

# Cross-disciplinary Team Science: Strategies for Success



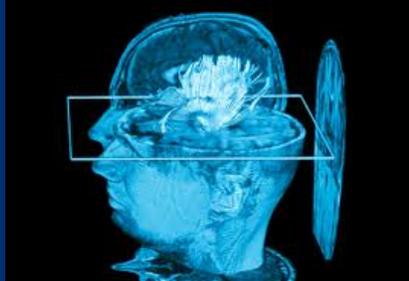
KARA L. HALL, PHD

DIRECTOR, SCIENCE OF TEAM SCIENCE (SCITS)  
DIRECTOR, THEORIES INITIATIVE  
BEHAVIORAL RESEARCH PROGRAM  
THE NATIONAL CANCER INSTITUTE



# WHAT ARE WE TRYING TO DO?

## NIH MISSION



...enhance health, lengthen life,  
& reduce illness & disability



# WHY TEAM SCIENCE?

The societal & scientific problems are complex –

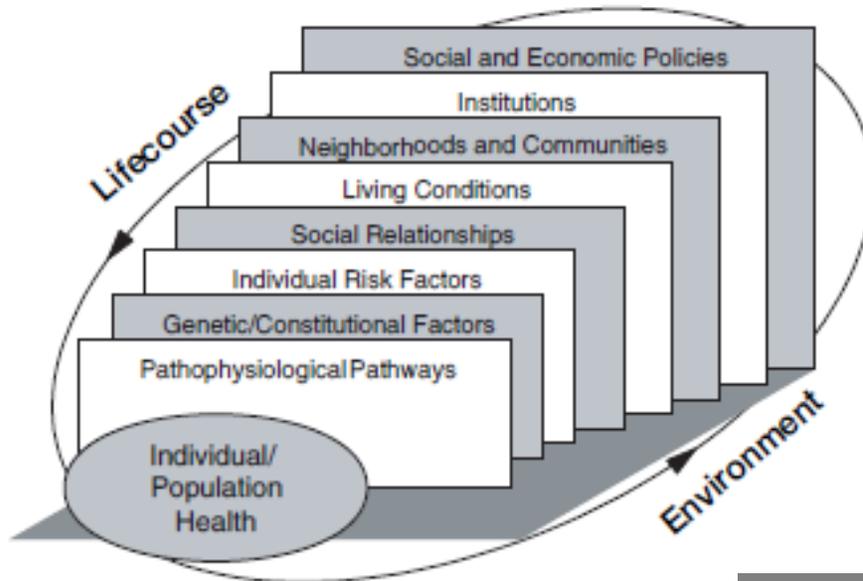
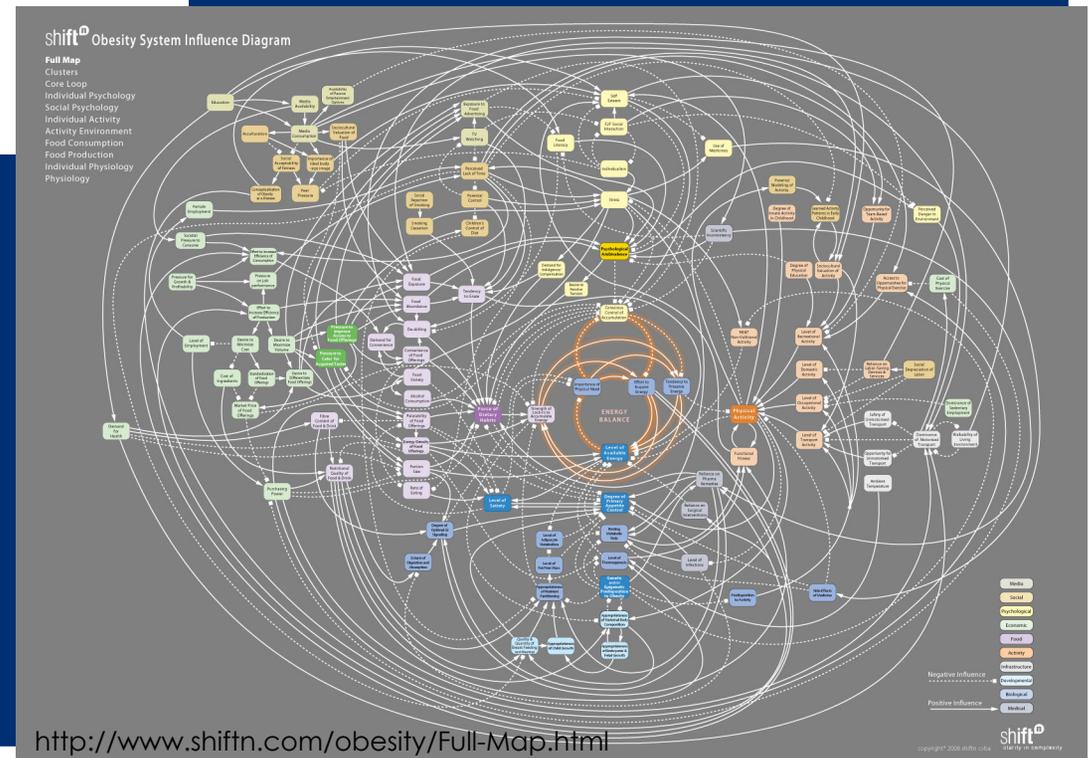


