The New ABCs of Research

Ben Shneiderman `ben@cs.umd.edu` **@benbendc**

Distinguished University Professor,
Dept of Computer Science
Founding Director (1983-2000),
Human-Computer Interaction Lab

Member, Institute for Advanced Computer Studies

Photo: BK Adams

UNIVERSITY OF MARYLAND

Tools for Governance in Cyber Social Systems:

Community Formation/Management,
Deliberation,

Conflict Resolution

Ben Shneiderman, August 28, 2016
University of Maryland

NSF CRA CCC Workshop: Cyber Social Systems

CSS Framing Document

- Transform all major sectors of our society:
  - Healthcare delivery, education, community services, transportation,
  - Justice, civil rights, environment,
  - Homeland & international security, bio-security,
  - Business & commerce

- Novel syntheses of computer & information science & engineering with human & social sciences:
  - Human cognition and communication; collaboration & teamwork; mechanism design, including social reward & recognition;
  - Ethics; behavioral, social, and organizational design; behavior change; social psychology; practice culture; implementation science; complexity & network science;
  - Online community design; motivation & persuasion; behavioral economics; sociology; political science; humanistic thinking; ethnographic methods

Cyber-Social System Participants
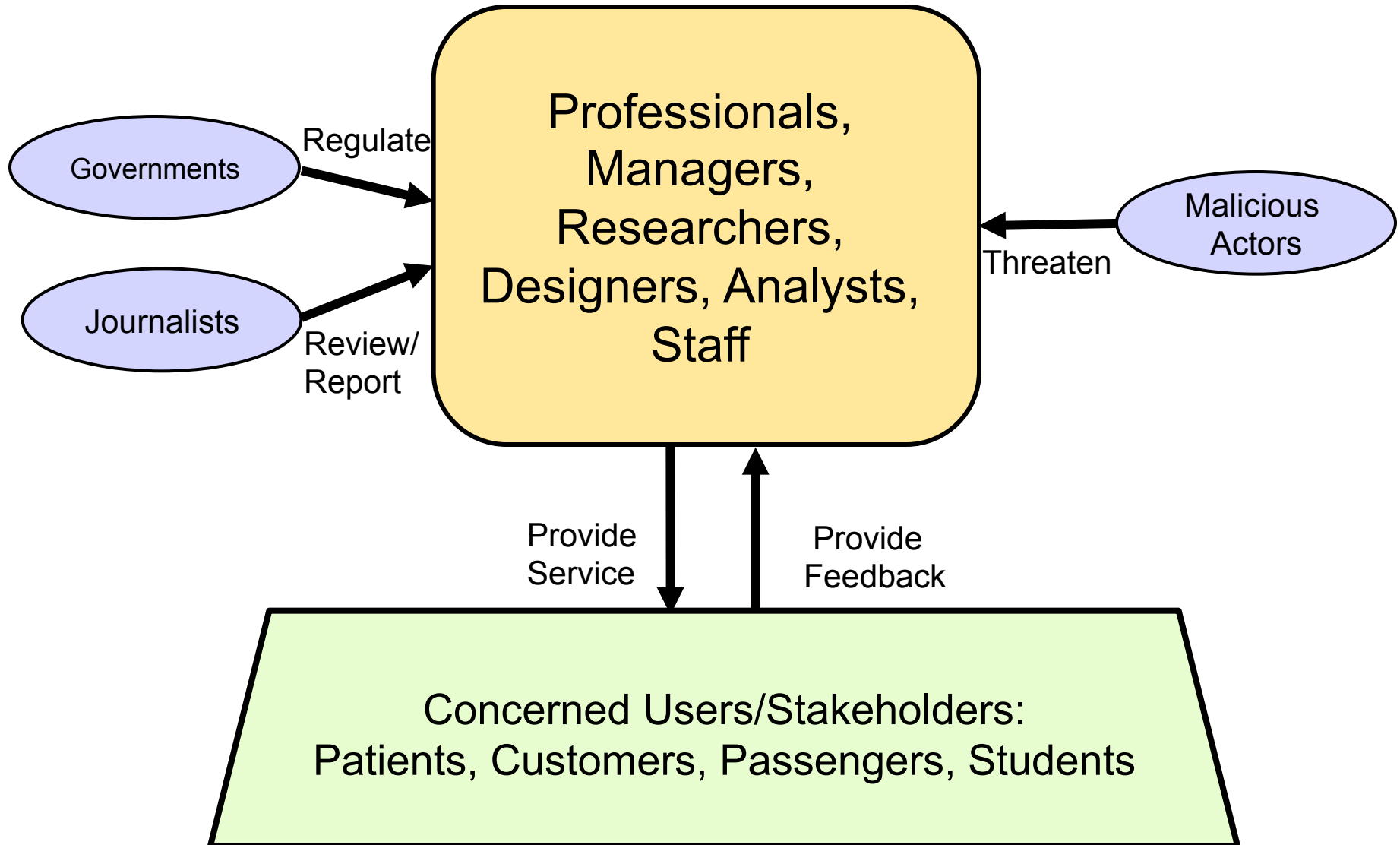
Cyber-Social System Activities
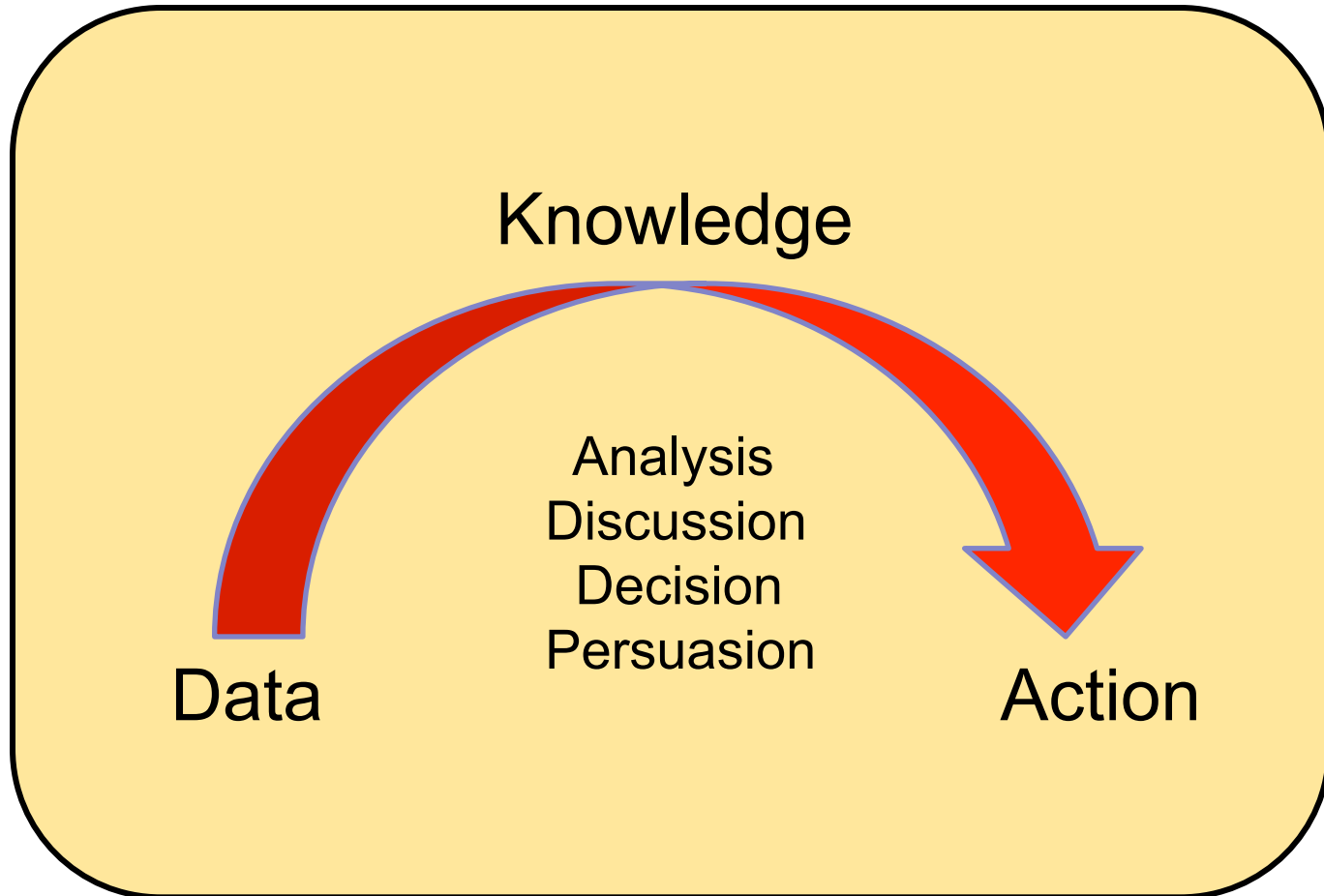
Knowledge

Data

Analysis
Discussion
Decision
Persuasion

Action

Example CSS

Great successes

- Air Traffic Control System
- American College of Cardiologists
- World Wide Web: W3C, ICANN, etc.
- Linux/Apache, Mozilla, R, etc.
- Wikipedia

Example CSS

Great successes
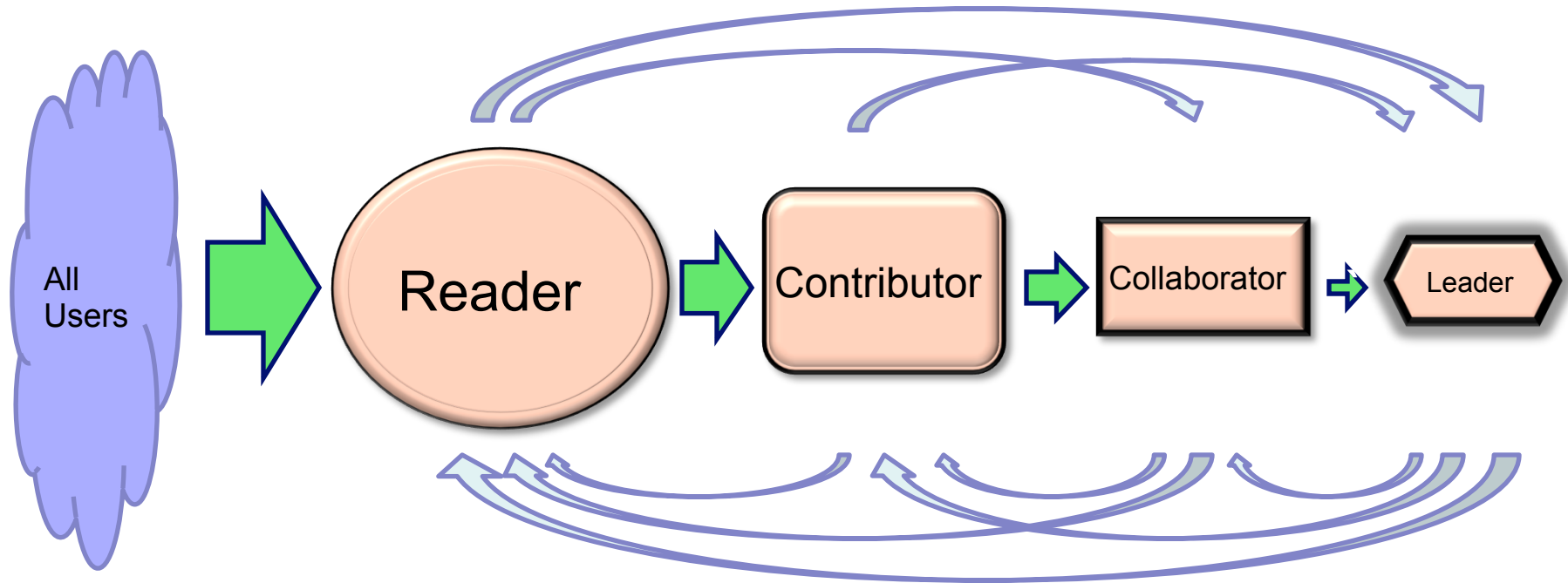
- Air Traffic Control System

- American College of Cardiologists

- World Wide Web: W3C, ICANN, etc.

- Linux/Apache, Mozilla, R, etc.

- Wikipedia

BUT 98% failure rate

- NASA's EOSDIS

- NCI's CaBIG

- Open source projects

- Wikis

From Reader to Leader:
Motivating Technology-Mediated Social Participation

All Users → Reader → Contributor → Collaborator → Leader

Governance Tools in CSS

1) Deliberative systems design
2) Large-scale teamwork monitoring systems
3) Collaboration toolkits & remote teamwork
4) Online dispute or conflict resolution tools

1) Deliberative systems design

How to engage large numbers of people in:

- Sharing ideas
- Refining ideas into plans
- Developing consensus
- Obtaining & allocating resources
- Getting commitment to shared goals

2) Large-scale teamwork monitoring systems

- Enabling 1000+ people to work together towards a common goal

- Assigning tasks (Linux-like strategies for posting tasks that members take on)

- Sharing of critical path diagrams to monitor progress

- Evaluating peers & mentoring for improvement

- Bug reporting schemes (e.g. Bugzilla)

- Repairing problems as they emerge
  (github-like posting of issues and closing them)

- Collecting guidelines for future use

MindTools
Essential skills for an excellent career

Toolkit

› **Leadership Skills** (59)

› **Team Management** (270)

› **Strategy Tools** (129)

› **Problem Solving** (40)

› **Decision Making** (49)

› **Project Management** (64)

› **Time Management** (61)

› **Stress Management** (61)

› **Communication Skills** (135)

› **Creativity Tools** (28)

› **Learning Skills** (48)

› **Career Skills** (174)

3) Collaboration toolkits

- Checklists
- Communications tools
- Shared documents, calendars
- Task lists & schedules
- Remote work support

The **Good** Project

Home   Projects   **Toolkits & Curricula**   Courses

teamworkprojects

slack | Team communication for the 21st century.

