



# Structure and Function of Cross-Disciplinary Collaboration and the Flow of Information

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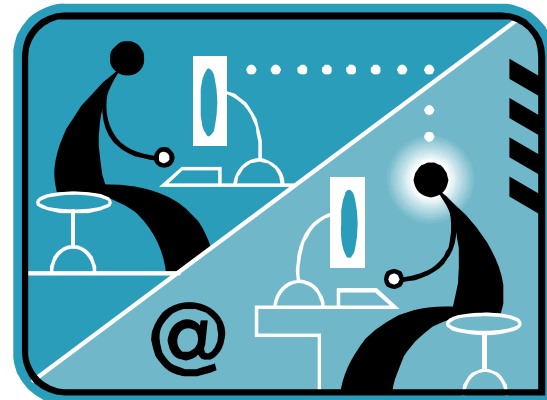
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University of New Mexico

East Asian Pacific ILTER Symposium  
Seoul, South Korea  
October 15, 2007

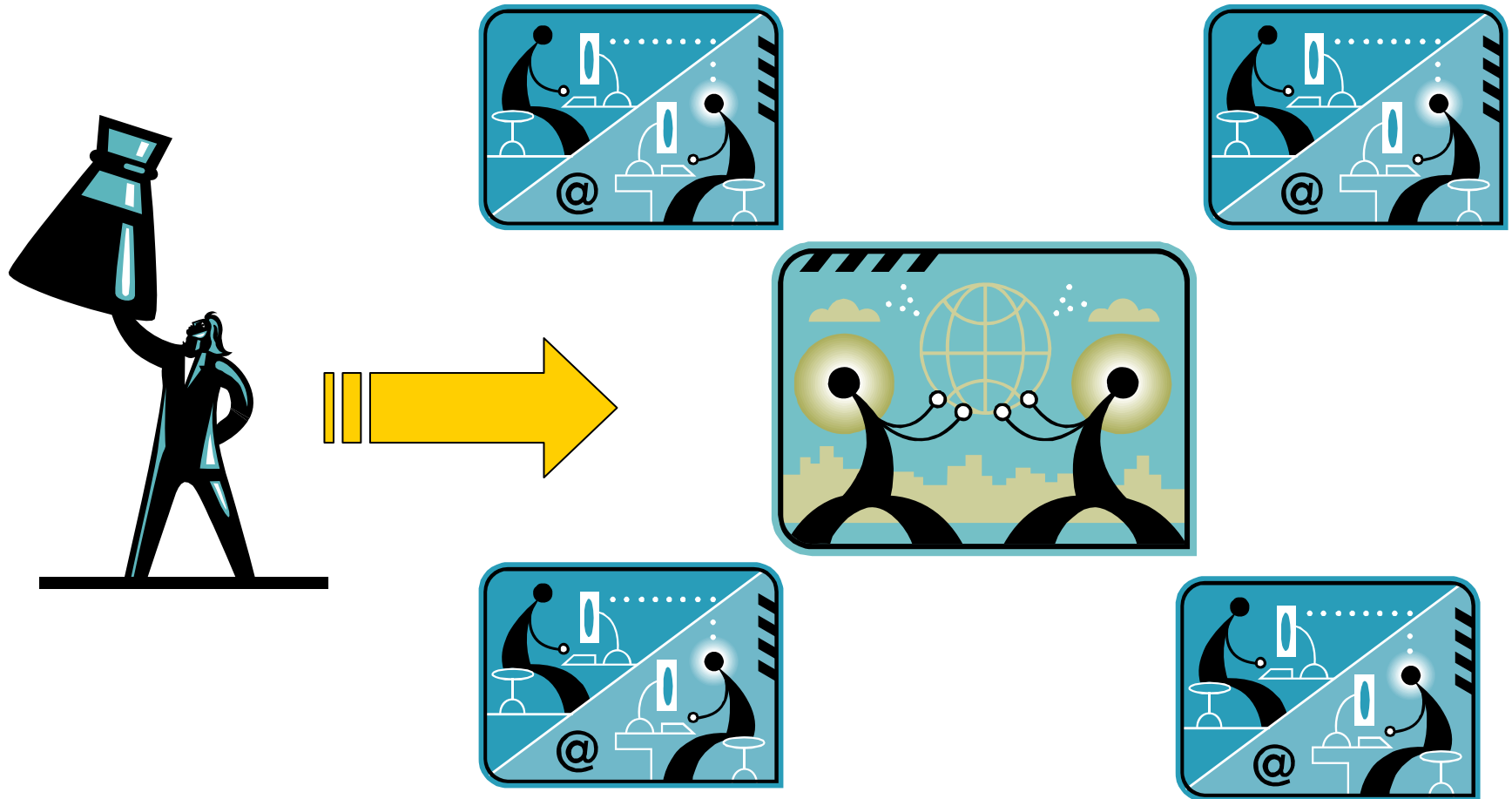
# Global Environmental Problems

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- Climate change impacts
  - Desertification
  - Biodiversity loss
  - Water issues
  - Invasive species
  - Animal-borne disease

