



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

Knowledge Creation, Integration, and Dissemination in Design Communities

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Presentation, JAIST Forum 2004, November 2004

Overview

♣ The Basic Message

♣ Design and Design Communities

♣ Knowledge Management and Knowledge of the Past

♣ **Conceptual Frameworks for KM**

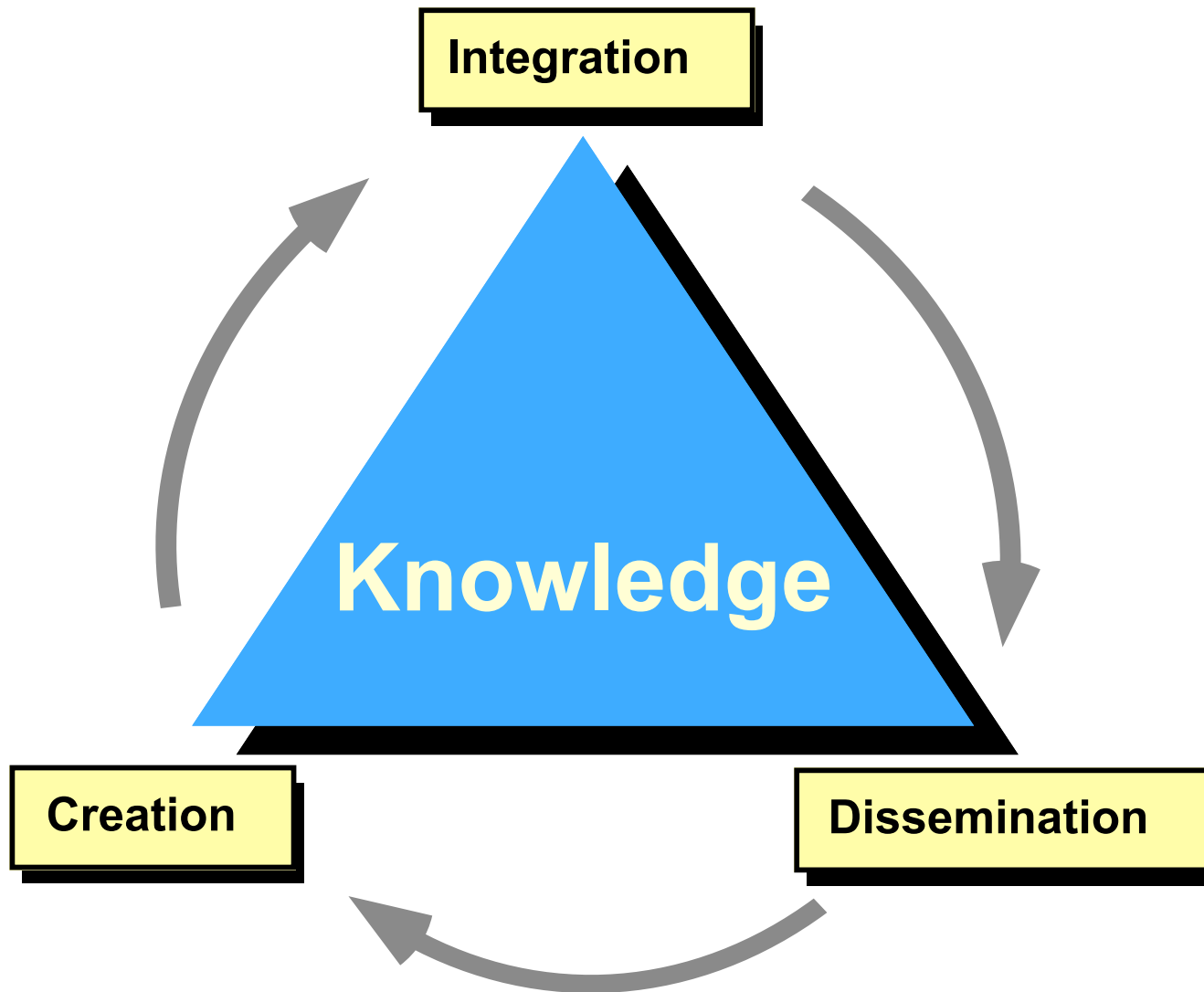
- Informed Participation
- Seeding, Evolutionary Growth, Reseeding Model
- Meta-Design
- Open Source and Open Systems

♣ **Systems in Support of KM**

- Domain-Oriented Design Environments
- Group Memory Systems / Living Organizational Memories
- Envisionment and Discovery Collaboratory
- Software Reuse as a KM Problem

♣ Myths, Realities, Challenges, and Conclusions

Major Processes in Knowledge Management (KM)



The Basic Message

- ♣ **claim:** KM is one of the most critical challenges in an information society — but so far it has been a **limited success**

- ♣ **limitation:** remembering lessons from the past and archiving information is **necessary, but not sufficient**, because the information needs (specifically in design) of the future will **not be the same** as they were in the past

- ♣ **the challenge:** knowledge is not a commodity to be consumed but is collaboratively designed and constructed emphasizing innovation, individual and social creativity, continuous learning, and collaborative knowledge construction

Design

♣ design

- **natural science**: how things are
- **design**: how things ought to be

♣ design problems are

- **complex** ◇ requiring multidisciplinary approaches in which stakeholders from different disciplines have to collaborate
- **ill-defined** ◇ requiring the integration of problem framing and problem solving
- **unique** (“a universe of one”) ◇ **knowledge of the past is not enough**