FIGURE A-2 Multilevel approach to epidemiology.  
SOURCE: Institute of Medicine (2000).

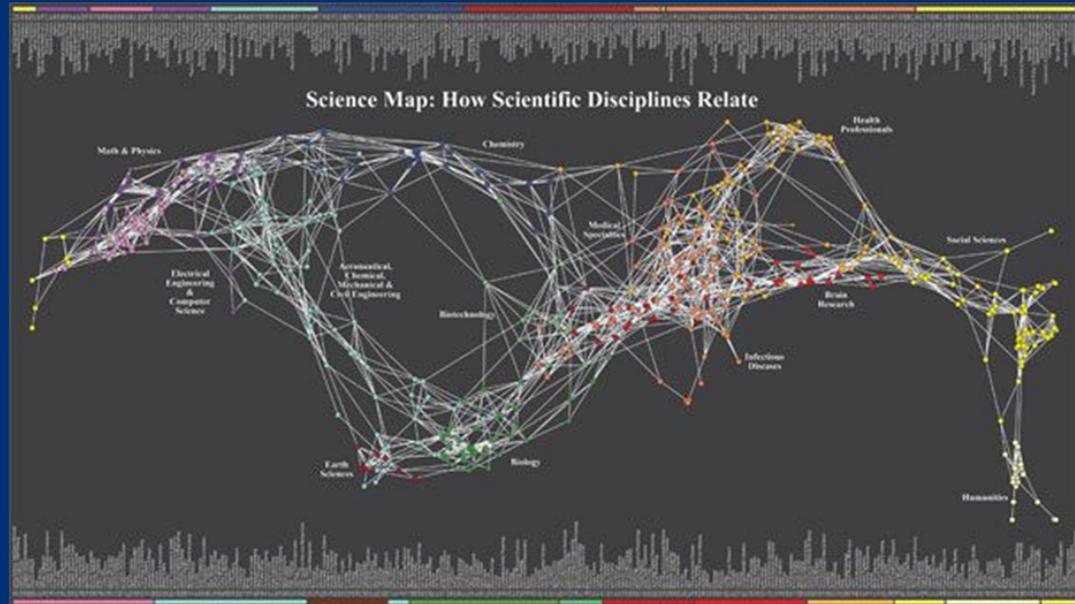
Multi-level, multi-factorial,  
interacting influences



<http://www.shiftn.com/obesity/Full-Map.html>

copyright 2008 shiftn, LLC  
shift<sup>o</sup>  
OBSERVING COMPLEXITY

# VARIATIONS IN TEAM SCIENCE



# DIMENSIONS OF TEAM SCIENCE THAT CREATE UNIQUE PROFILES & CHALLENGES

DIMENSION	RANGE	
Diversity	HOMOGENEOUS	HETEROGENEOUS
Integration	UNIDISCIPLINARY	TRANSDISCIPLINARY
Size	SMALL (2)	MEGA (1000S)
Proximity	CO-LOCATED	GLOBALLY DISTRIBUTED
Goal alignment	ALIGNED	DIVERGENT OR MISALIGNED
Boundaries	STABLE	FLUID
Task interdependence	LOW	HIGH