21 tools that will help your remote team work better together

# 4) Online dispute or conflict resolution tools

- Ebay, PayPal, Amazon, etc.
- Online mediation services
- Modern Delphi methods

Science, Engineering & Design

- Scientific Method
  - Controlled Laboratory Tests
  - Reductionist Thinking
- Engineering Process
  - Iteratively refine prototypes
  - Guided by measurable criteria
  - Modular design, interdependent components
- Design Thinking
  - Challenge the goals/requirements
  - Empathize with users
  - Divergent/Convergent thinking
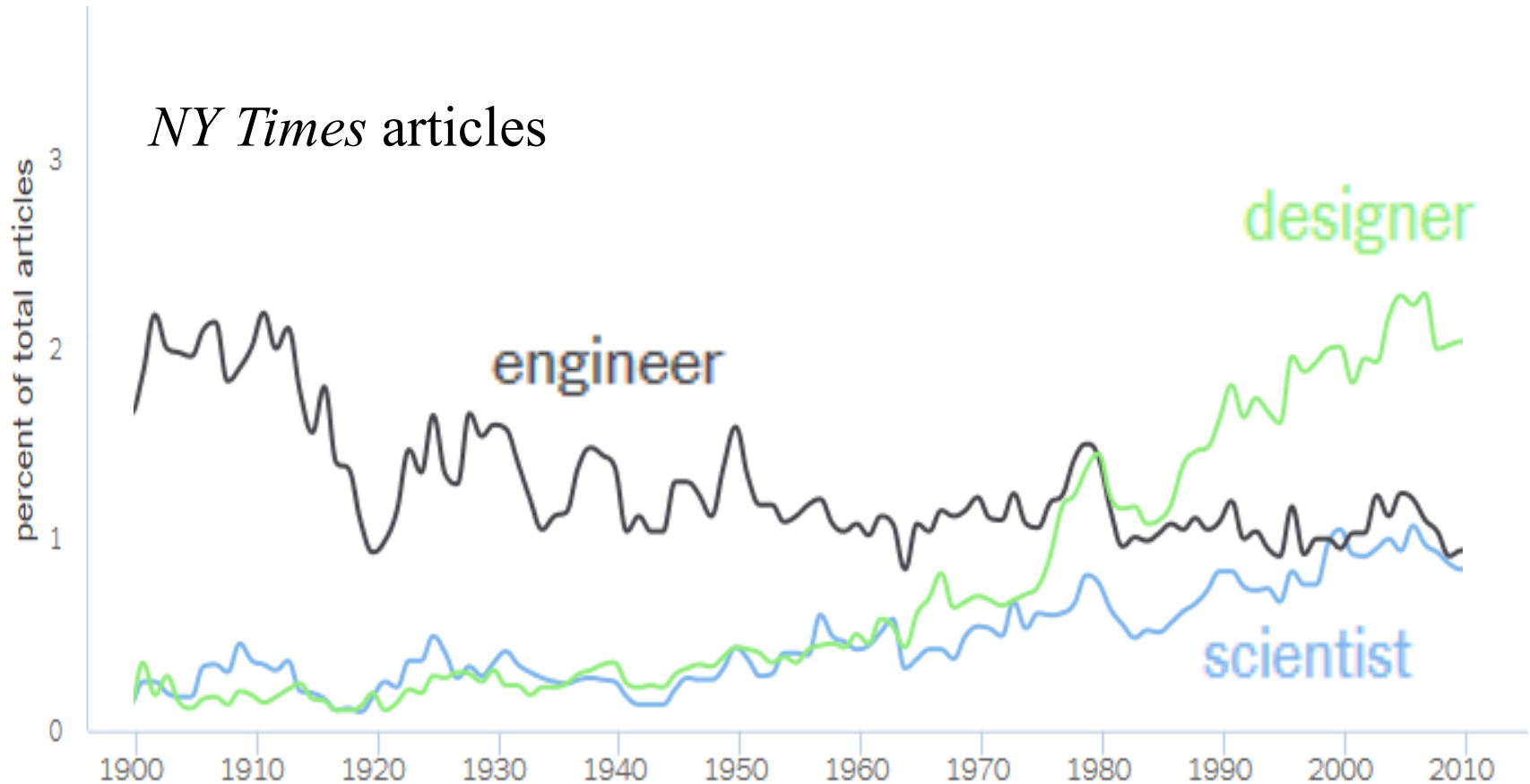 - Celebrate teamwork & diverse viewpoints

Science, Engineering, Design
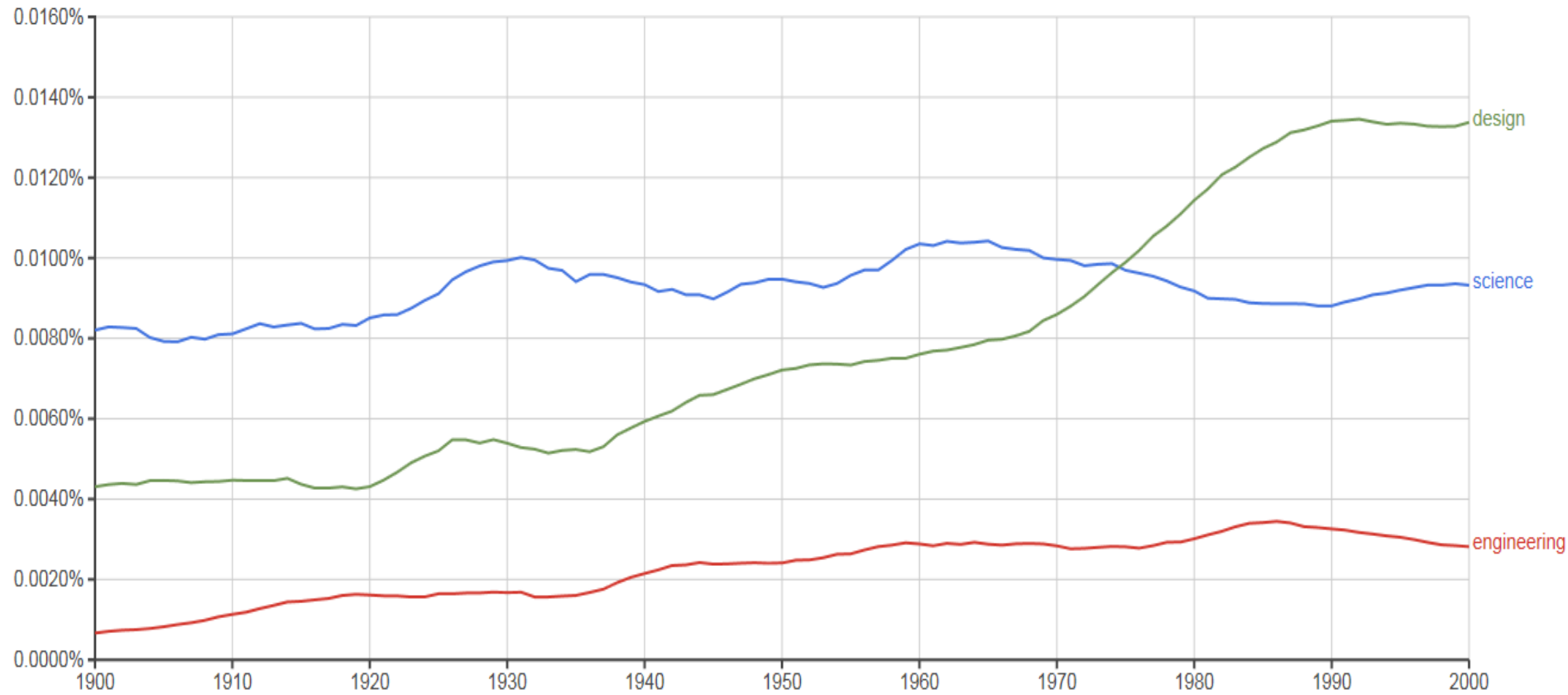
https://books.google.com/ngrams

Scientist, Engineer & Designer

*NY Times* articles

http://chronicle.nytlabs.com/

Applied & Basic Combined

- Teams that follow SED & ABC Principles
  are more likely to produce breakthroughs
- New collaboration technologies
  empower research groups
- Greater ambition
  to take on societal challenges
  - Healthcare delivery
  - Environmental sustainability
  - Energy conservation
  - Community safety
  - Education, Housing, Transportation, …

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www.cs.umd.edu/hcil/newabcs
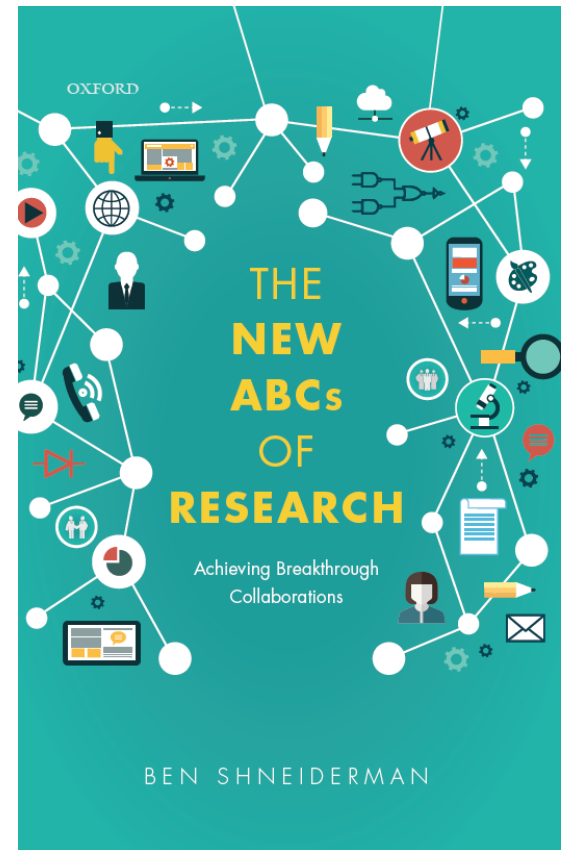
Interdisciplinary research community
- Computer Science & Info Studies
- Psych, Socio, Educ, Jour & MITH

www.cs.umd.edu/hcil
vimeo.com/72440805

Designing the User Interface

- Guidelines & Theories
- Input devices & strategies
  - Keyboards, pointing, voice
  - Direct manipulation
  - Menus, forms, commands
- Output devices & formats
  - Windows, color, sound
  - Text, tables, graphics
  - Instructions, messages, help
- Social Media
- Visualization
- Design
- Search

SHNEIDERMAN • PLAISANT • COHEN • JACOBS • ELMQVIST

SIXTH EDITION

DESIGNING THE USER INTERFACE

STRATEGIES FOR EFFECTIVE
HUMAN-COMPUTER INTERACTION

`http://bit.ly/1T5UGn0`

Sixth Edition: 2016

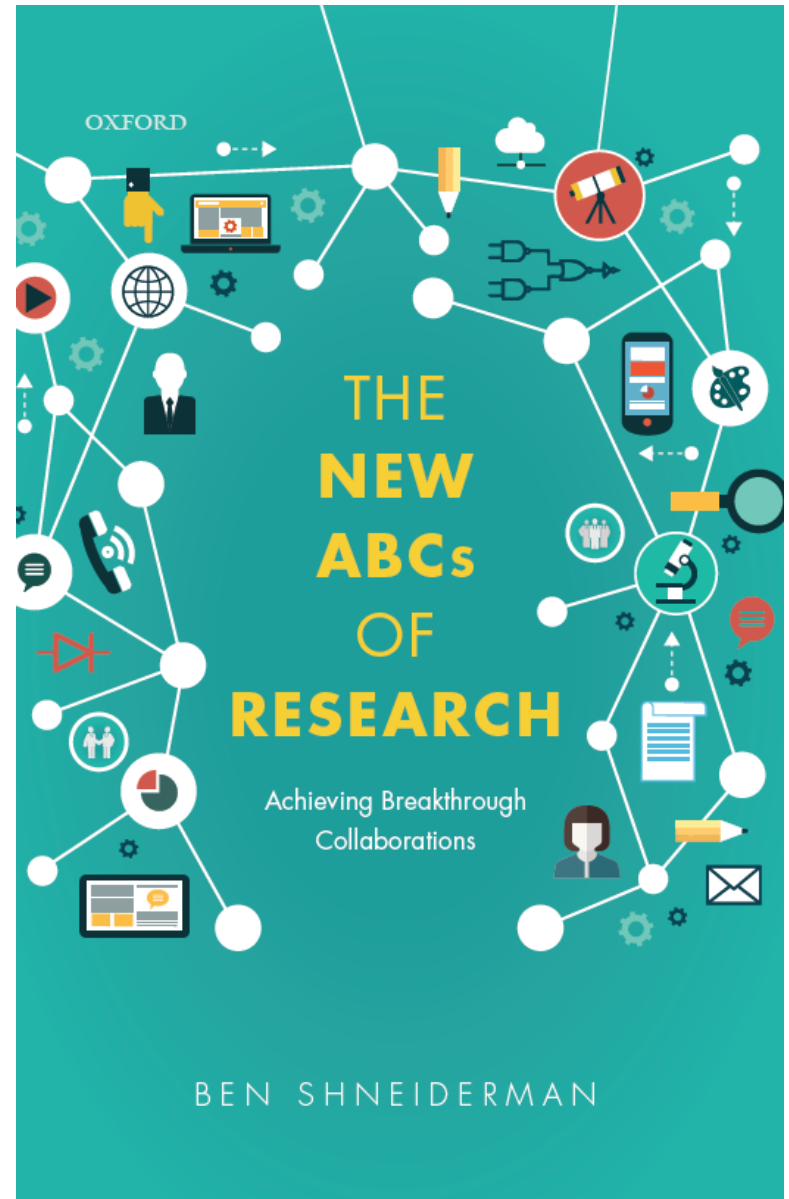# The New ABCs of Research (Oxford, 2016)