New approaches to *computer supported collaborative work* are believed to hold the answer to innovation in the global science arena



The problem: how to transform scientists from the discipline-focused individual researchers into computationally-savvy interdisciplinary teams



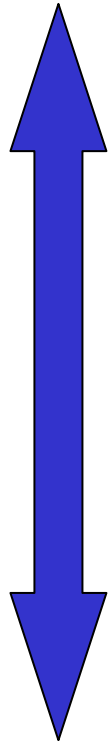


# Problem-Solving Teams

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Cross-disciplinary:

- Ecologists, hydrologists, geoscientists, climatologists, soil scientists
- Social scientists, economists, population scientists
- Information managers, information scientists
- Computer scientists and engineers



Disciplinary  
Disparity

# Collaboration: Problem/Task Focused

Distributed cognition: Edward Hutchins (1995)  
“Cognition in the Wild”  
Anthropologic navigation example



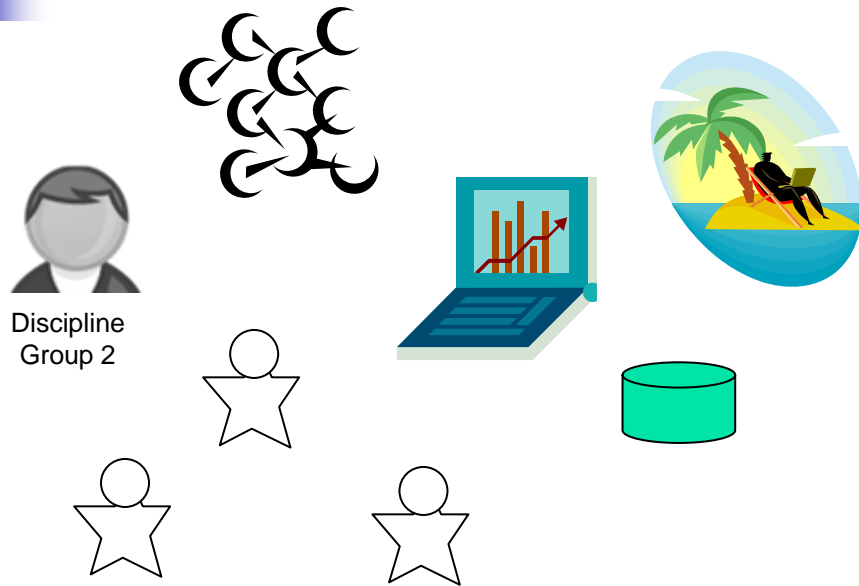
Philosophies of team design: Kuldeep Kumar (2007)  
“Organizing & Managing  
Large-Scale, Globally Distributed, Collaborative, e-  
Science:

*Contributions from Management Theory”*

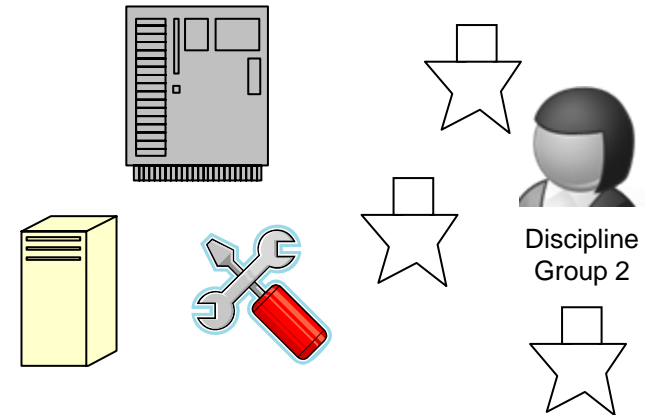
1. The Battleship Model: Design and Execute
2. The Raft Model: No conscious design –  
“muddle through”
3. The Sailboat Model: Emergent design
4. The Flotilla: Inter-organizational collaboration