# A Continuum of Disciplinary Integration



## Transdisciplinary

Researchers from *different disciplines work jointly* to develop & use a shared conceptual framework that synthesizes & extends discipline-specific theories, concepts, & methods to create *new approaches* to address a common problem



## Multidisciplinary

Researchers from *different disciplines work sequentially*, each from their own discipline-specific perspective, with a goal of eventually combining results to address a common problem

Across

Disciplines



## Interdisciplinary

Researchers from *different disciplines work jointly* to address a common problem. Some integration of perspectives occurs, but contributions remain anchored in their own disciplines

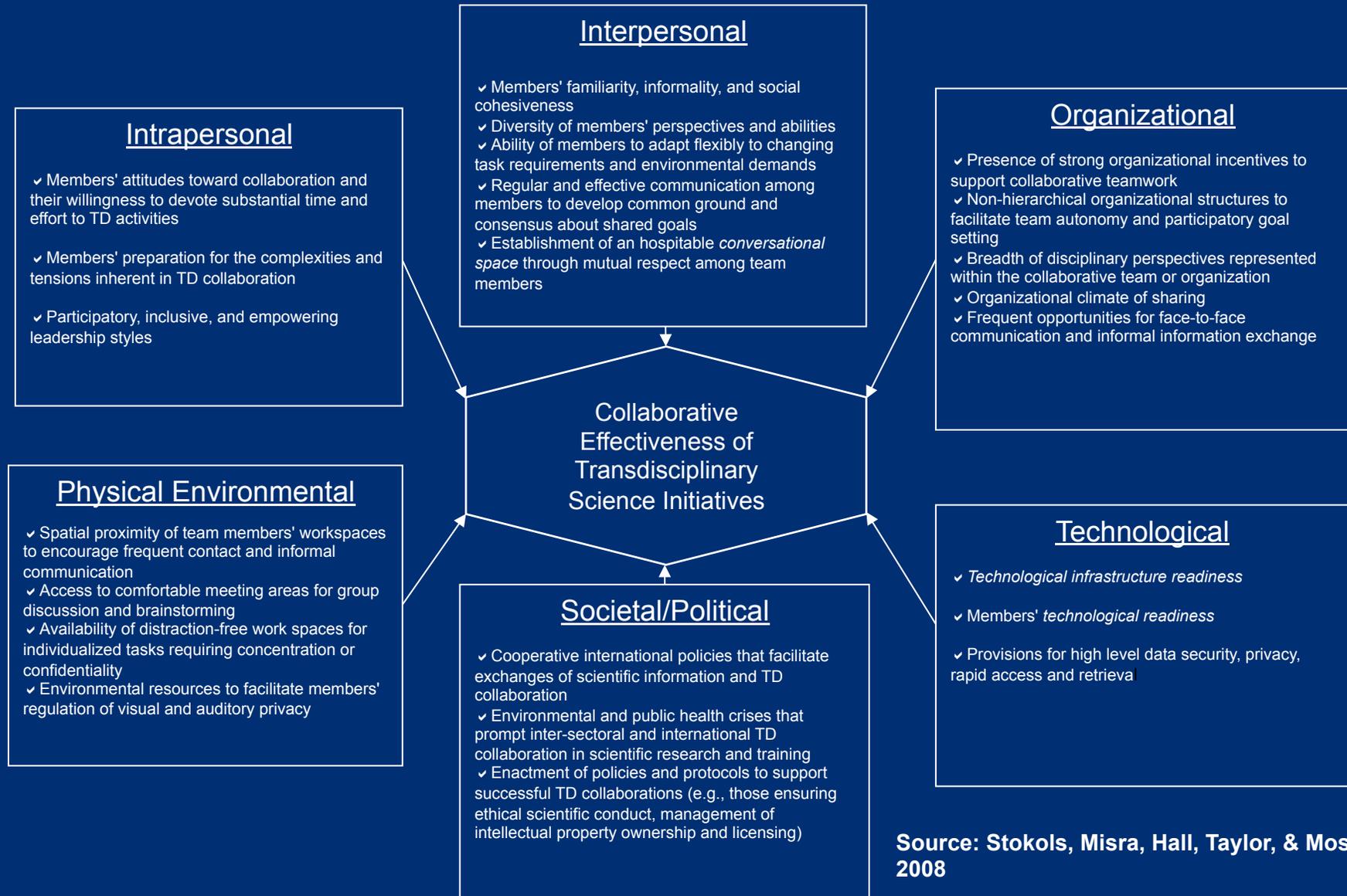


## Unidisciplinary

Researchers from a *single discipline* work together to address a common problem

# COLLABORATION IS COMPLEX

## MULTI-LEVEL CONTEXTUAL FACTORS





SciTS

Building the knowledge base  
for effective team science

The **Science of Team Science** (SciTS) is a cross-disciplinary field of study that aims to...

*(1) Build an evidence-base*

*(2) Develop translational applications*

...to help maximize the efficiency & effectiveness of team-based research

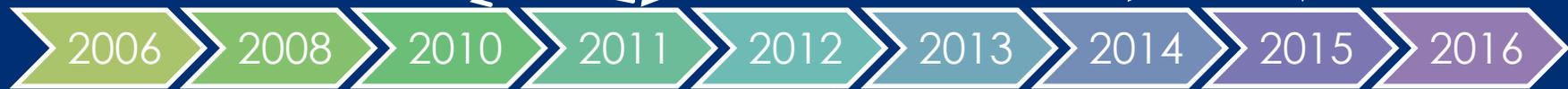
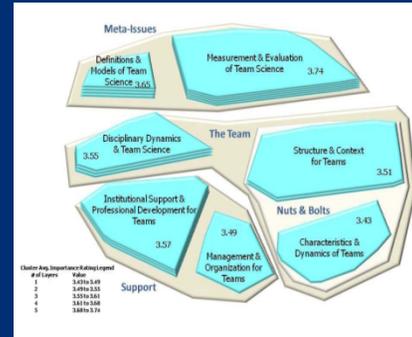
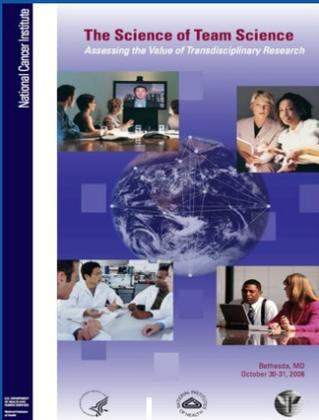
# Building the SciTS Evidence-Base

NCI Conference: The Science of Team Science: Assessing the Value of Transdisciplinary Research