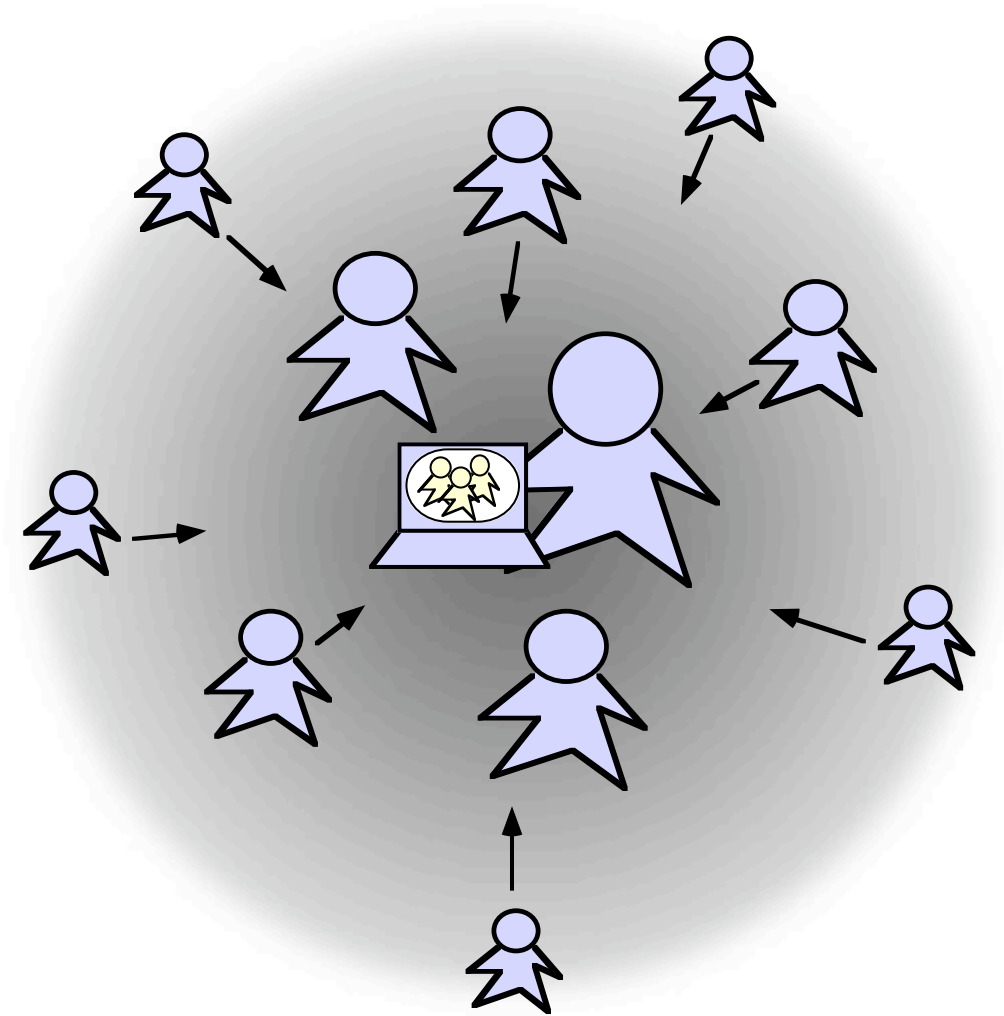
Design Communities: Communities of Practice and Communities of Interest

- ♣ **basic assumption:** (some form of) communities are the heart and soul of knowledge sharing
- ♣ **Communities of Practice (CoPs)**, defined as groups of people who share a professional practice and a professional interest
- ♣ **Communities of Interest (Cols)**, defined as groups of people (typically coming from different disciplines) who share a common interest (e.g., solve complex design problems, engage in complex decision making)
- ♣ **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.
[\[http://www.cs.colorado.edu/~gerhard/papers/iris24.pdf\]](http://www.cs.colorado.edu/~gerhard/papers/iris24.pdf)

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,

Learning in CoPs



Cols: Heterogeneous Design Communities

“Innovations come from outside the city wall.”