Guide for
> Junior researchers

Manifesto for
> Senior researchers
> Academic administrators
> Business leaders
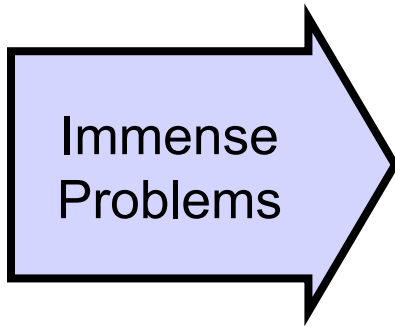> Funding agencies

www.cs.umd.edu/hcil/newabcs

The New ABCs of Research

Context   Guiding   Lifecycle   New
                 Principles   Strategies   Knowledge

Immense
Problems

The New ABCs of Research

Context	Guiding Principles	Lifecycle Strategies	New Knowledge

Immense Problems

New Technologies

The New ABCs of Research

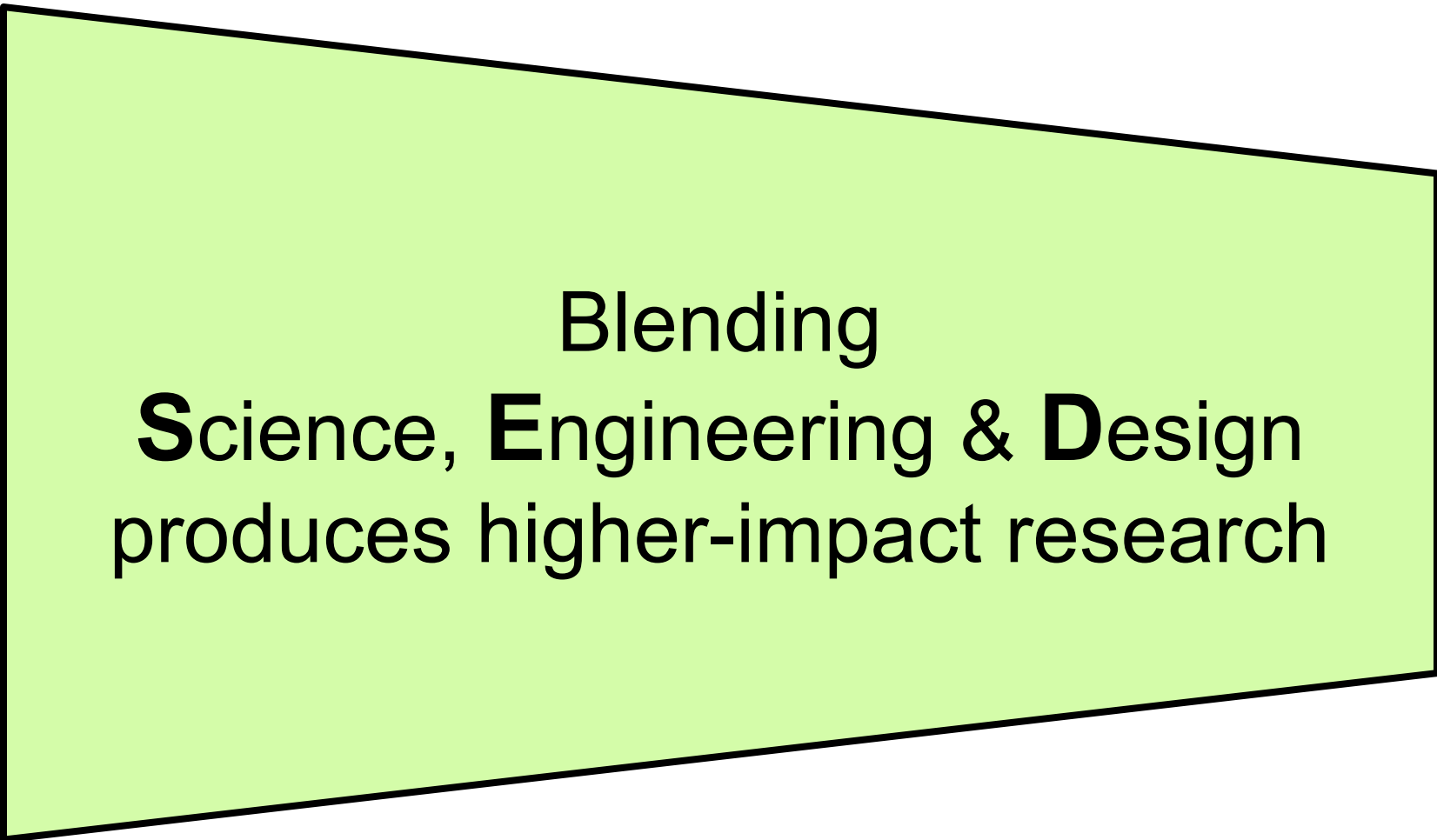| Context	Guiding Principles	Lifecycle Strategies	New Knowledge
Immense Problems			
New Technologies			
Raised Ambitions			

ABC Principle

Applied & **B**asic **C**ombined

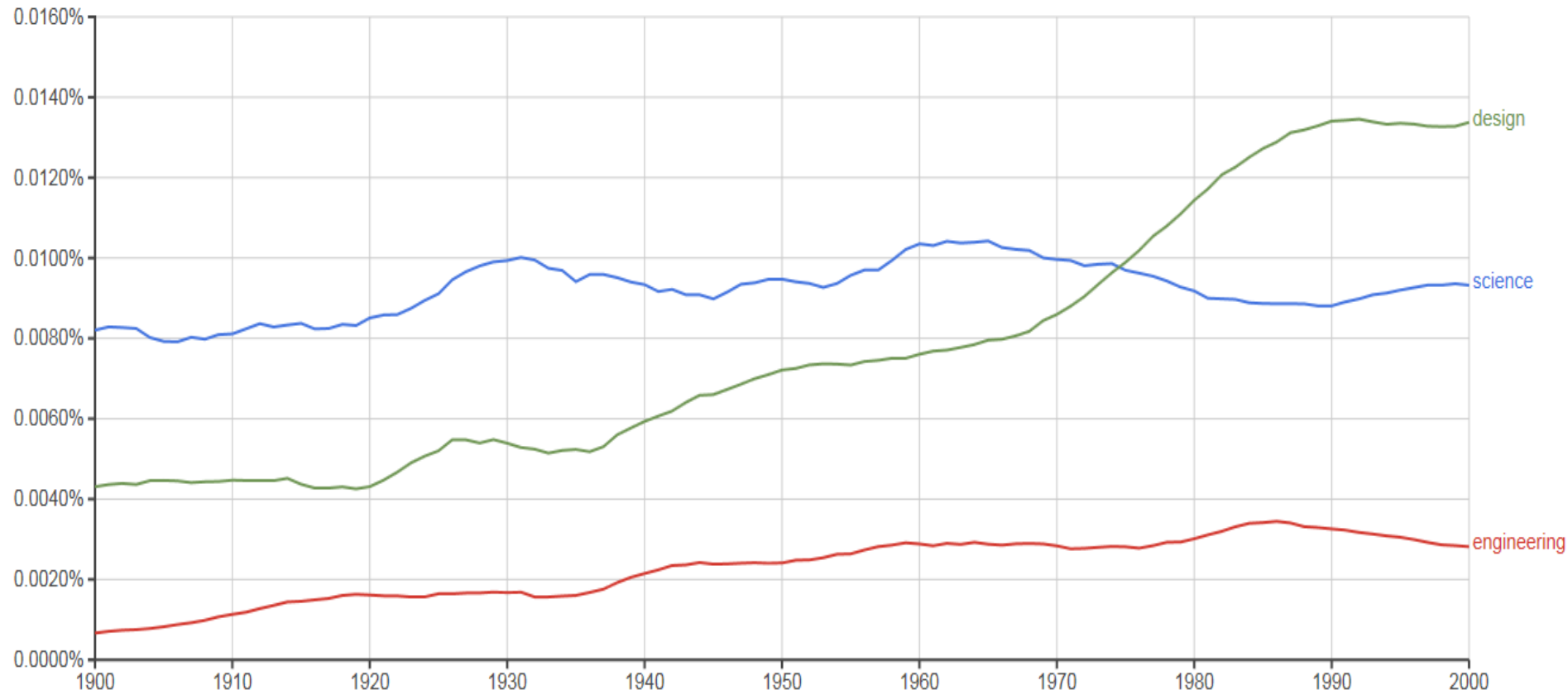Combining applied with basic research produces more rapid progress in both

SED Principle

Blending
Science, **E**ngineering & **D**esign
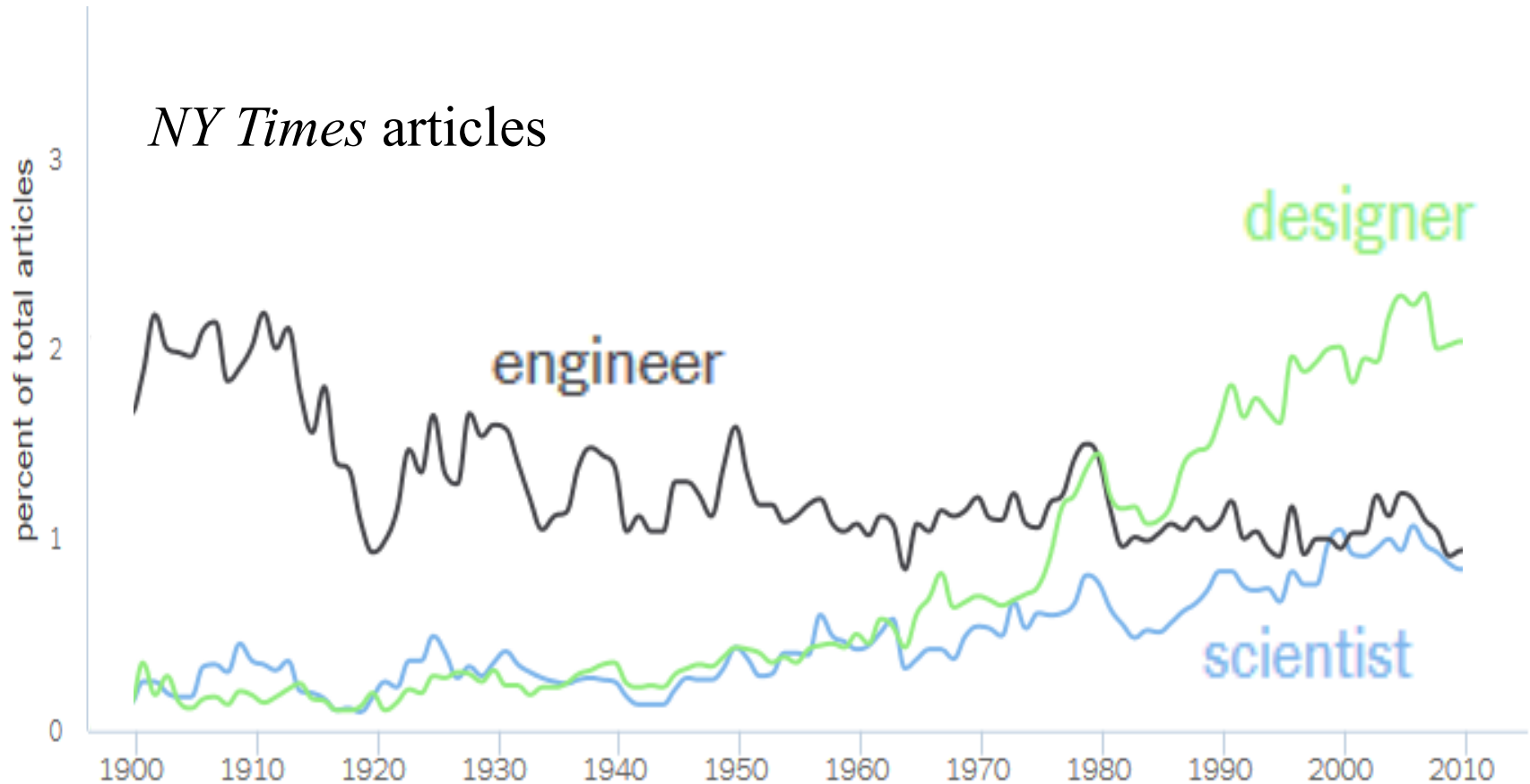produces higher-impact research

Science, Engineering, Design

https://books.google.com/ngrams

Scientist, Engineer & Designer

NY Times articles

http://chronicle.nytlabs.com/

The New ABCs of Research

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Context
- Immense Problems
- New Technologies
- Raised Ambitions

Guiding Principles
- **A**pplied & **B**asic **C**ombined
- **S**cience, **E**ngineering & **D**esign

Lifecycle Strategies
- Choose actionable problems: civic, business & global priorities
- Apply observation, intervention & controlled experiments
- Form teams with diverse individuals & organizations
- Test ideas & prototypes with realistic interventions
- Promote adoption & assess impact