Applying the Science of Teams to inform Policy & Research on Team Science

Mapping a Research Agenda for SciTS

Annual SciTS Conference



SciTS Journal Supplement



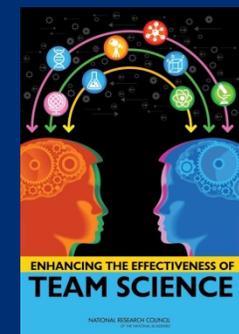
Team Approaches to Science, Practice, & Policy in Health



Collaboration Science & Translational Medicine



NATIONAL ACADEMIES CONSENSUS STUDY



# DEVELOPING TRANSLATIONAL APPLICATIONS

National Cancer Institute  
at the National Institutes of Health | www.cancer.gov

## Team Science Toolkit

An interactive website to help you support, conduct and study team-based research.

Home | About Team Science | About the Toolkit | Discover | Contribute | Connect | News & Events | About Us

**2014 Science of Team Science Conference**  
The SciTS conference will be held on August 6, 8, 2014 in Austin, TX. A forum for sharing knowledge to maximize the effectiveness of team-based research, it is relevant to a wide range of stakeholders including individuals using, managing, facilitating, or supporting team-based research. The abstract submission deadline for oral presentations and posters has been extended to April 17.  
> Learn More

**Discover** what resources are available.  
Search for a keyword    
OR  
Browse by type of resource or goal

**Contribute** new resources to the Toolkit.  
Share your knowledge by uploading tools and information about the practice or study of team science.

**Connect** to colleagues across disciplines.  
Join expert discussions on the blog, add your name to the directory, or stay up-to-date on News and Events.