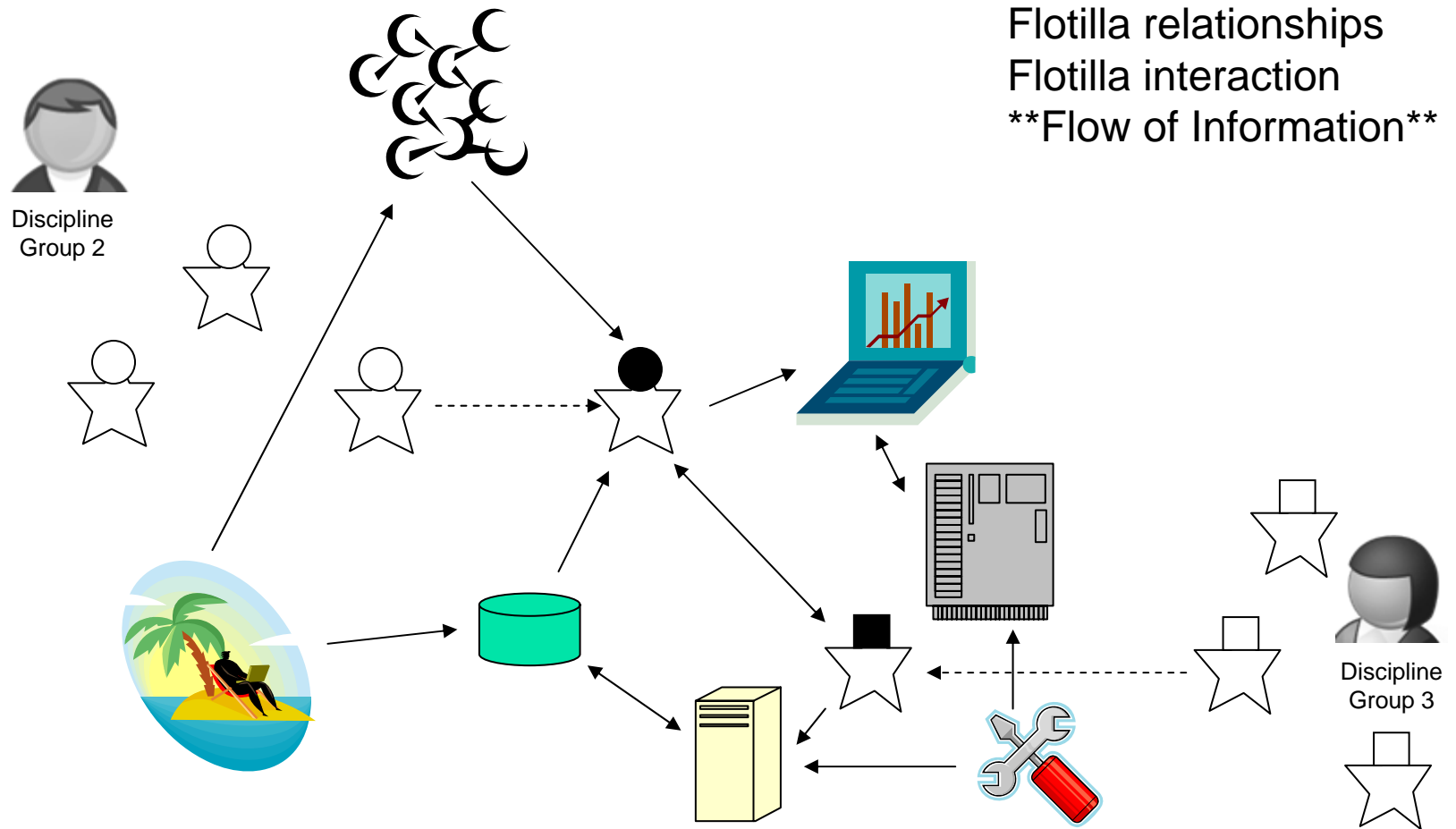
# Knowledge Ecosystem



Ecosystem Structure (easier):  
Components of the flotilla  
Arrangement



# Knowledge Ecosystem



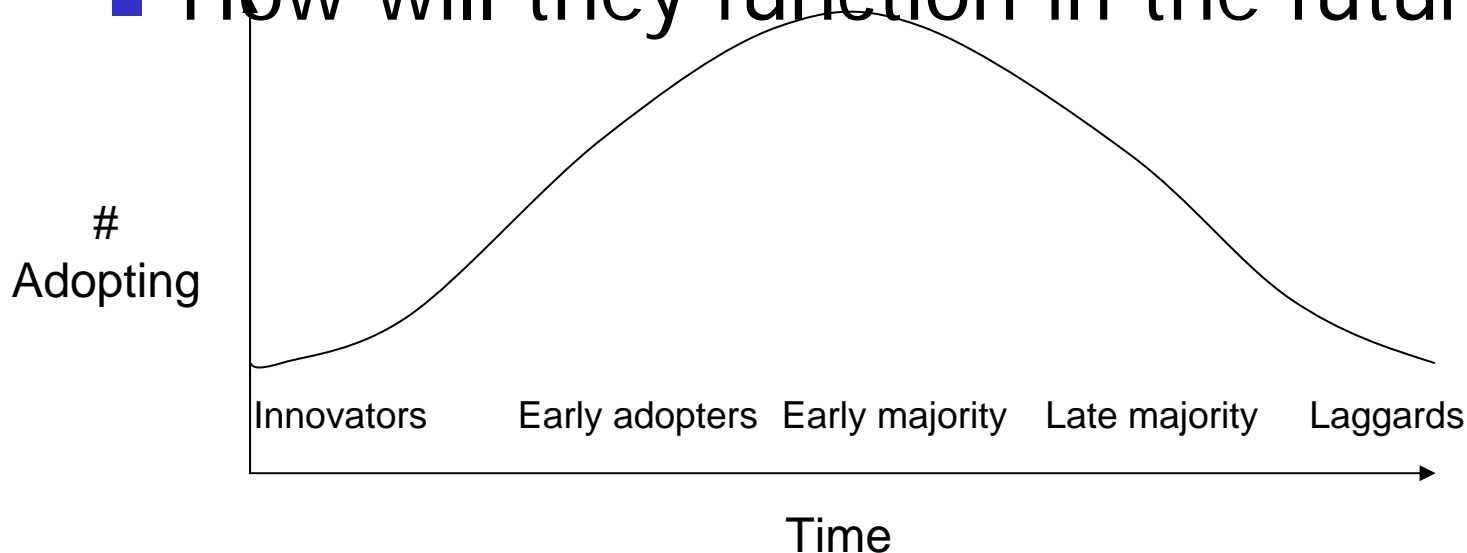




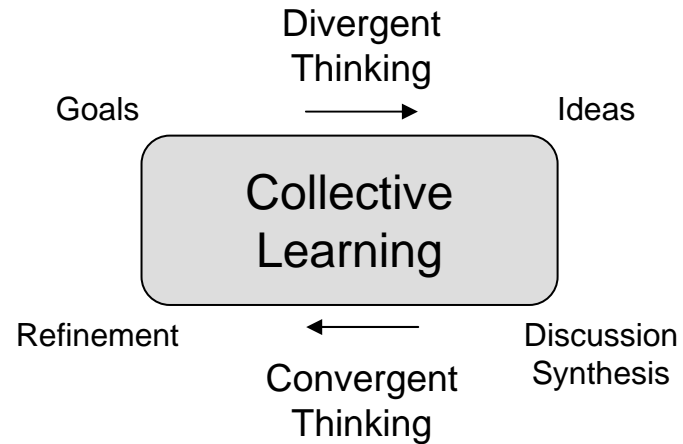
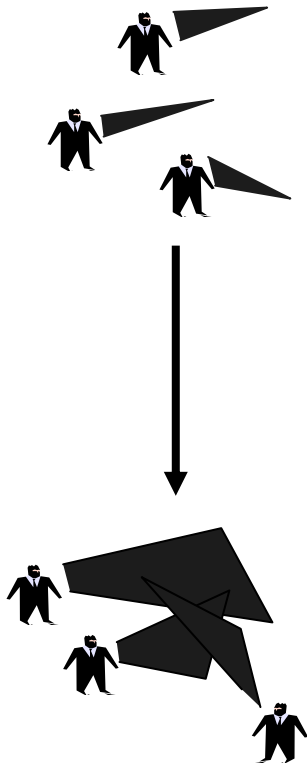
# Three Questions of Interest

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- How do knowledge ecosystems function now?
- How do they function during innovation?
- How will they function in the future?