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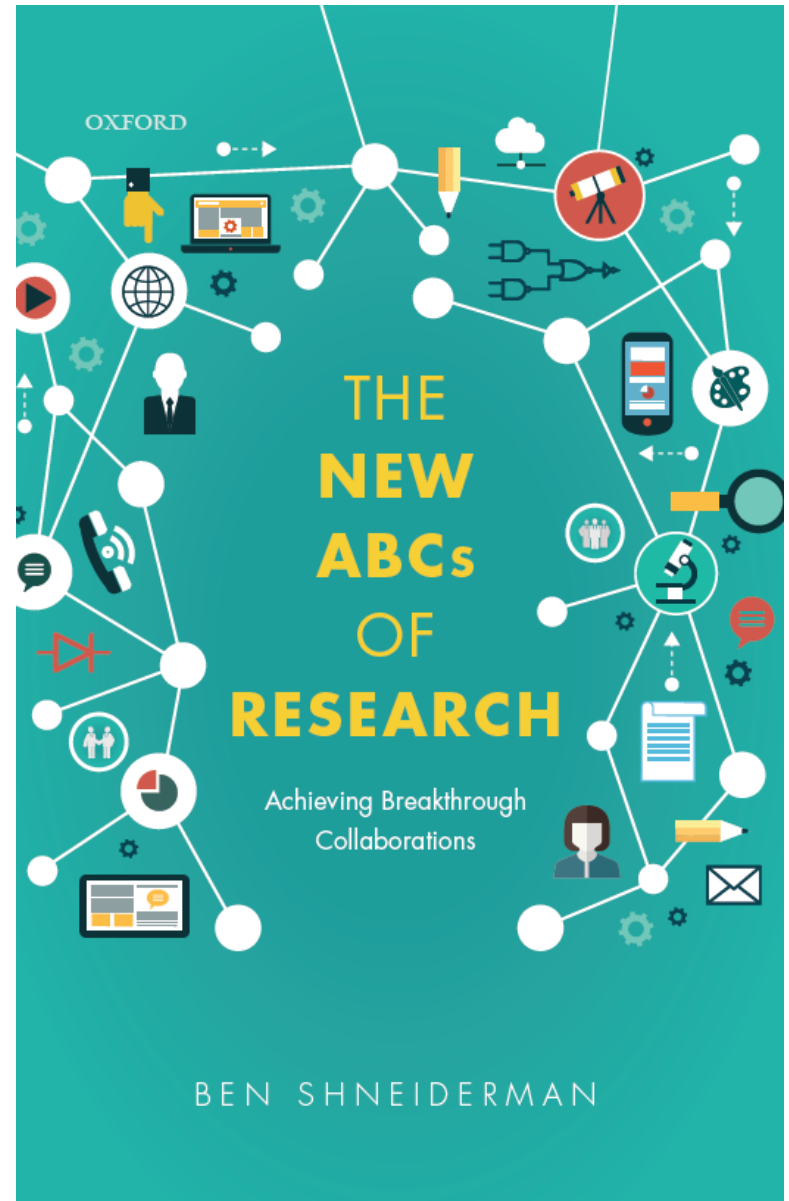
New Knowledge

- Solutions
- Theories

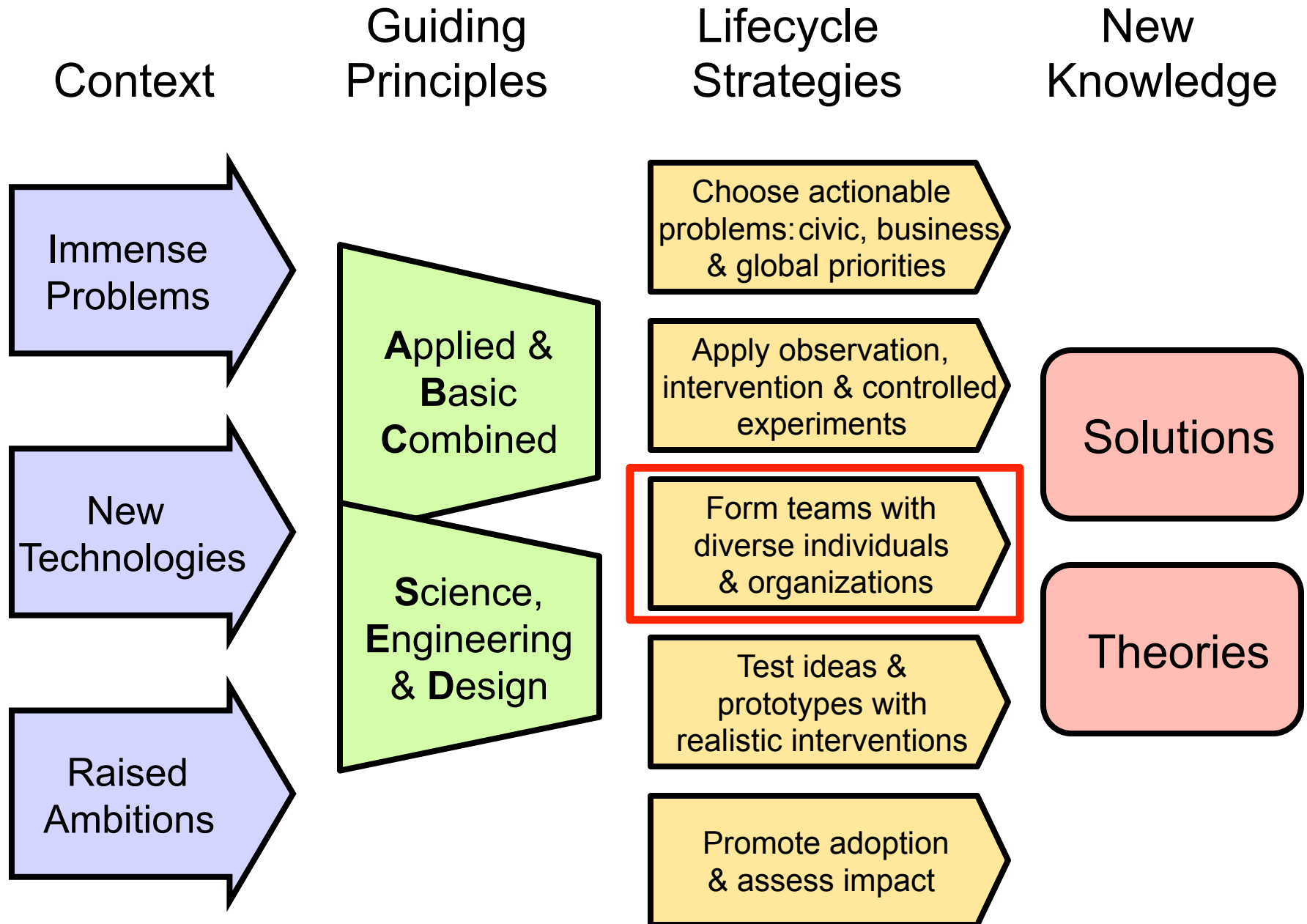# The New ABCs of Research (Oxford, 2016)

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   Funding agencies

www.cs.umd.edu/hcil/newabcs

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                 Principles   Strategies   Knowledge
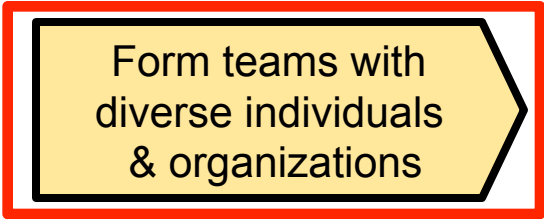
Form teams with
diverse individuals
& organizations

The New ABCs of Research

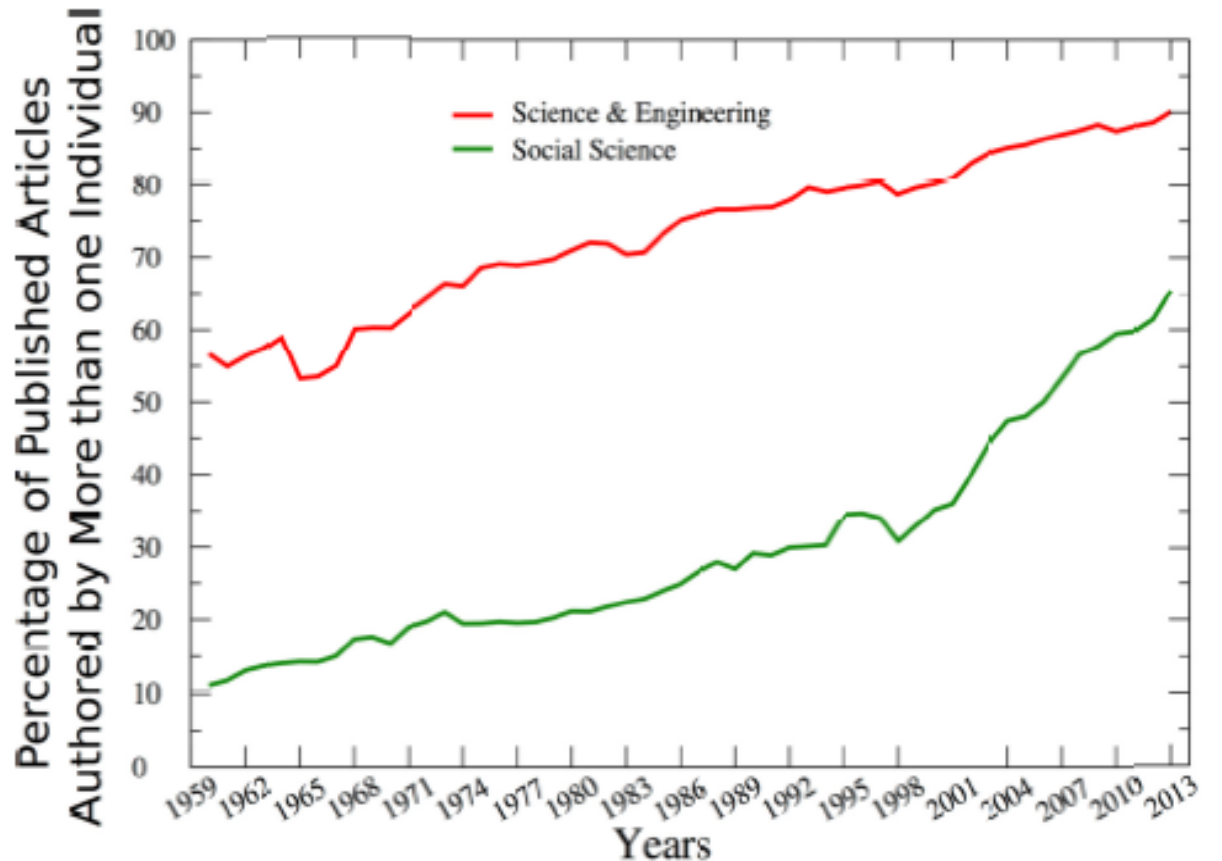| Context	Guiding Principles	Lifecycle Strategies	New Knowledge

Form teams with diverse individuals & organizations

Teamwork is the New Norm

Percentage of publications by more than one author

Cooke & Hilton (Eds), *Enhancing the Effectiveness of Team Science*
http://www.nap.edu/catalog/19007/enhancing-the-effectiveness-of-team-science

Teams: Guidelines

- Formation
    1. Choose those with previously successful collaborations
    2. Create balanced teams: skills, age, gender, personality,…

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    3. Ensure collaboration readiness
        - Willing/eager to work in teams
        - Fluent with technology
        - Experienced in working remotely

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    1. Choose those with previously successful collaborations
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        - Fluent with technology
        - Experienced in working remotely
    4. Recruit experienced leadership

Teams: Guidelines

- Management
    - 5. Define goals & roles clearly
    - 6. Make explicit statements of who does what by when

Teams: Guidelines

- Management

  5. Define goals & roles clearly

  6. Make explicit statements of who does what by when

  7. Practice good communication: listening, speaking, writing, etc.

  8. Hold regular & open discussions

  9. Use effective brainstorming strategies: diverge then converge

Teams: Guidelines

- Management

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    7. Practice good communication: listening, speaking, writing, etc.

    8. Hold regular & open discussions

    9. Use effective brainstorming strategies: diverge then converge

    10. Provide adequate administrative resources & services

Books: Teamwork

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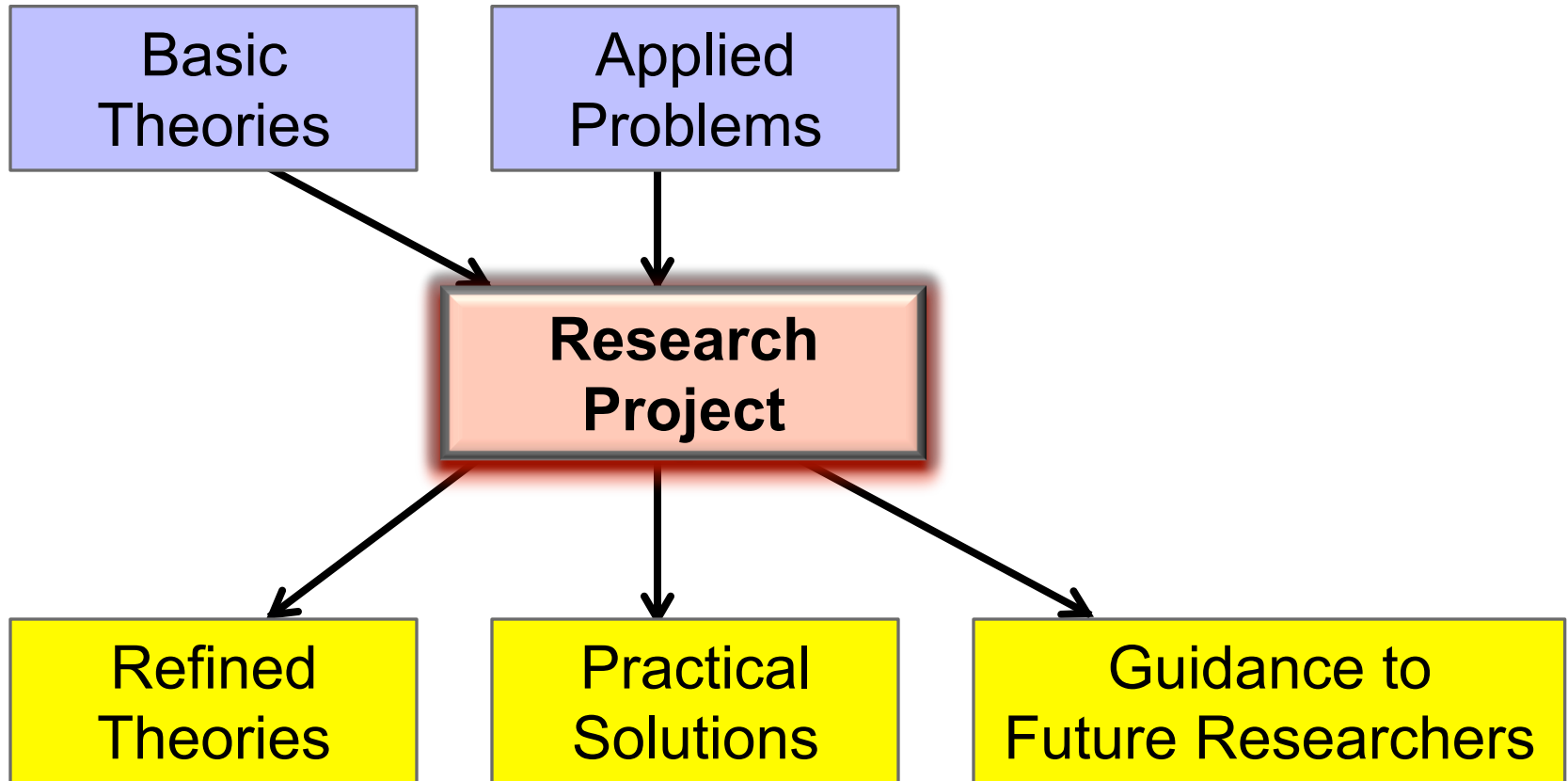# Teams: Guidelines