What Users Are Saving >

Recently Added Resources

- Appointment, Tenure, Promotion, and Merit Rev...
- Big Science teams built on research discovery...
- The Malaysian experience: A new approach in m...

The Toolkit currently includes **942** resources.

Tools  
Measures  
Bibliography

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Recent Blog Posts  
Editorial Board  
Listserv  
Communication Materials



National Council for Science and the Environment  
Improving the scientific basis for environmental decisionmaking

## Interdisciplinary Hiring and Career Development: Guidance for Individuals and Institutions

## Collaboration & Team Science:

A Field Guide



Team Science Online Learning Modules

**COALESCE**  
CTSA Online Assistance for Leveraging the Science of Collaborative Effort

## TEAMSCIENCE

ABOUT | MODULE DESCRIPTIONS | MESSAGE BOARDS | RESOURCES

Introduction START HERE

The Science of Team Science

Team Science Research Process in Behavioral Science

Team Science Research Process in Basic Biomedical Science

Team Science Research Process in Clinical Medical Science

Please disable your pop-up blockers before launching the modules

## COLLABORATION SUCCESS WIZARD



# Team Science Trends



## KEY EMPIRICAL FINDINGS

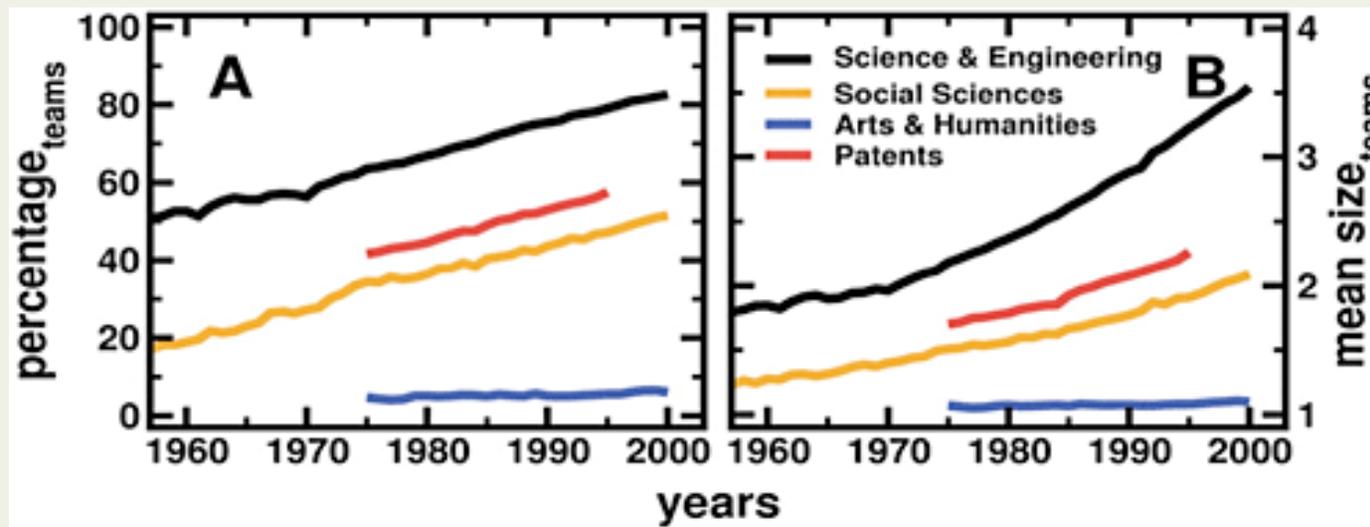
# Teams in science

More of them, greater impact



Number of papers and patents written by team over time

Changes in mean team size over time

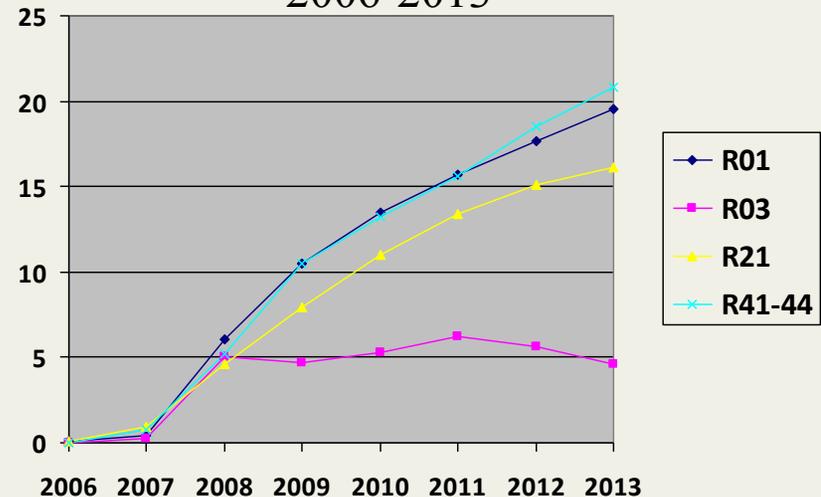


- Research is increasingly conducted in teams across virtually all fields
- ~90% of all work in science & engineering disciplines is done in teams