# Problem Definition



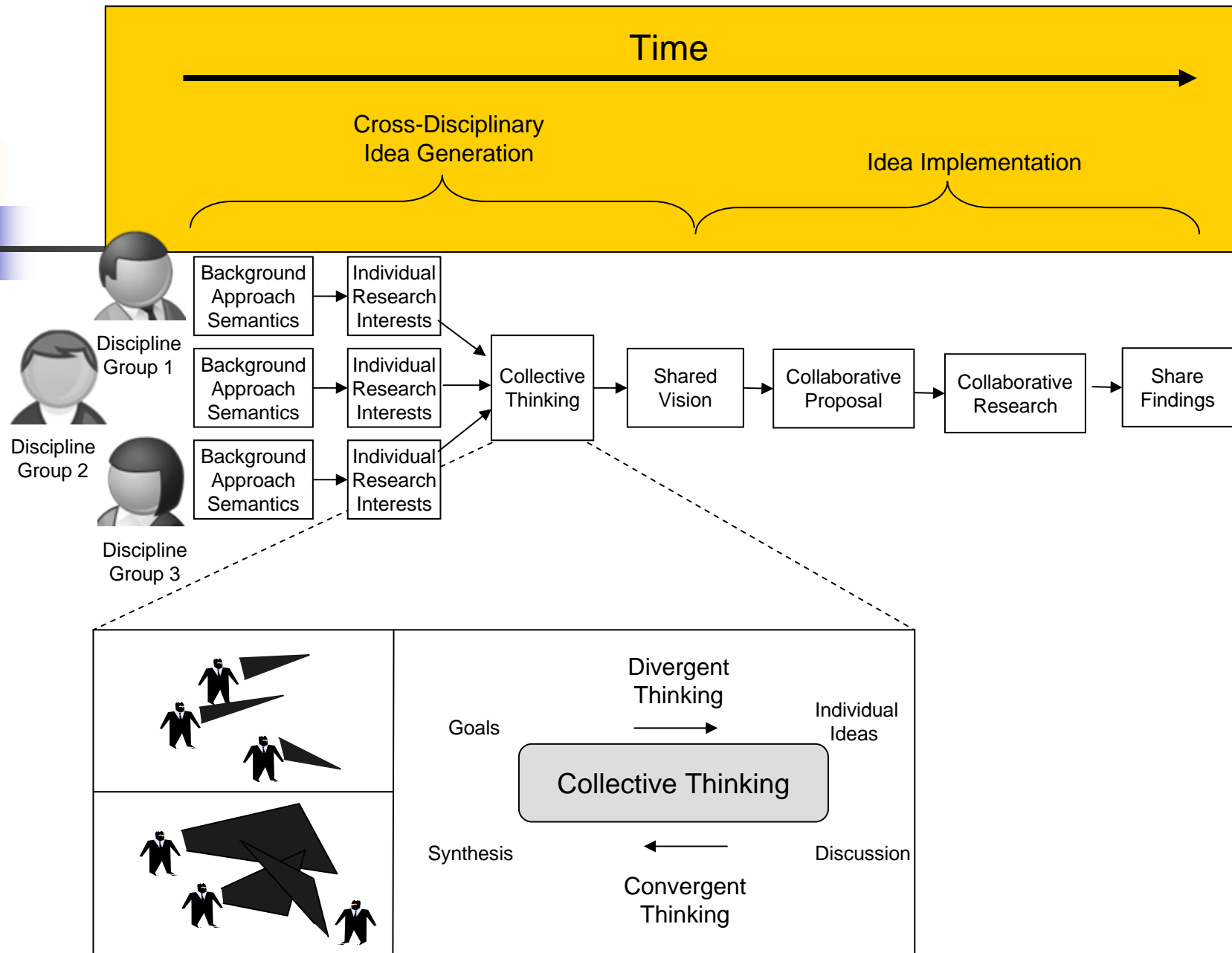
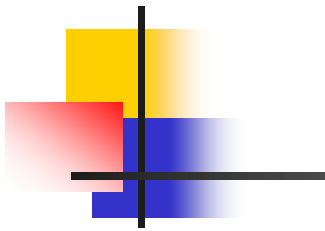