- Formation:
  - Previously successful collaborations
  - Balanced teams
  - Collaboration readiness
  - Technology readiness for remote teamwork
  - Technology readiness for collaboration
  - Trained experienced leadership

Teams: Guidelines

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  - Clearly defined goals & roles
  - Explicit statements of who does what by when
  - Good communication
  - Regular and open discussions
  - Use of effective brainstorming strategies
- Adequate administrative resources and services

National Academies Report (2015):
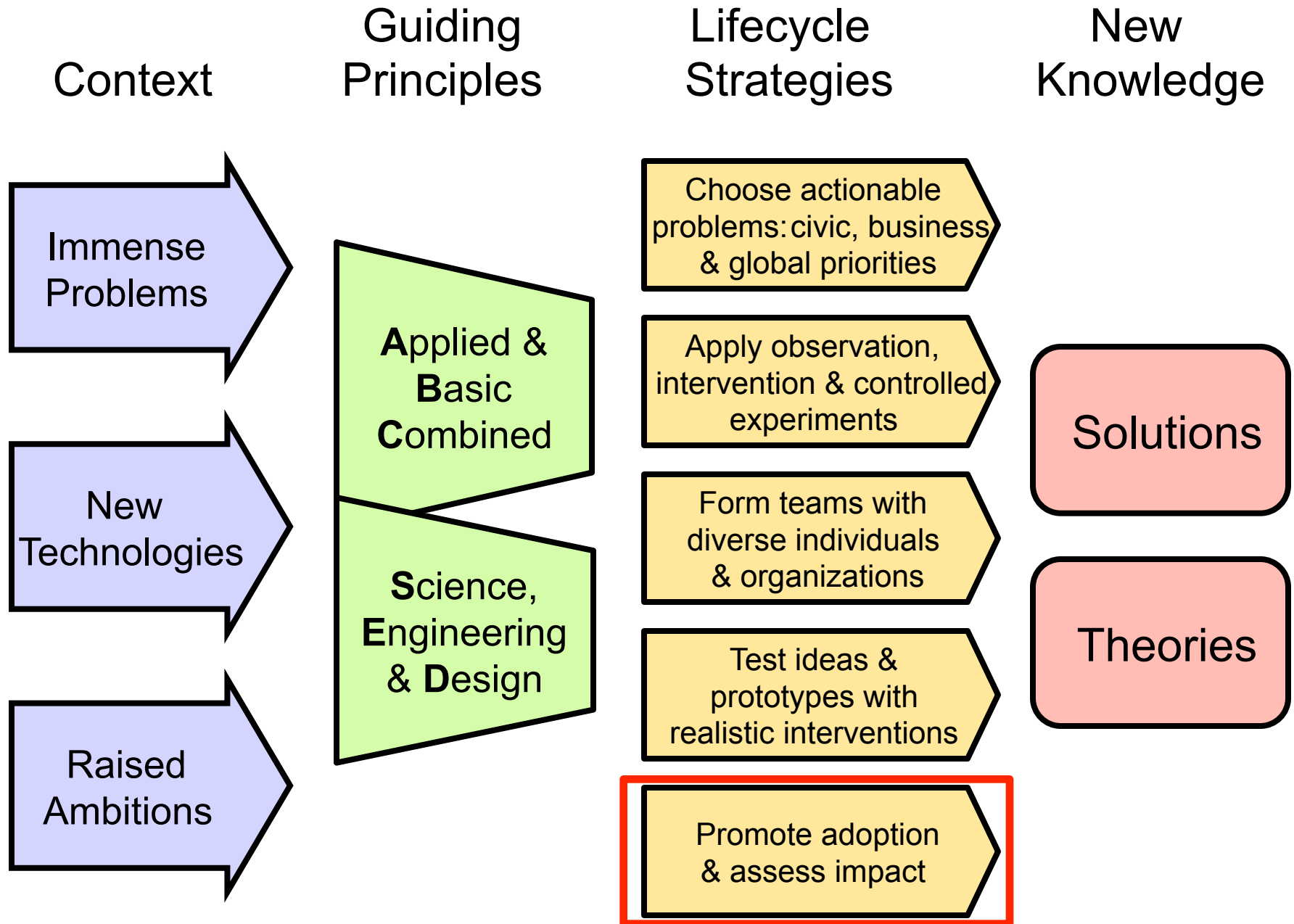## *Enhancing the Effectiveness of Team Science*
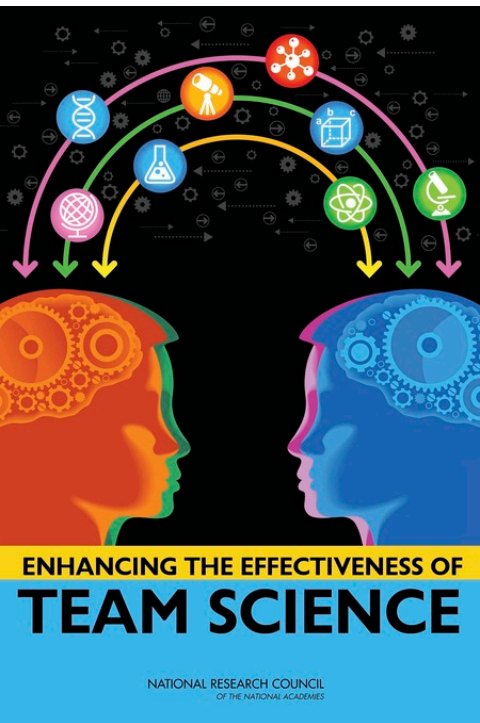
Dimension	Low	High
Diversity	Homogeneous	Heterogeneous
Disciplinary Integration	Unidisciplinary	Transdisciplinary
Team or group size	Small (2-10)	Mega (1000s)
Goal alignment	Aligned	Divergent
Permeable boundaries	Stable	Fluid
Proximity	Co-located	Globally distribute
Task interdependence	Low	High

Cooke & Hilton (Eds), *Enhancing the Effectiveness of Team Science*
http://www.nap.edu/catalog/19007/enhancing-the-effectiveness-of-team-science

Research Project: 2 parents, 3 children
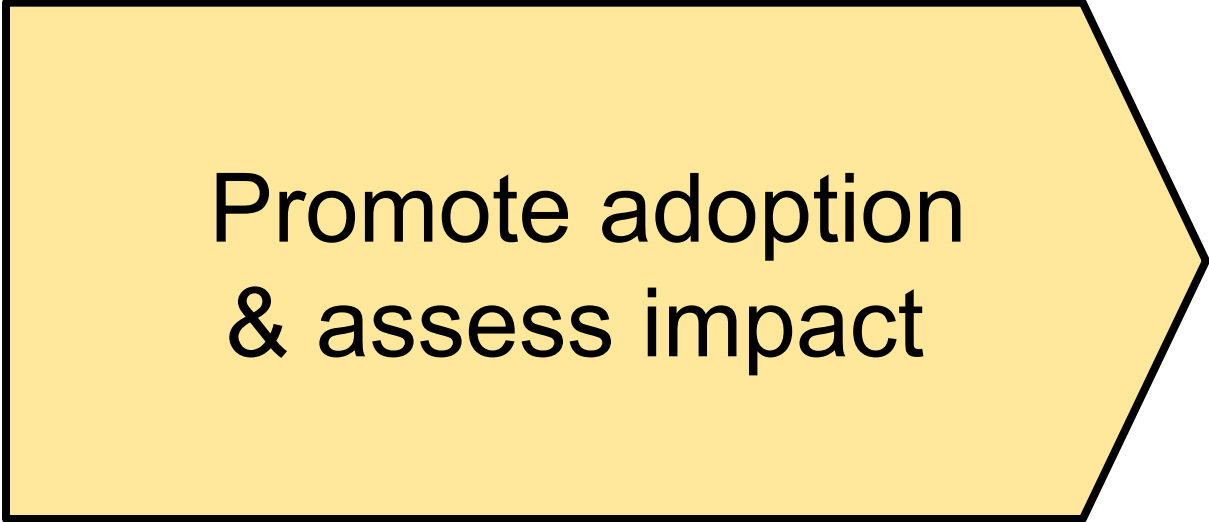
The New ABCs of Research

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The New ABCs of Research

Context   Guiding
Principles   Lifecycle
Strategies   New
Knowledge

Promote adoption
& assess impact

Promote Adoption & Assess Impact

- Clear writing begets clear thinking
    - Story-telling trajectories

- Promote adoption
    - Send Five & Thrive
    - Papers, websites, videos, tweets, blogs

- Assess impact
    - Citations, downloads, tweets, blogposts
    - Best Paper Awards, testimonials, usage reports

Promoting Adoption: Becker Model

- Ideas travel through networks and relationships
- Cultivate champions.
- Present, Present, Present!
- Join relevant committees
      & insert your findings into decision making
- Don't wait for publication. Disseminate early

`https://becker.wustl.edu/impact-assessment/strategies`

Online Services

- **Open Research: arXiv.org, PLOS, Open Science**

- **Community Building Sites:**
  - **Academia:** platform for academics to share research papers…
    to accelerate the world's research (19M users)
  - **ResearchGate:** connect researchers
    share scientific output, knowledge & expertise
  - **ORCID, VIVO, FORCE11, …**

- **Research Paper Managers:**
  - **Mendeley:** The best free way to organize your research
  - **Zotero:** free, easy-to-use tool to help you collect, organize,
    cite & share your research sources
  - **CiteULike:** free service to help you to store, organise & share
    the scholarly papers you are reading

The New ABCs of Research

Applied &	**B**asic	**C**ombined
Achieving	**B**reakthrough	**C**ollaborations
Analysis	**B**ased on	**C**reativity
Actively	**B**uild	**C**onnections
Ask	**B**igger	**C**uestions

The New ABCs of Research

Context	Guiding Principles	Lifecycle Strategies	New Knowledge

Information Visualization & Visual Analytics

READINGS IN

INFORMATION VISUALIZATION

USING VISION TO THINK

WRITTEN AND EDITED BY
STUART CARD
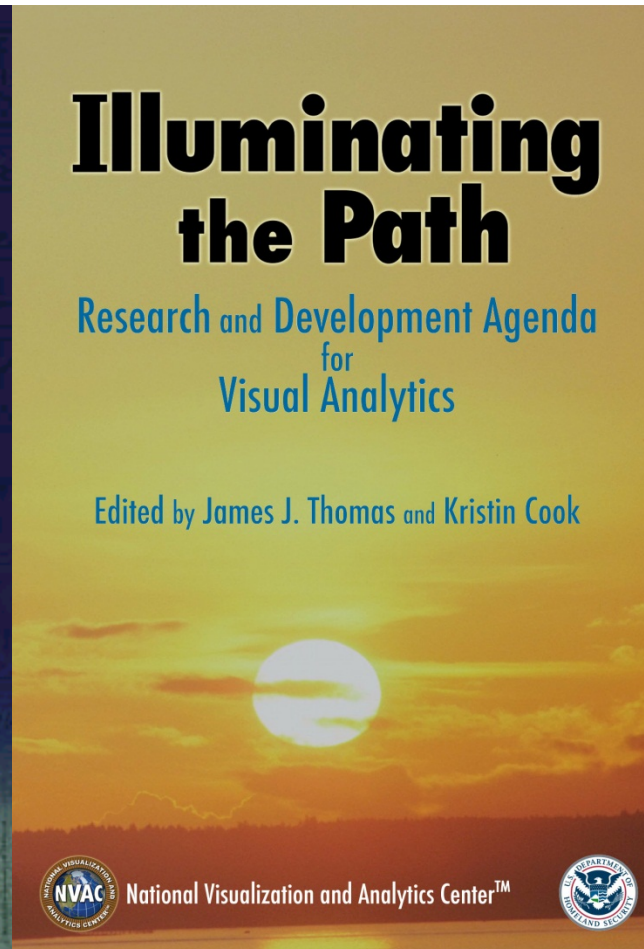JOCK MACKINLAY
BEN SHNEIDERMAN

1999
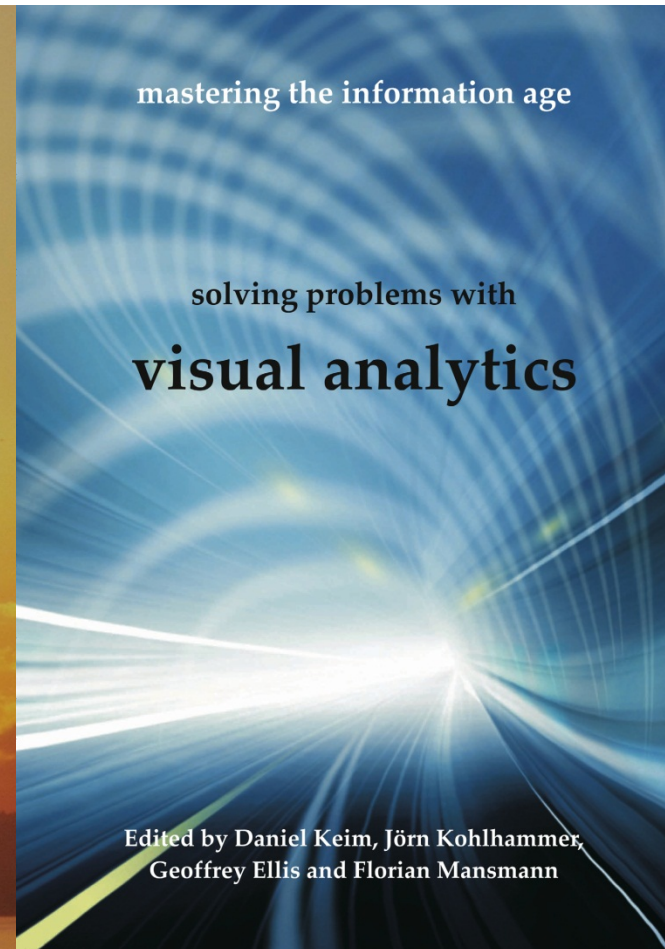
Information Visualization & Visual Analytics