♣ 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

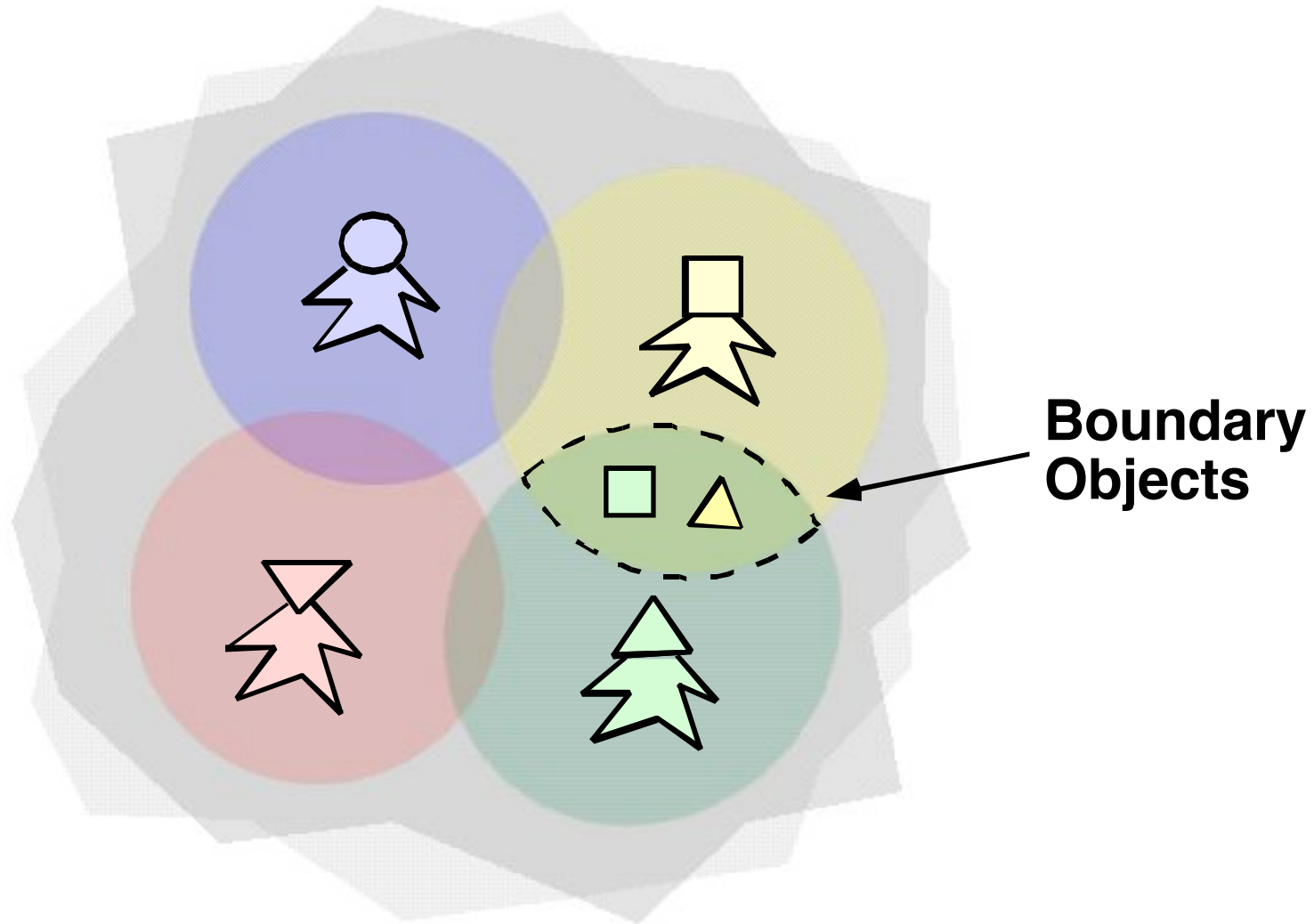
♣ diverse cultures

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

♣ fundamental challenges:

- establish a common ground
- 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”**

Cols: Bringing Different CoPs Together



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 Col
- the interaction between users and (computational) environments

♣ **perform a brokering role** involving translation, coordination, and alignment between the perspectives of different CoPs by building bridges between different ontologies ◇ examples:

- **prototypes** serve as boundary objects between developers and users in participatory system design
- **stories** convey the essence of an experience

Knowledge of the Past is Important

- ♣ **“do not reinvent the wheel”** — do not stand on the toes, but on the hips or shoulders of the smart people who proceeded us (one form of social creativity)
- ♣ **George Santayana:** “Those who cannot remember the past are condemned to repeat it.”
- ♣ **Herbert Simon:** “Complex systems evolve fast if they can built on stable subsystems”

Why Knowledge of the Past is Not Enough

♣ design

- design problem are unique \diamond the information needs of the future are **not the same** as they were in the past

♣ world-as-imagined \Downarrow world-as-experienced:

- in a world that is not predictable, improvisation and innovation are more than desirable: they are essential
- planning \Downarrow situated action

Contrasting two Different Views of KM

	Commodity Perspective	Community Perspective
	specialists (e.g., knowledge engineers)	everyone (e.g., people doing the work), collaborative activity
integration	at design time (prior to system deployment)	at use time (an ongoing process)
dissemination	lecture, broadcasting, classroom, decontextualized	on-demand, integration of learning and working, relevant to tasks, personalized
learning paradigm	knowledge transfer	knowledge construction
tasks	system driven (canonical)	user/task driven (situated)
social structures	individuals in hierarchical structures; communication primarily top-down	CoPs; CoIs; communication primarily peer-to-peer
work style	standardize	improvise
information spaces	closed, static	open, dynamic
breakdowns	errors to be avoided	opportunities for innovation and learning

Comparison of Information Access (“Pull”) and Delivery Approaches (“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)