# Divergent Thinking & Collective Creativity

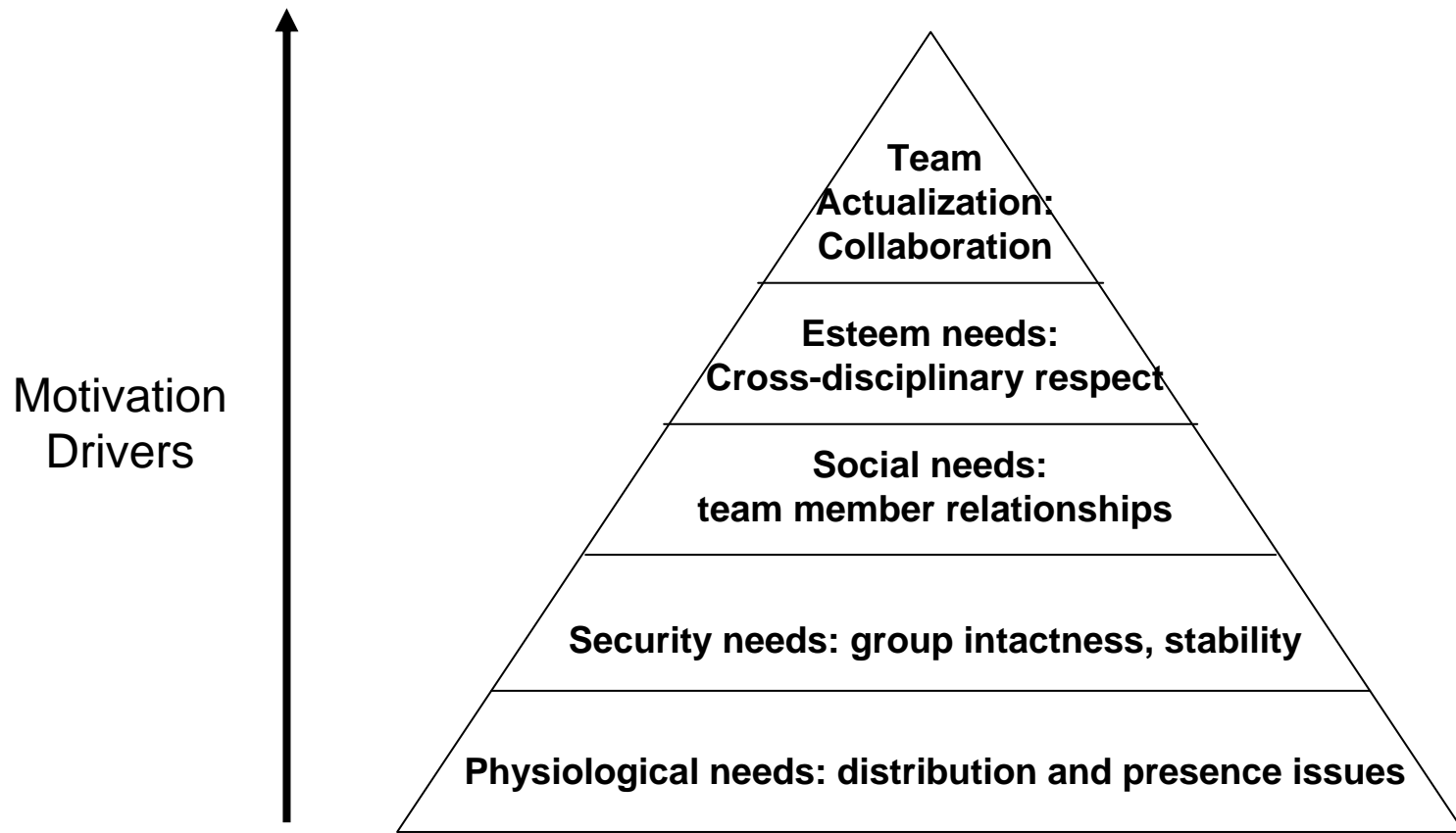
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Rules of engagement:

- Uninhibited exchange of ideas (power relationships)
  - Everyone gets a turn - participatory
  - “I’m thinking out loud here...”
  - Use different communication methods
- Flexible participation
  - Exploratory matching of people and problem
  - Social loafing – only those who contribute
- Strive for goal congruence
  - Shared vision broad enough to encompass all
  - Everyone knows their part
- Do not converge on a solution too soon!



# Maslow's Hierarchy of Needs



# Team Development Model

## Tuckman 1965

### Stage (Repeating often)

Tasks

Member behavior

Management Needs

#### ■ **Forming**

Learn about opportunities  
Agree on goals  
Begin tasks

Independent  
Motivated

Directive

#### ■ **Storming**

Competing ideas  
Issue identification  
Team functioning

Conflicting  
Motivation loss

Directive  
Enforcing tolerance

#### ■ **Norming**

Agreeing  
Trust building

Adjustment  
Motivation increase  
Creativity loss (groupthink)

Facilitative  
Participative

#### ■ **Performing**

High-performance  
Get the job done

Function as unit  
Interdependent  
"Appropriate" dissent ok

Participative

#### ■ **Transforming**

Synergy identification

Major changes in performance

Transformational





# Factors affecting team member effectiveness (Lefasto 2001)

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- Working knowledge
  - Experience
  - Problem-solving ability
- Teamwork capability
  - Openness
  - Supportiveness
  - Action orientation
  - Personal style