1999   2004

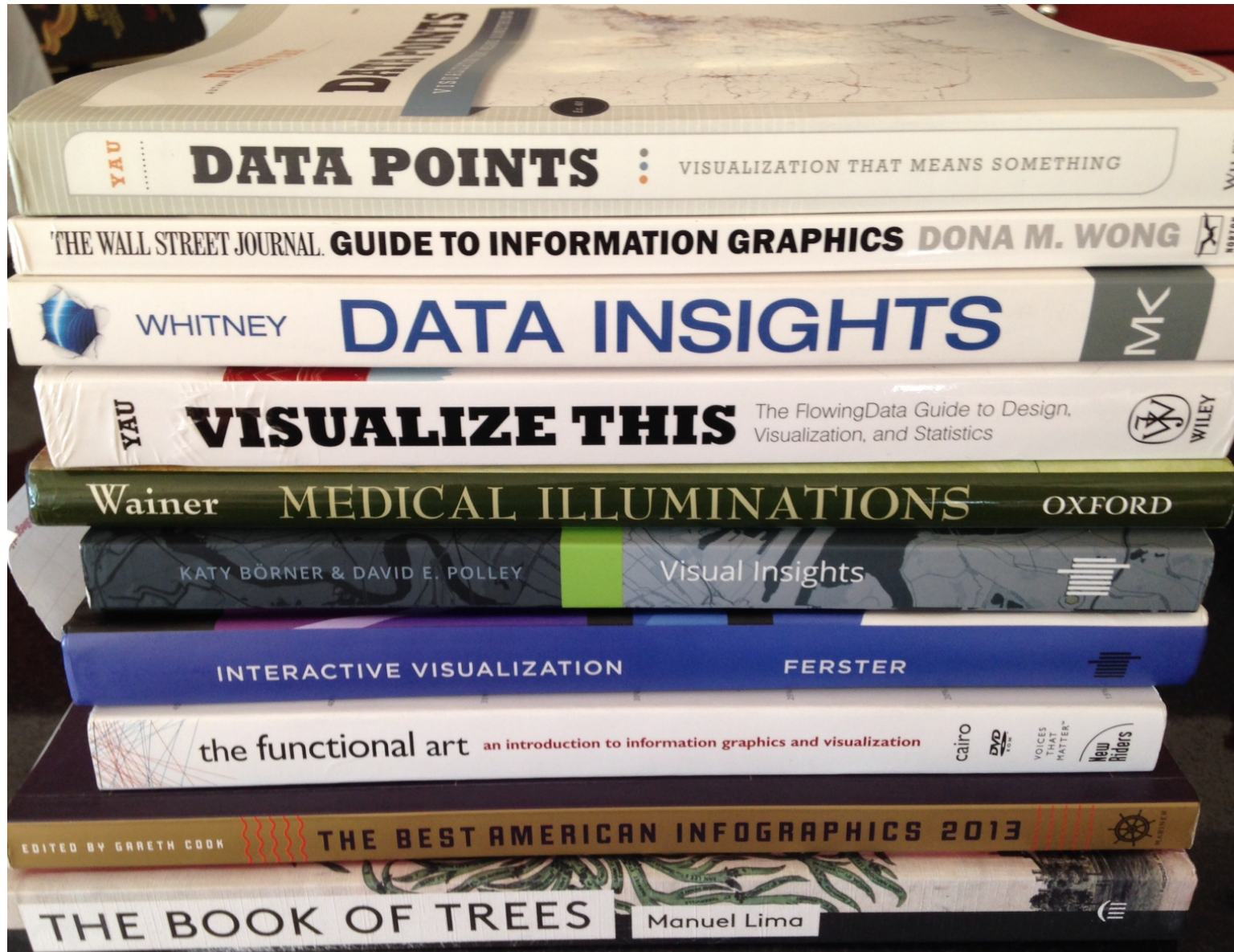# Information Visualization & Visual Analytics
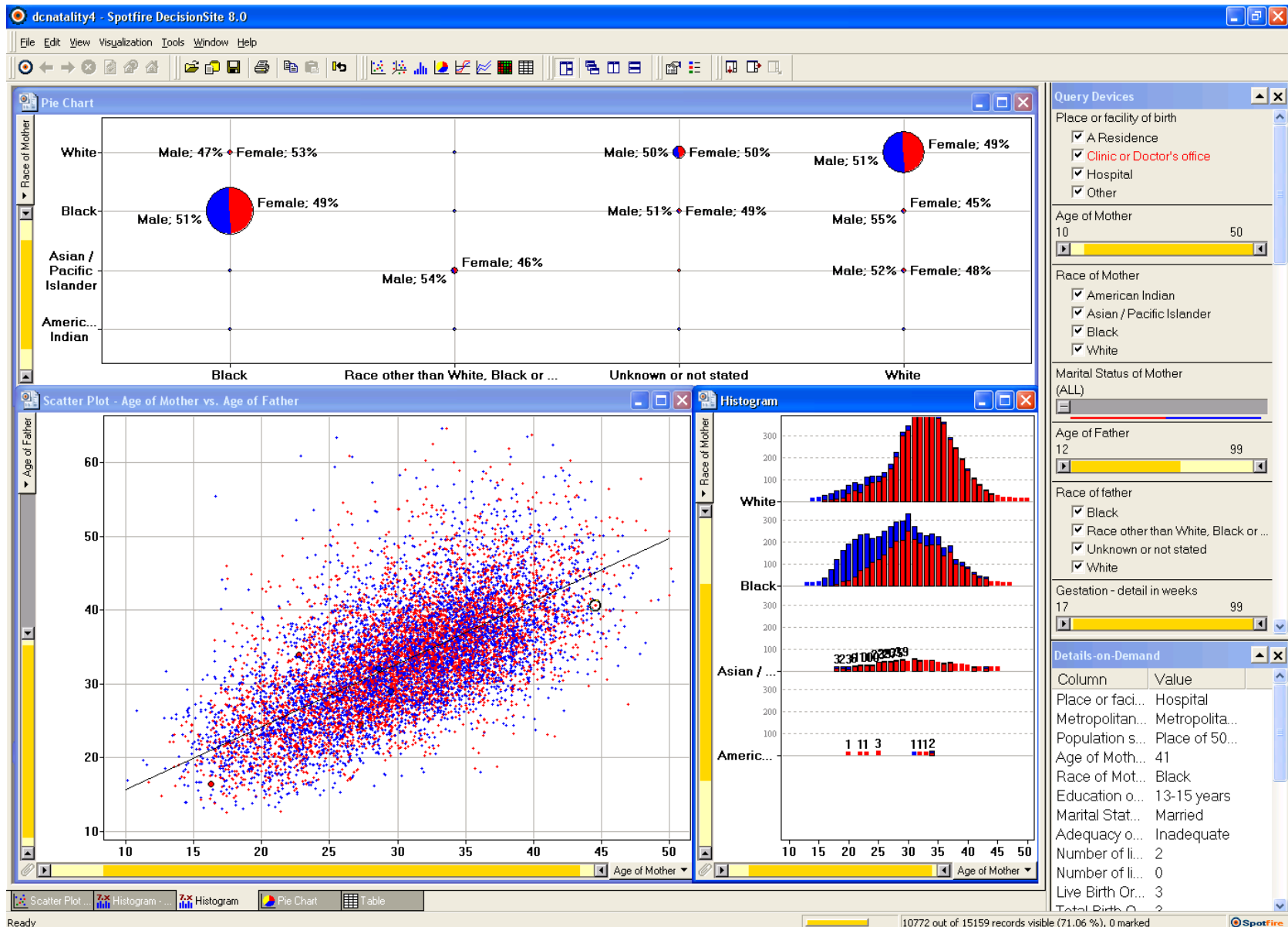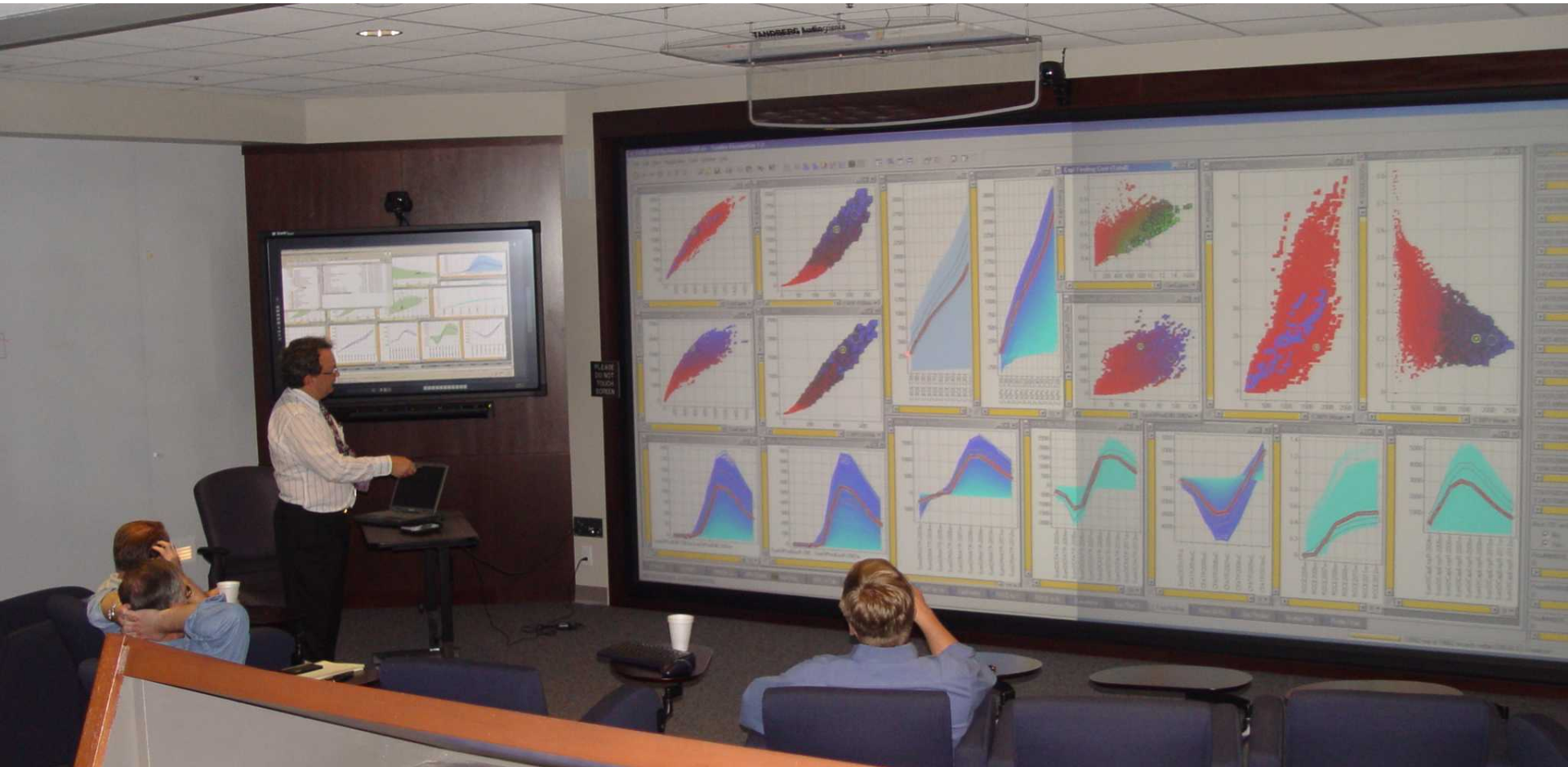