Theories / Conceptual Frameworks Relevant to KM

♣ Informed Participation

♣ Seeding, Evolutionary Growth, Reseeding Model

♣ Meta-Design

♣ Open Source and Open Systems

Beyond Access: Informed Participation

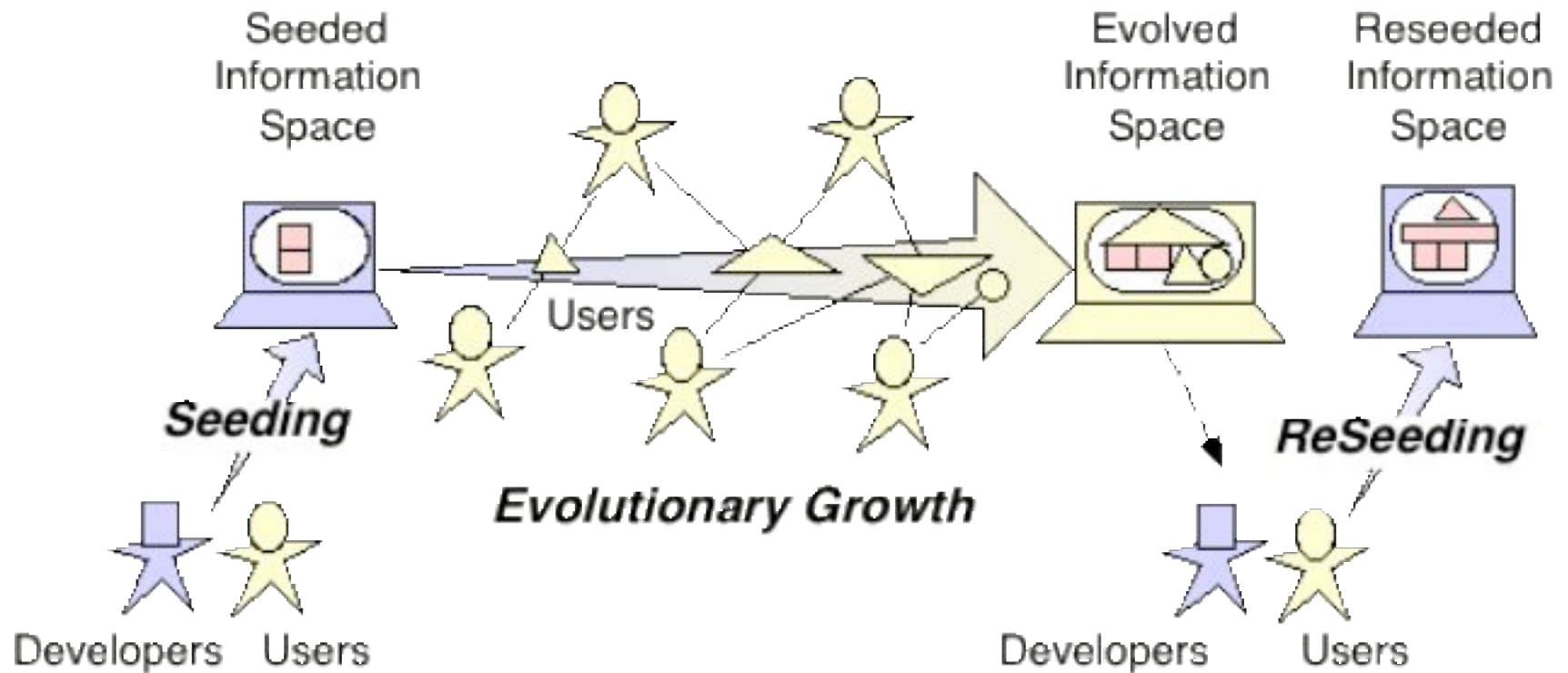
- ♣ **informed participation:** focuses not on knowledge as information stored in repositories, but rather on a continual process in which knowledge is
 - **created** as a by-product of work
 - **integrated** in an open and evolving repository
 - **disseminated** to others in the organization when it is relevant to their work

- ♣ requires users who act as **active contributors and designers**, not passive consumers
 - **art:** looking ◇ interactive art
 - **courses:** passive listening ◇ collaborative knowledge construction

♣ **more information:**

Gerhard Fischer: “Beyond 'Couch Potatoes': From Consumers to Designers and Active Contributors”, First Monday, volume 7, number 12 (December 2002),
[\[http://firstmonday.org/issues/issue7_12/fischer/index.html\]](http://firstmonday.org/issues/issue7_12/fischer/index.html)