- **Teams produce more highly cited research & patents than individuals**

# NIH Funding Trends: Multiple PI Grants

- **The multiple PI model was adopted in 2006** in response to –
  - recommendations from the NIH Bioengineering Consortium (BECON), an NIH Roadmap Initiative to stimulate interdisciplinary science, and
  - A directive from the White House Office of Science and Technology Policy (OSTP).
- Allows applicants to identify more than one PI on a single grant application.
- Recognizes that the single PI grant model does not optimally support multidisciplinary collaborations.
- Since 2006, **7,224 multiple PI awards have been funded. The vast majority (81.5%) include two PIs.**

Percent of new NIH grants funded by R-mechanisms that use the multiple PI model, 2006-2013





# Precision Medicine Initiative

Highlighting Culture Shifts in Science



- \$215 million initiative
- Create a cohort = 1 million participants
- Support research at the ***intersection of human biology, behavior, genetics, environment, data science and computation, and much more*** to produce new knowledge with the goal of developing more effective ways to prolong health and treat disease.

The goal of the PMI Cohort Program is to set the foundation for:

- a ***new way of doing research that fosters open, responsible data sharing*** with the highest regard to participant privacy,
- and that puts ***engaged participants at the center of research*** efforts.



## Cancer Moonshot

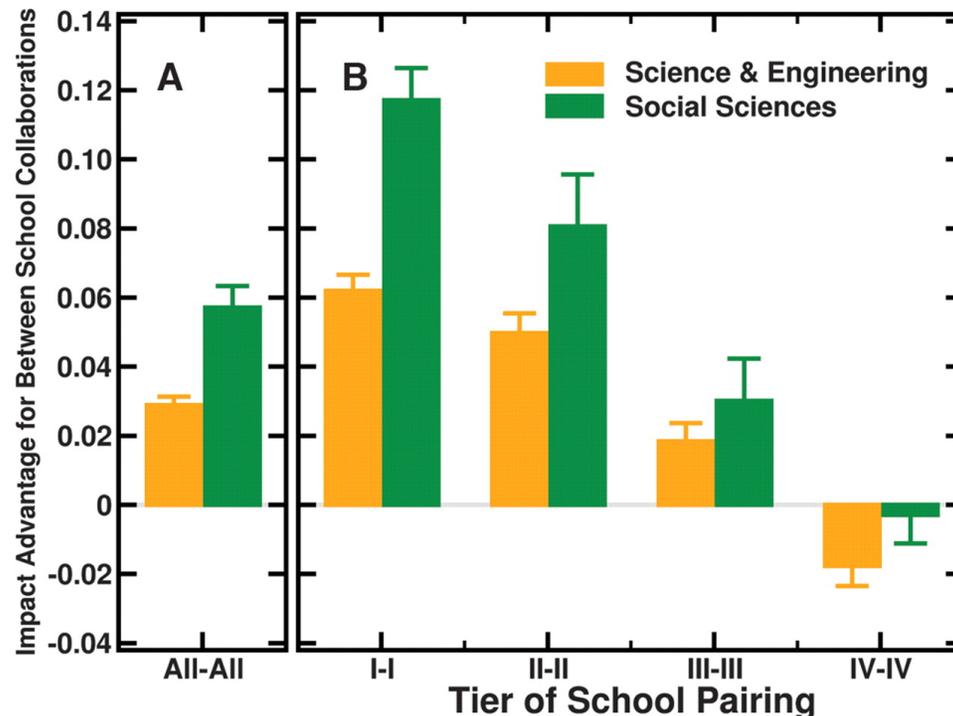
### Highlighting Culture Shifts in Science



