischer, G., Gorman, A., Kintsch, A., & Sullivan, J. F. (2004) "Socio-Technical Environments Supporting People with Cognitive Disabilities Using Public Transportation," Transactions on Human-Computer Interaction (ToCHI), p. (in press).
  http://www.cs.colorado.edu/~gerhard/papers/tochi-social-issues-final.pdf

♣ Envisionment and Discovery Collaboratory

- Arias, E. G., Eden, H., Fischer, G., Gorman, A., & Scharff, E. (2000) "Transcending the Individual Human Mind—Creating Shared Understanding through Collaborative Design," ACM Transactions on Computer Human-Interaction, 7(1), pp. 84-113.
  [http://www.cs.colorado.edu/~gerhard/papers/tochi2000.pdf]

♣ information overload (push and pull technologies):

- Fischer, G., & Ostwald, J. (2001) "Knowledge Management — Problems, Promises, Realities, and Challenges," IEEE Intelligent Systems, January/February 2001, pp. 60-72.
  http://www.cs.colorado.edu/~gerhard/papers/km-ieee-2001.pdf