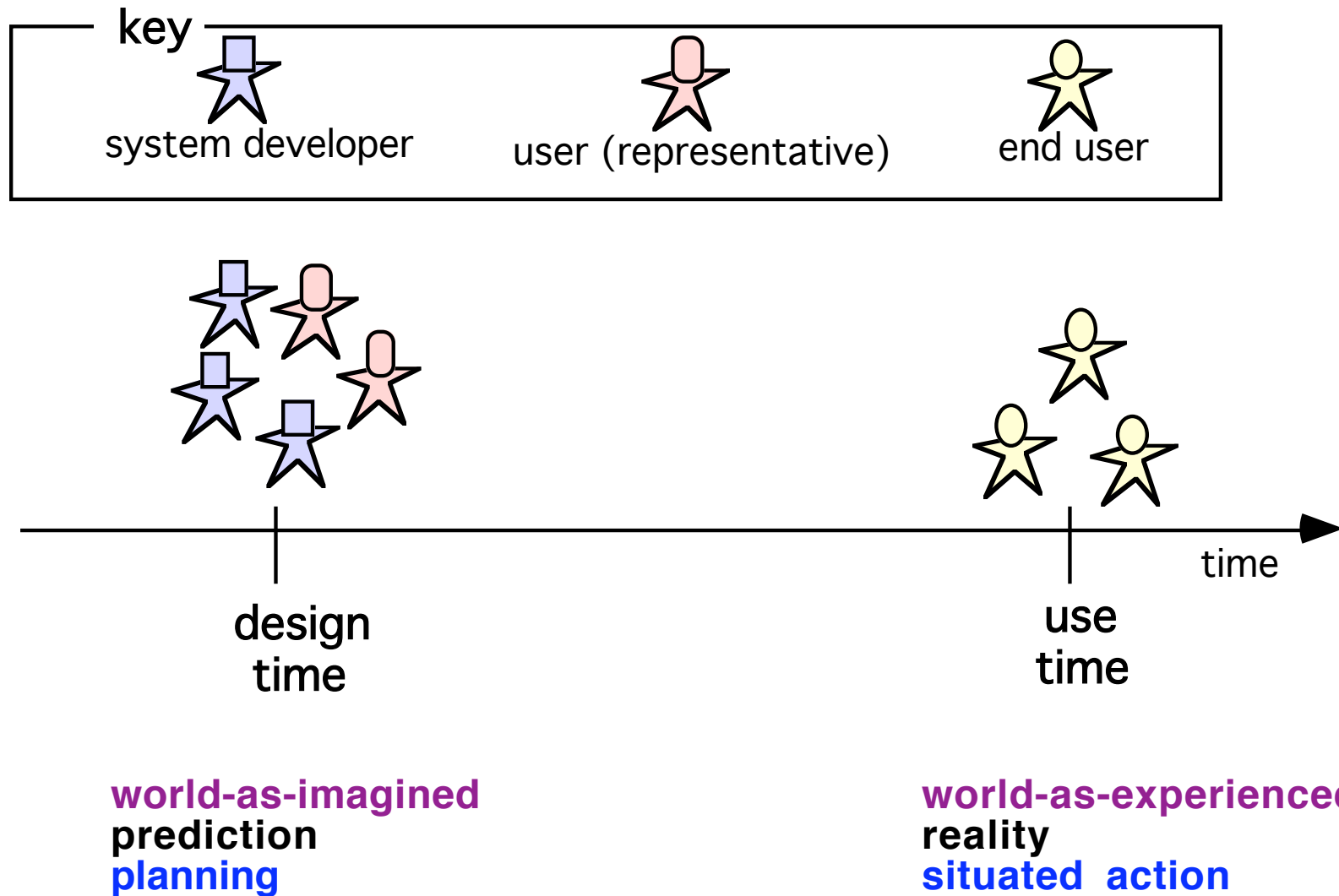
The Seeding, Evolutionary Growth, and Reseeding (SER) Process Model



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



Open Source and Open Systems

♣ an intellectual paradigm requiring a new mindset

- open source: collaborative development of software
- objective: leverage is gained by engaging the whole world as a talent pool
- from users/consumers \diamond co-designers/active contributors

♣ some characteristics:

- evolutionary design of complex systems
- success stories so far: technically sophisticated developers **not end-users**

Social Capital and Gift Cultures

- ♣ the incentive to be a good colleague, to contribute and receive knowledge as a member of a community
- ♣ **hacker milieu (and academia) as gift culture:** human beings have an innate drive to compete for social status
 - in gift cultures, social status is determined not by what you control but by *what you give away*
 - prestige is a good way (and in a pure gift economy, the *only* way) to attract attention and cooperation from others
 - *“utilization is the sincerest form of flattery”*

♣ more information:

Fischer, G., Scharff, E., & Ye, Y. (2004) "Fostering Social Creativity by Increasing Social Capital." In M. Huysman, & V. Wulf (Eds.), *Social Capital and Information Technology*, MIT Press, Cambridge, MA, pp. 355-399. [<http://www.cs.colorado.edu/~gerhard/papers/social-capital-2002.pdf>]

Systems Exploring and Supporting the Different Conceptual Frameworks

♣ Domain-Oriented Design Environments

♣ Group Memory Systems / Living Organizational Memories

♣ Envisionment and Discovery Collaboratory

♣ Software Reuse as a KM Problem

A Domain-Oriented Design Environment for Computer Network Design

The screenshot displays the Netscape browser window titled "Netscape: NetDE -- College of Engineering, University of Colorado". The main content area shows the "NetDE" logo and a navigation menu with options like "Back", "Forward", "Home", "Reload", "Images", "Open", and "Print". Below the navigation is a "Catalog" sidebar (labeled (5)) listing various network diagrams such as "Ot8-7", "Cr1-1", "Ot6-9", and "Ae5-3".

The central workspace is titled "Worksheet: Publications -- OT 8-6" and shows a network diagram with several computer icons connected by red lines. A "Printer" icon is also present. A "Design" section at the bottom left contains a "Group Memory" list with checkboxes for "Meeting Notes", "Priorities", "Machinery", "Miscellaneous", and "All email". A "Launch Construction Component" button is visible at the bottom of the design area.

A configuration dialog box titled "Priorities to be used for devices in this area" is overlaid on the right side (labeled (4)). It contains three priority settings:

- 1st priority: **Cost** (weight: 10)
- 2nd priority: **Expandability** (weight: 8)
- 3rd priority: **Reliability** (weight: 6)

 The dialog has "OK" and "Cancel" buttons.

On the far right, a vertical sidebar (labeled (2)) lists network components: "Wire", "Mac", "Sun", "Server", "Printer", and "Local-Area".