1999   2004   2010

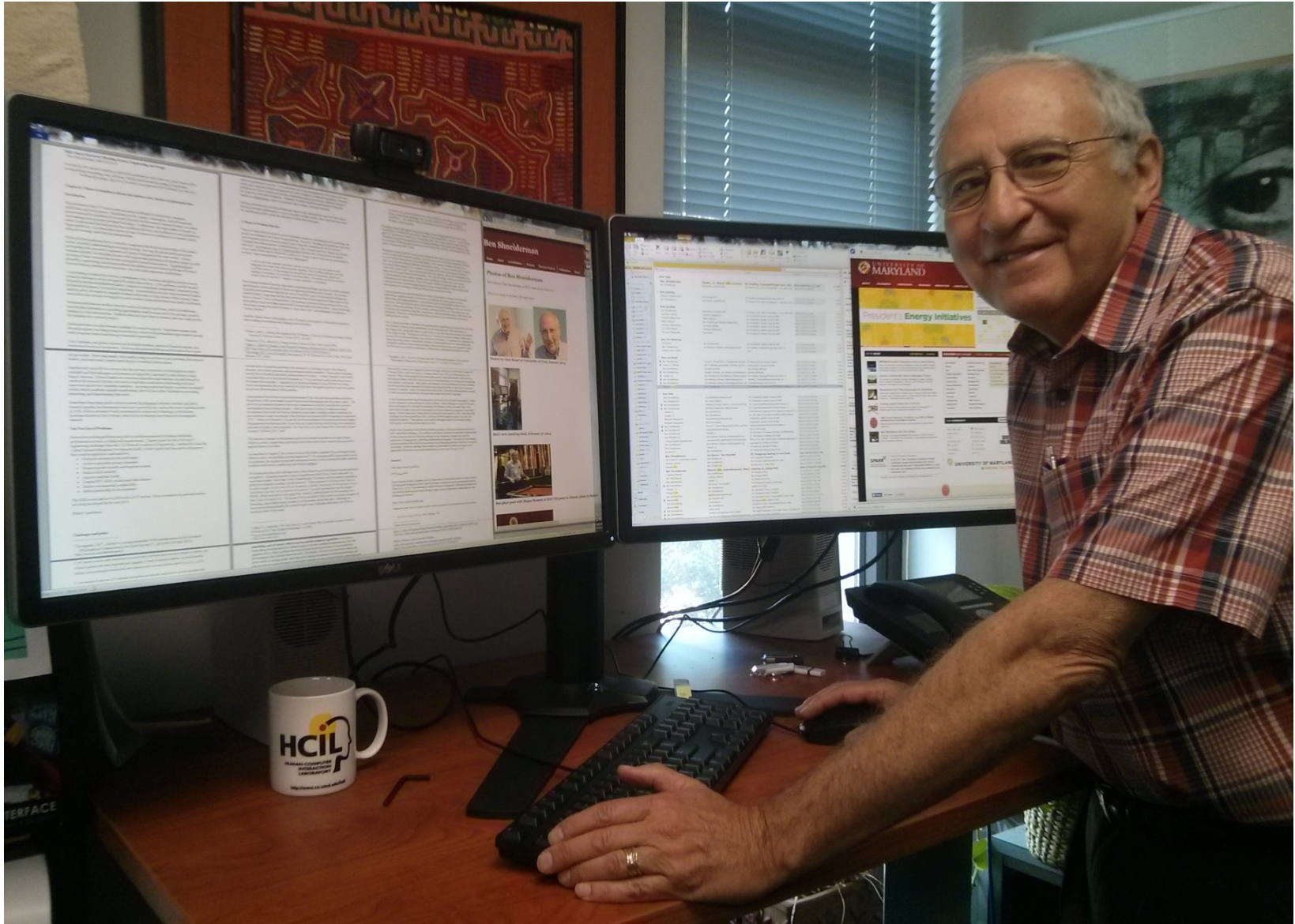# Information Visualization: Cultural Meme

Spotfire: DC natality data

http://registration.spotfire.com/eval/default_edu.asp

10M - 100M pixels: Large displays

Innovations for Global MBA program

16M pixels: My New Workstation

100M-pixels & more

1M-pixels & less

Small mobile devices
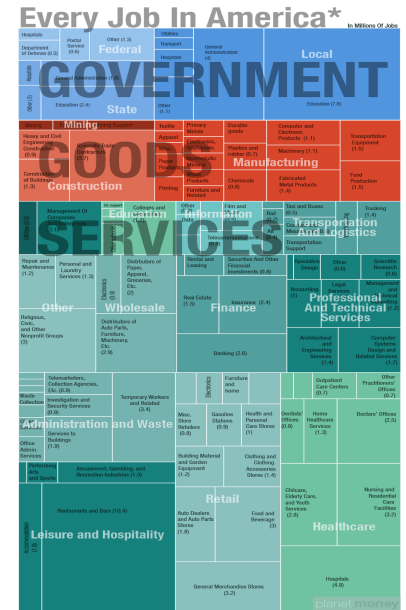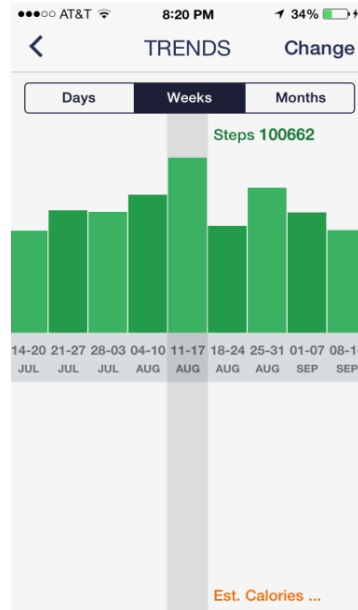
Information Visualization: Mantra

- **Overview, zoom & filter, details-on-demand**
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Information Visualization: Data Types

SciViz

- **1-D Linear** Document Lens, SeeSoft, Info Mural
- **2-D Map** GIS, ArcView, PageMaker, Medical imagery
- **3-D World** CAD, Medical, Molecules, Architecture

InfoViz

- **Multi-Var** Spotfire, Tableau, Qliktech, Visual Insight
- **Temporal** EventFlow, TimeSearcher, Palantir, DataMontage
- **Tree** Cone/Cam/Hyperbolic, SpaceTree, Treemap
- **Network** Pajek, UCINet, NodeXL, Gephi, Tom Sawyer
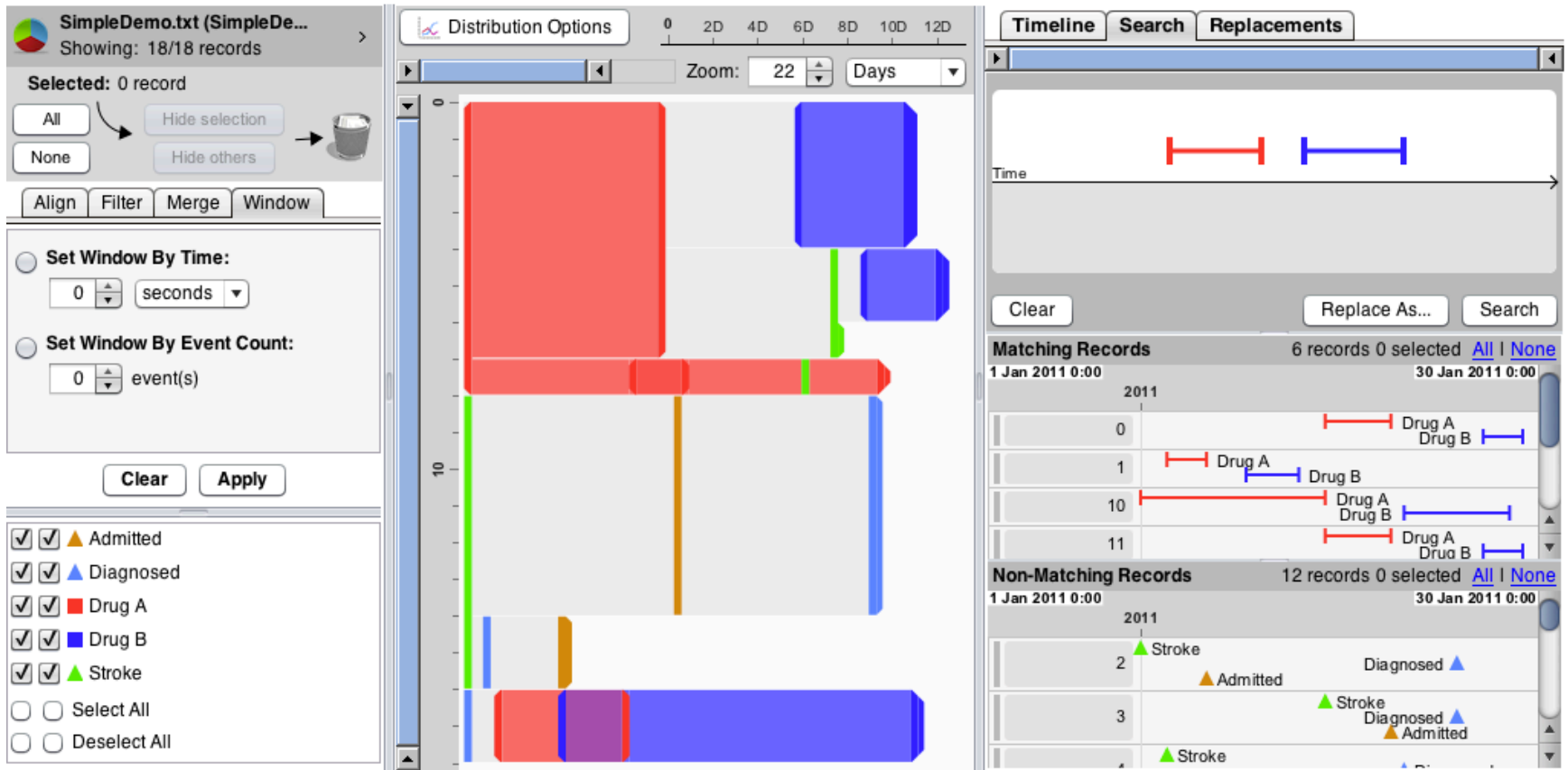- **Text** TagClouds, Wordle, ManyEyes, Ngram Viewer

```
flowingdata.com      visualcomplexity.com    eagereyes.org
visual.ly            perceptualedge.com      datakind.org
infosthetics.com     visualizing.org         infovis.org
```

EventFlow Project: Temporal Events
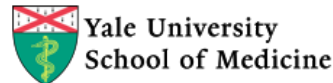
hcil.umd.edu/eventflow

EventFlow Project: Incident Analysis
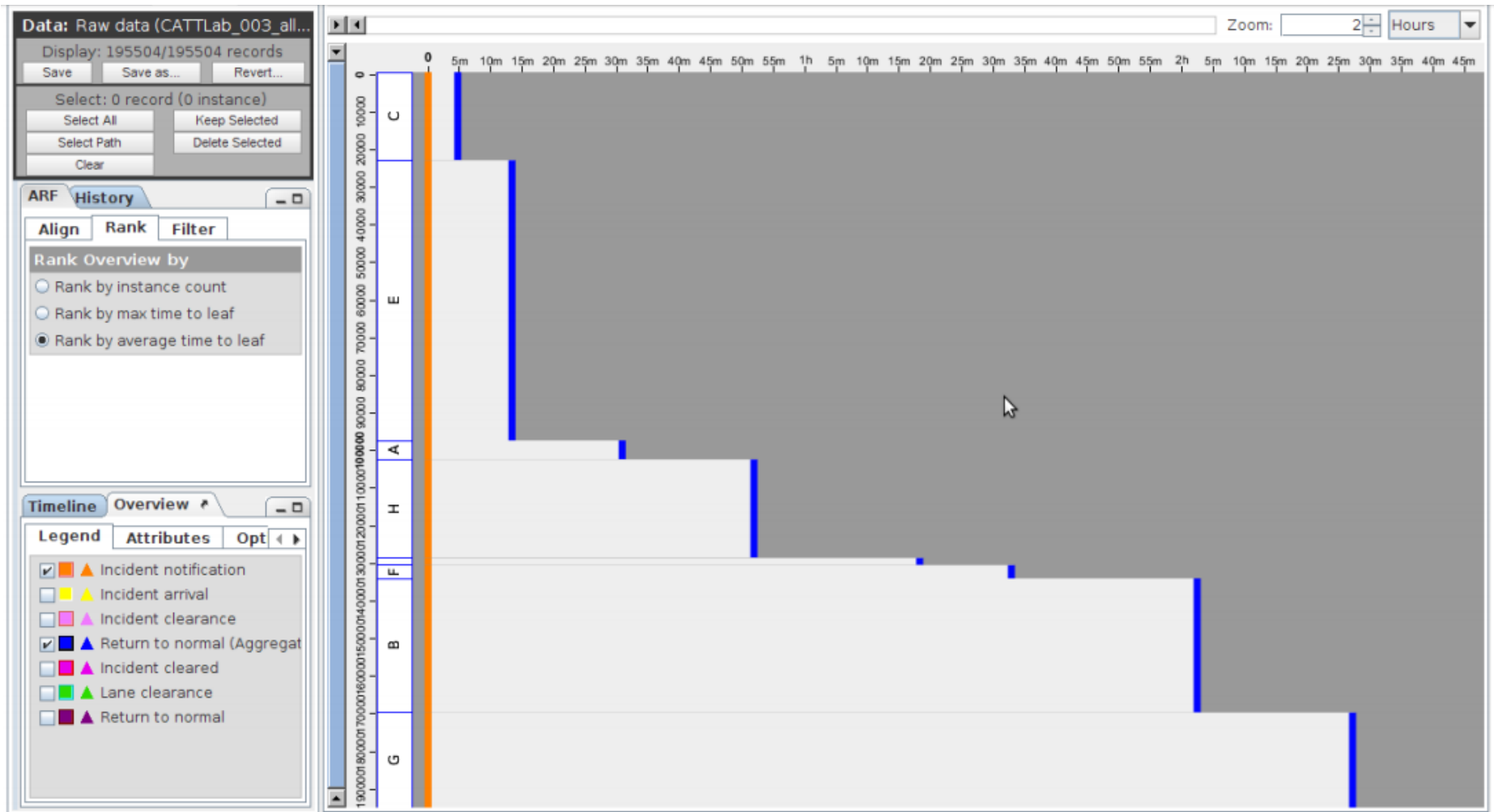
Treeversity: Traffic Bottlenecks