# Science of Collaboratories Project

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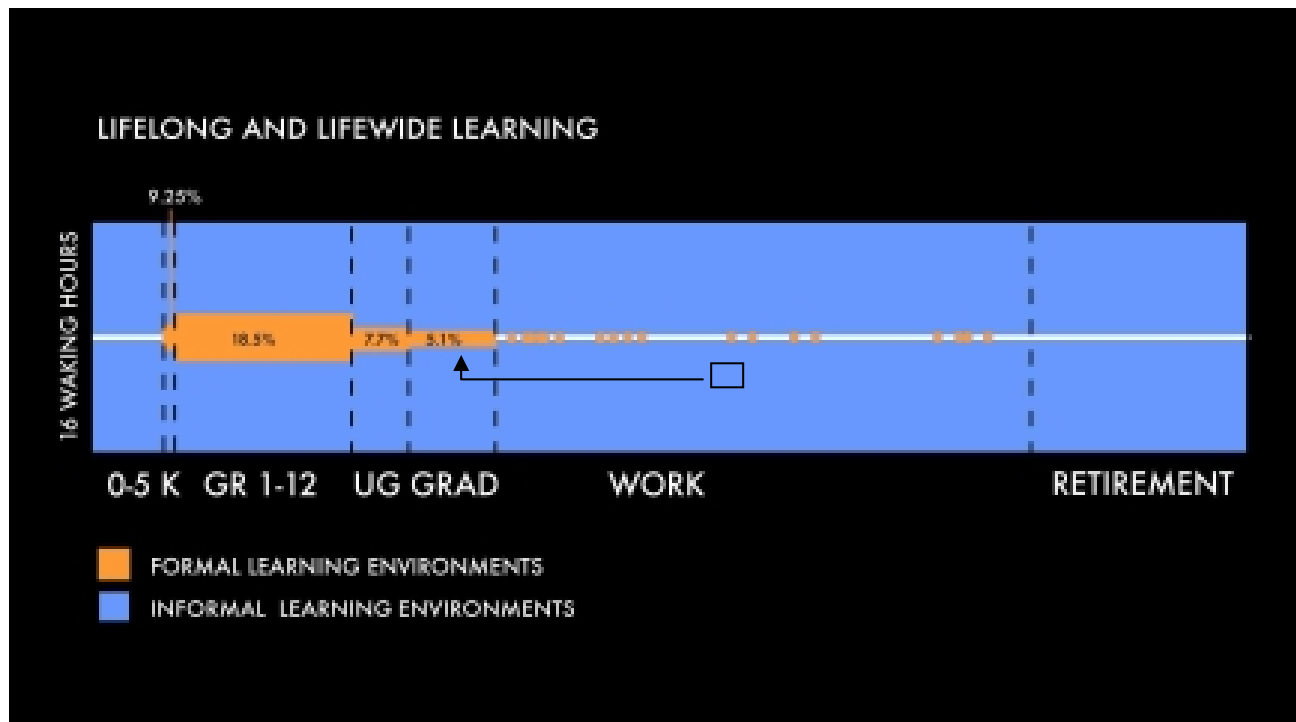
An alliance to advance understanding of collaborative research

- Factors that lead to success
  - Nature of the work – independent vs dependent, **work ambiguity**
  - Common ground - previous interaction, **common vocabulary**, common working style
  - Collaboration readiness – **goal alignment**, motivation, trust
  - Management, planning, & decision making – leadership style, time commitment, communication plan
  - Technology readiness – functional, easy to use, reliable, with tech support