Group Memory Systems / Living Organizational Memories

♣ Group Memory Systems

- supports awareness of the activities of group members
- finds answers to repeatedly posed questions
- focuses on reusing knowledge which is already there and applied knowledge mining and intelligent classification
- uncovered the concept of *media-competition*

♣ Dynasite / LivingOM

- explores alternatives to “put all the knowledge in at the beginning versus provide an empty framework” ◇ [SER model](#)
- supports informed participation
- creates linkages between different information repositories (e.g.: glossaries and publication analysis and documentation environments)
- provides a small-scale model for the “*Semantic Web*”

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**
- ♣ **support for:**
 - CoPs and Cols
 - reflection-in-action
- ♣ **specific major application:** urban planning ◇ build an end-user modifiable version of Simcity (**meta-design approach**)

The Envisionment and Discovery Collaboratory

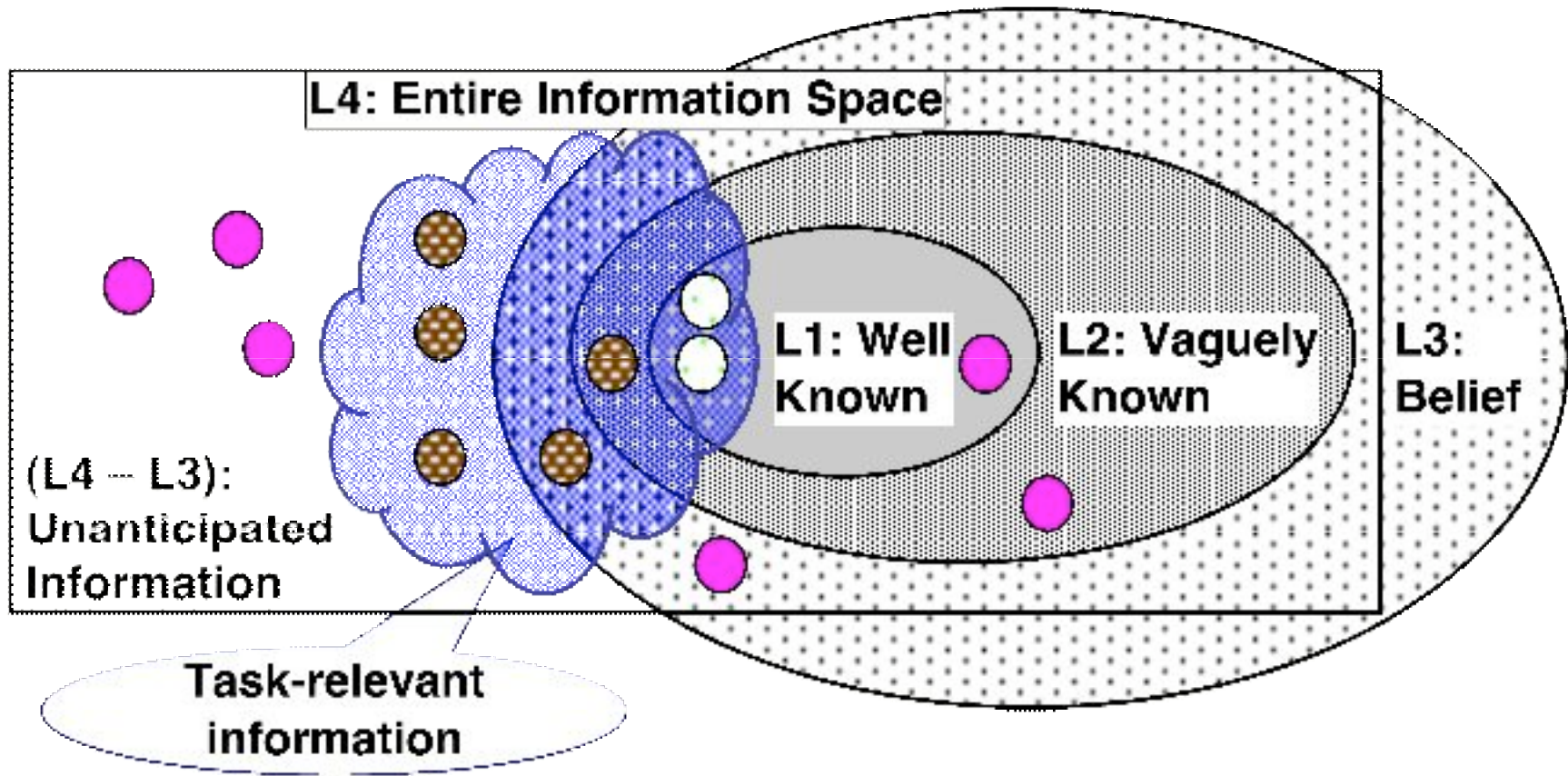


CodeBroker – Personalizing Delivered Information in a Software Reuse Environment

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**

KM Challenges in Large Software Reuse Repositories



Some Knowledge Management **Myths**

- ♣ **myth-1: knowledge is a commodity** ◇ “we can simply ‘capture’ the knowledge of a thirty-year expert in explicit form so we can fire the expert and hire someone with no relevant skills off the street who can now use the ‘knowledge base’ to perform like an expert”
 - ◇ **collaborative knowledge construction**
- ♣ **myth-2: self-organizing evolution** ◇ “informed participation leads to evolutionary growth and large information repositories which will be self-organizing”
 - ◇ **reseeding**
- ♣ **myth-3: information is a scarce resource** ◇ “access to information anytime and anywhere will solve a key KM problem”
 - ◇ **say the ‘right’ thing at the ‘right’ time in the ‘right’ way**

Realities based on Assessment Studies

- ♣ **KM: new technology is necessary, but not sufficient** ◇ change of work practices, mindsets and reward structures is necessary
 - design rationale research
 - reuse versus “not invented here”
 - media competition