www.cs.umd.edu/hcil/treeversity
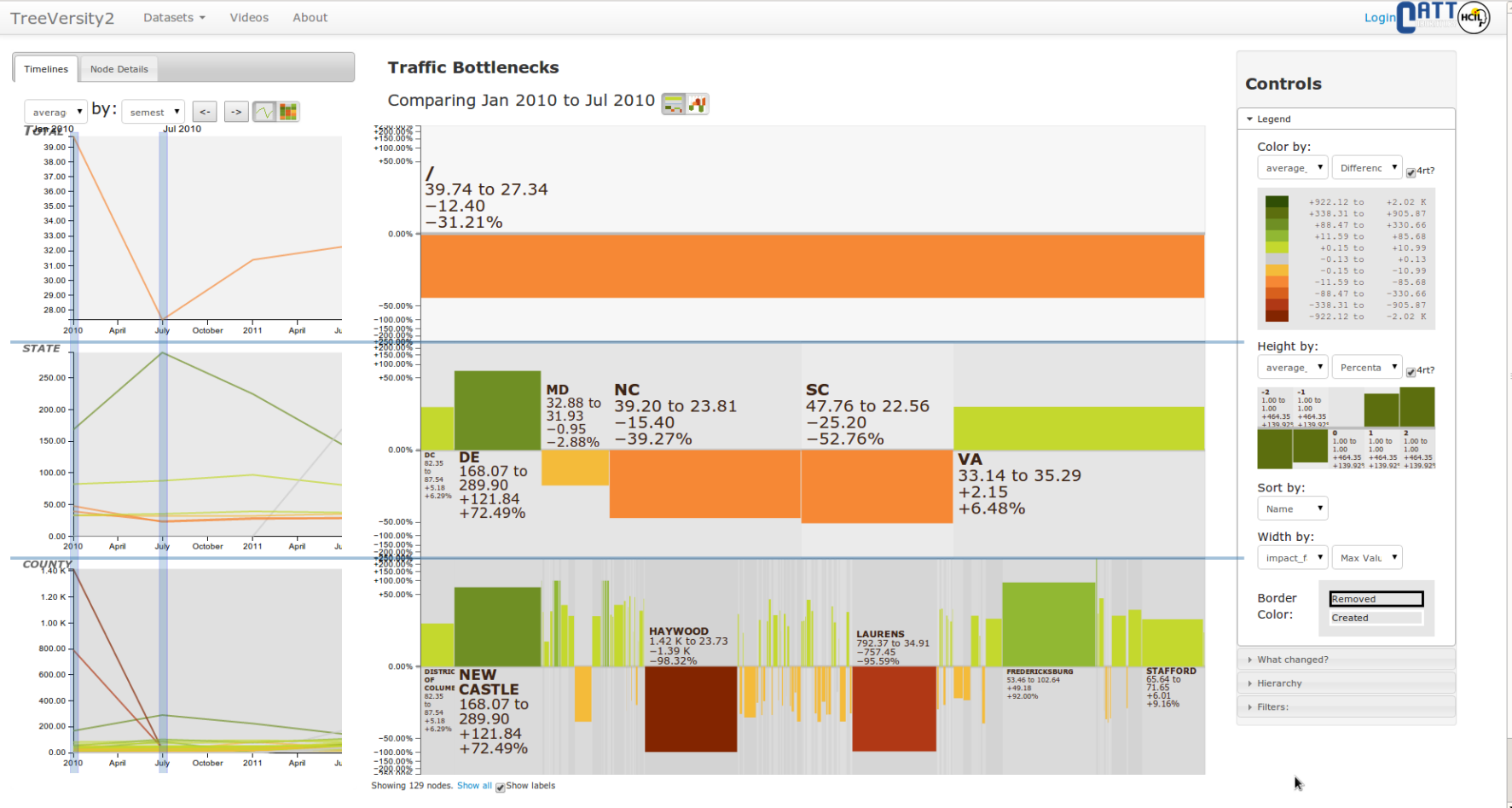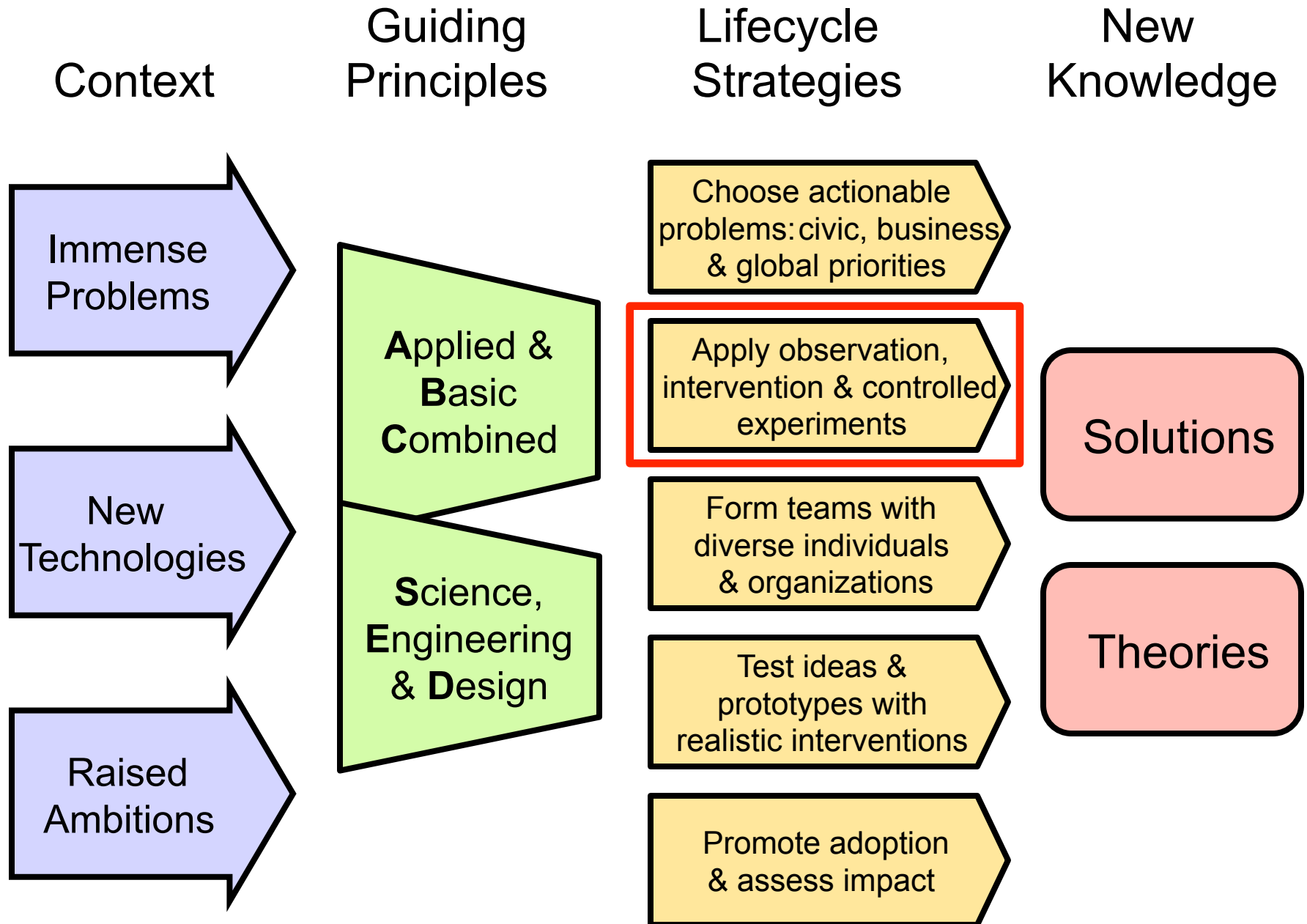
@benbendc

`hcil.umd.edu`

Books: Teamwork

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- Joshua Shenk, *Powers of Two: Finding the Essence of Innovation in Creative Pairs*, Houghton Mifflin Harcourt (2014).

Books: Writing

- Mark J. Kuchner, *Marketing for Scientists: How to Shine in Tough Times*, Island Press (2011).

- Steven Pinker, *The Sense of Style: The Thinking Person's Guide to Writing in the 21st Century*, Viking (2014).

- Joshua Schimel, *Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded*, Oxford University Press (2011).

- Turabian, K. L., Booth, W. C., Colomb, G. G., Williams, J. M., and the University of Chicago Press Staff, *A Manual for Writers of Research Papers, Theses, and Dissertations: Eighth Edition* (2013).

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Context	Guiding Principles	Lifecycle Strategies	New Knowledge

Immense Problems

New Technologies

Raised Ambitions

Applied & Basic Combined

Science, Engineering & Design

Choose actionable problems: civic, business & global priorities

Apply observation, intervention & controlled experiments

Form teams with diverse individuals & organizations

Test ideas & prototypes with realistic interventions

Promote adoption & assess impact

Solutions

Theories

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Apply observation, intervention & controlled experiments

Research Methods → Solutions & Theories

Observation

Intervention

Controlled Experiment

Solutions & Theories
- Clear Descriptions
- Causal Explanations
- Reliable Predictions
- Practical Guidelines
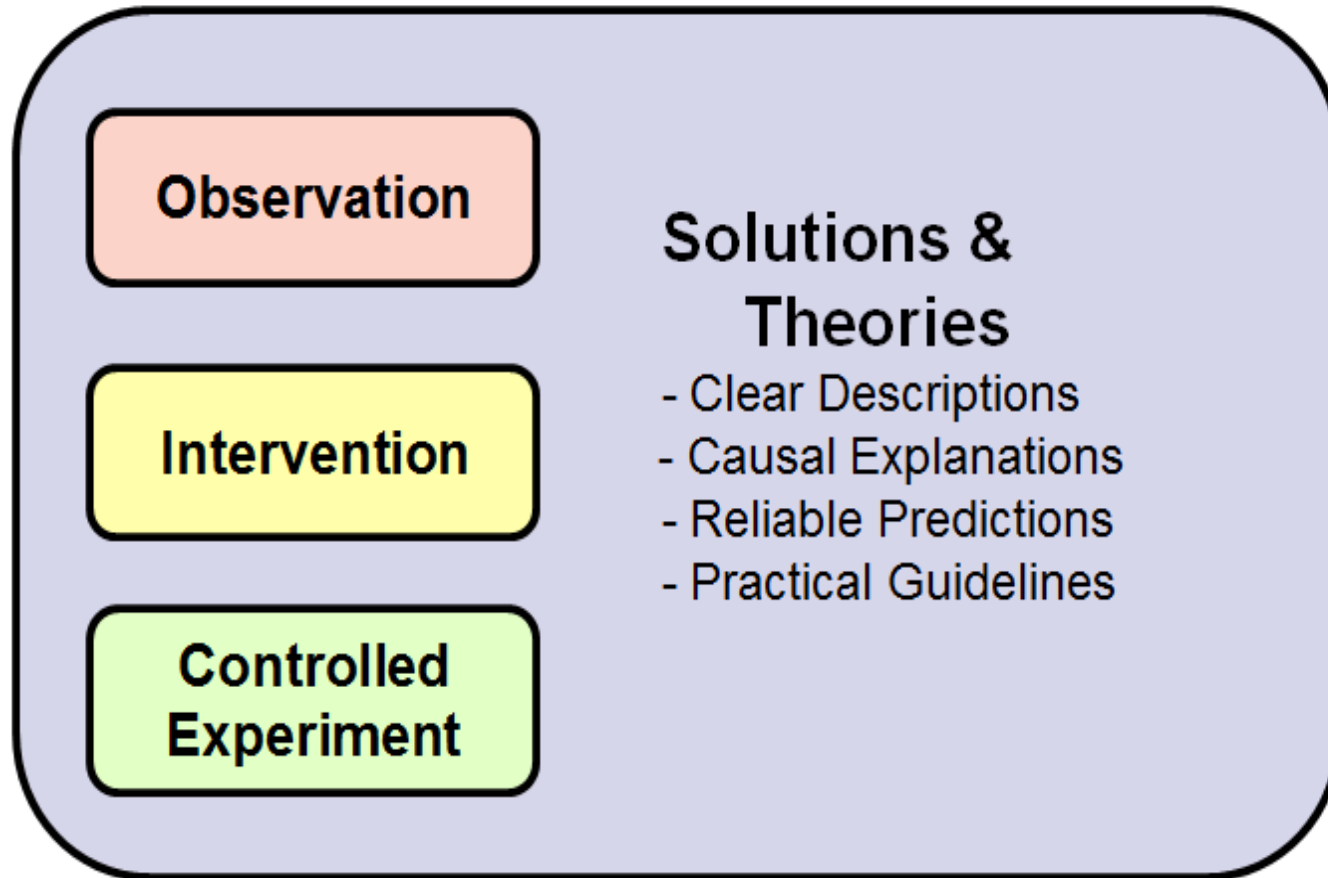
Teams: Winning Strategy

- *Powers of Two* (End of the Lone Genius) (Shenk, 2014)

- Teams: Difficult to form, hugely effective

- Takes practice to gain skills
  - Clear goals, clear roles: Who Does What by When
  - Trust, communication, recognition
  - WJU2007: teams → 2.1 times the impact

- Large teams need administrative support

- FUN!

scienceofteamscience.org   www.teamsciencetoolkit.cancer.gov