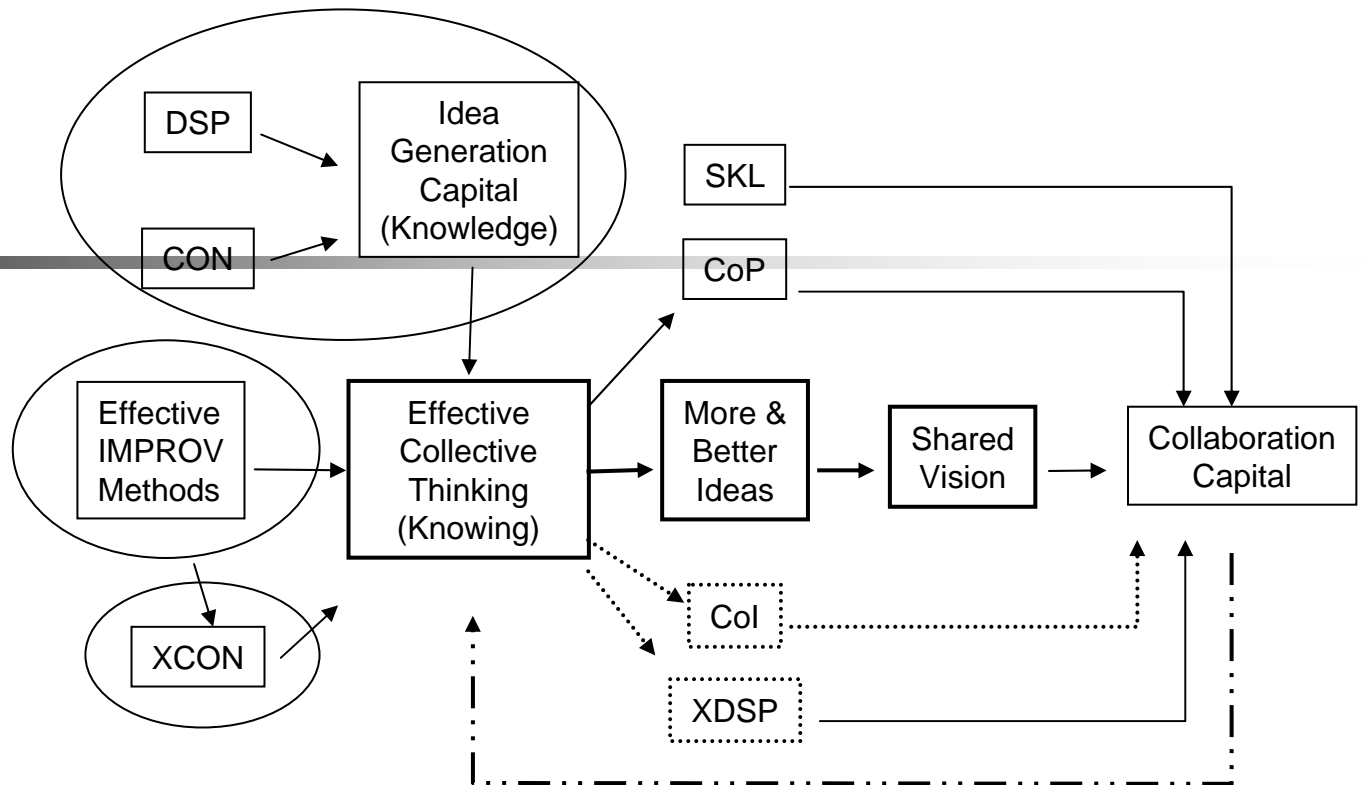


# Collective Learning

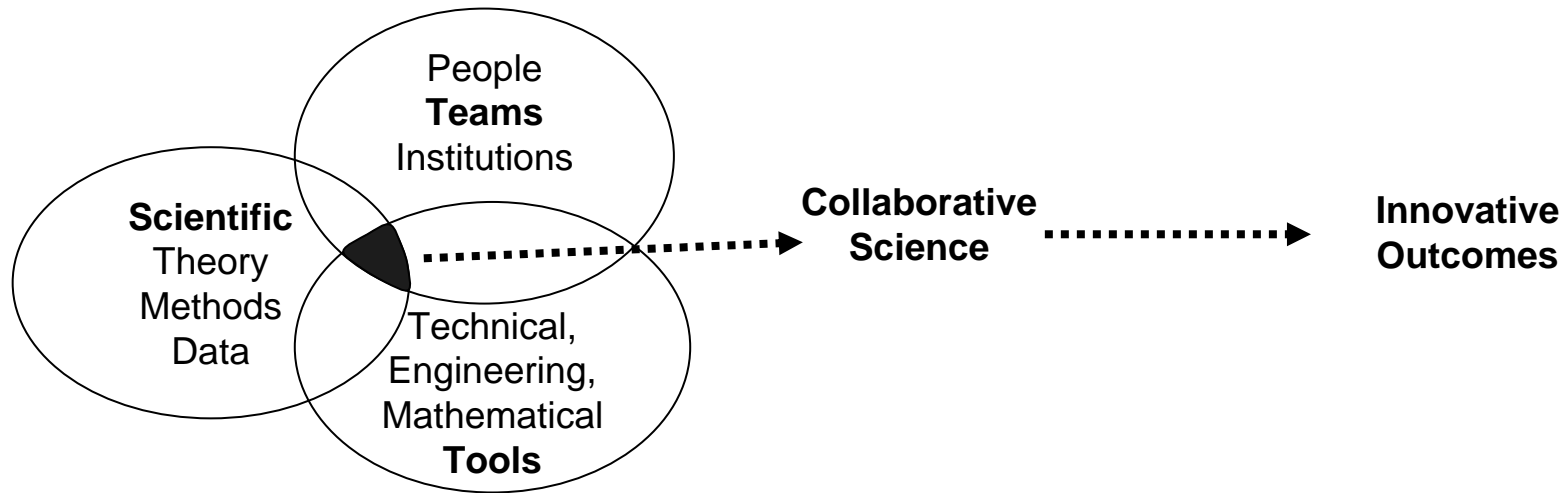
## Lifelong and Lifewide Learning



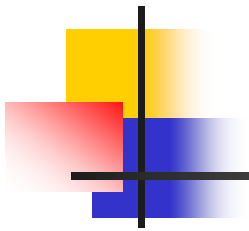
## A model of the flow of knowledge in cross-disciplinary collaboration (Pennington, in prep)



# People are as important as science and tools



Invest as much time, energy resources in team development as in science and tool development  
⇒ creates knowledge ecosystem function and flow out of components and structure



Questions?