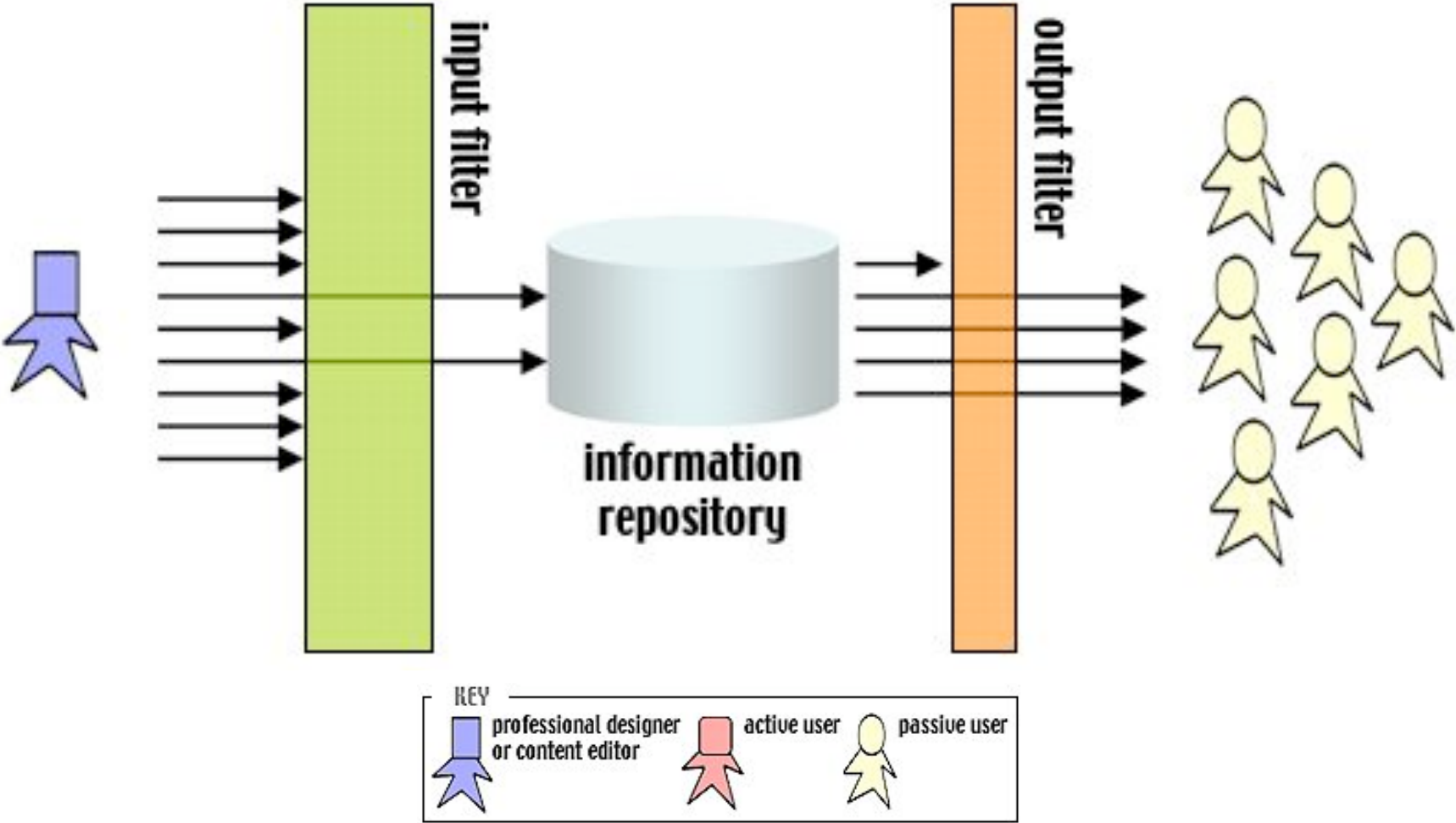
- ♣ **motivation for a group is different than for an individual**
 - “who is the beneficiary and who has to do the work?”
 - *utility = value / effort*

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

Experiences from Industry

- ♣ **Xerox** — Eureka: a widely studied and documented success story in KM
(Bobrow, D. G., & Whalen, J. (2002) "Community Knowledge Sharing in Practice: The Eureka Story," *Journal of the Society for Organizational Learning*, 4(2))
- ♣ **DaimlerChrysler Research, Ulm** — Experience Factory
- ♣ **Nynex, White Plains** — Gimme, Knowledge Depot (group memories)
- ♣ **IBM, Global Services, Boulder** — 1200 Help Desk People

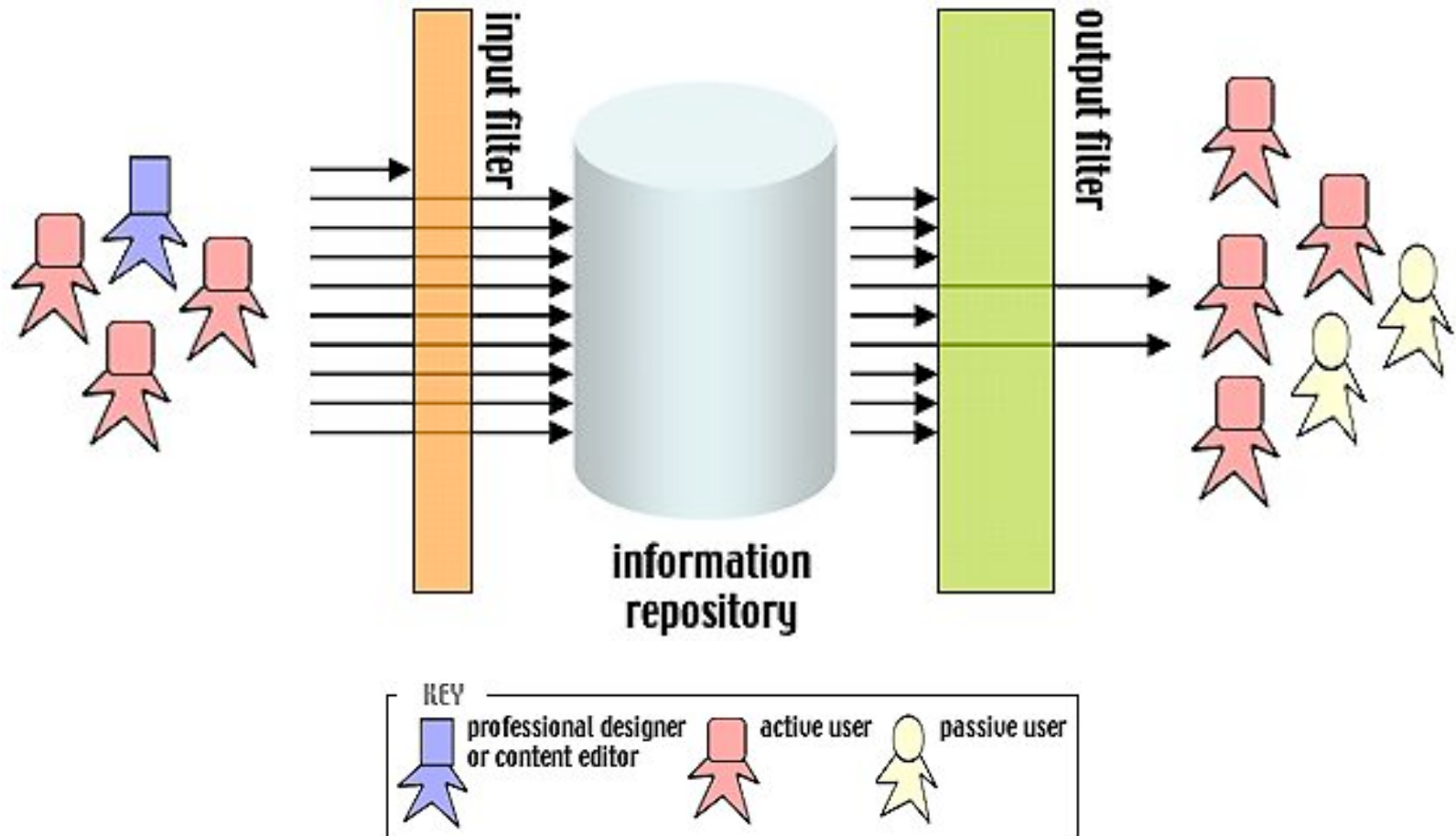
Producer/Consumer Models in a **Consumer Culture** (“Access”): Strong Input Filters, Small Information Repositories, Weak Output Filters



Limitation: Making All Voices Heard

Design Culture (“Informed Participation”):

Weak Input Filters, Large Information Repositories, Strong Output Filters



Limitation: Trust and Reliability of Information

Conclusion: Fundamental Challenges for KM

♣ **the basic message:** remembering lessons from the past and archiving information is **necessary, but not sufficient**, because the information needs (specifically in design) of the future will **not be the same** as they were in the past

♣ the challenge for the future: understanding KM as a **socio-technical problem** requiring the **co-evolution** of

- new technologies
- new mindsets
- new organizations
- new cultures

Some Publications Relevant to Knowledge Management

for a complete list including pdf files to be downloaded:

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

- ♣ Fischer, G., & Ostwald, J. (2001) "Knowledge Management — Problems, Promises, Realities, and Challenges," *IEEE Intelligent Systems*, January/February 2001, pp. 60-72.
- ♣ Fischer, G., Grudin, J., McCall, R., Ostwald, J., Redmiles, D., Reeves, B., & Shipman, F. (2001) "Seeding, Evolutionary Growth and Reseeding: The Incremental Development of Collaborative Design Environments." In G. M. Olson, T. W. Malone, & J. B. Smith (Eds.), *Coordination Theory and Collaboration Technology*, Lawrence Erlbaum Associates, Mahwah, NJ, pp. 447-472.
- ♣ 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.
- ♣ Fischer, G. (2002) *Beyond 'Couch Potatoes': From Consumers to Designers and Active Contributors*, in *FirstMonday (Peer-Reviewed Journal on the Internet)*, Available at http://firstmonday.org/issues/issue7_12/fischer/.

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- ♣ Fischer, G., Scharff, E., & Ye, Y. (2004) "Fostering Social Creativity by Increasing Social Capital." In M. Huysman, & V. Wulf (Eds.), *Social Capital and Information Technology*, MIT Press, Cambridge, MA, pp. 355-399.
- ♣ 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.
- ♣ 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 — Empowering people to flexibly employ advanced information and communication technology*, Kluwer Academic Publishers, Dordrecht, The Netherlands, p. (in press).