- **Key impetus:** “Innovations in data and technology offer the promise to speed research advances and improve care delivery. But the science, data, and ***research results are trapped in silos, preventing faster progress and greater reach to patients.*** It’s not just about developing game-changing treatments—it’s about delivering them to those who need them.”  
- Vice President Biden
- **Key priority: Enhanced Data Sharing:** Data sharing can break down barriers between institutions, including those in the public and private sectors, to enable maximum knowledge gained and patients helped. ***The cancer initiative will encourage data sharing and support the development of new tools to leverage knowledge*** about genomic abnormalities, as well as the response to treatment and long-term outcomes.

# Multi-institutional teams

More of them, greater impact



- Multi-university teams increasingly seen in team publications
- Publications by teams of collaborators from **different universities produced higher impact** work than comparable co-located teams or solo scientists

# “Projects in the wild”

Considerations for enhancing outcomes



- **Multidisciplinary** projects were **superior** to **unidisciplinary** projects in producing **innovative new ideas and tools**
- The projects that used **more coordination mechanisms** also had **more successful outcomes**
  - ▣ e.g., direct supervision, face-to-face mechanisms
  - ▣ Less coordination especially predicted less training and project outreach
- **Greater number of universities** involved in a collaboration **predicted fewer coordination activities and fewer project outcomes**
  - ▣ Dispersed projects that **used more coordination mechanisms** were **more successful** than dispersed projects that used fewer coordination mechanisms

# NCI's investment in TD team science



## **CHALLENGES AND STRATEGIES TD RESEARCH**

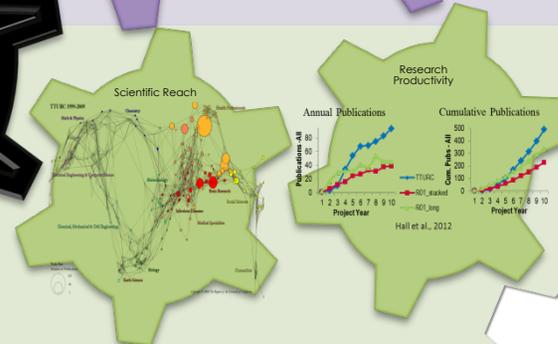
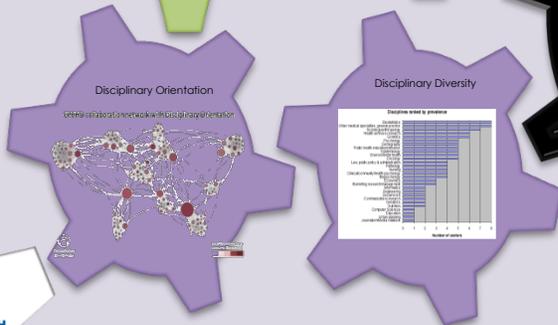
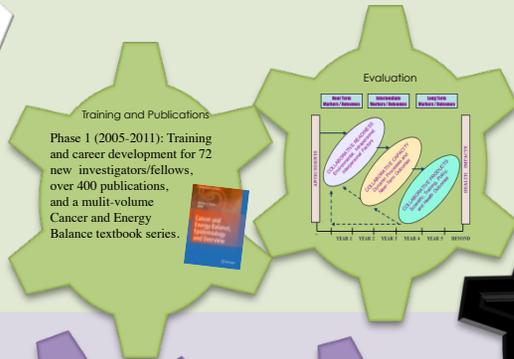
# INTERVENTIONS TO FOSTER DISCIPLINARY INTEGRATION: NCI TRANSDISCIPLINARY (TD) CENTER INITIATIVES

\*in collaboration with NIDA, NIAAA & RWJF (TTURCs) and NHLBI & OBSSR (CPHHD)



Transdisciplinary Research on Energetics and Cancer Centers (TREC) U54 - \$74,811,868

Centers of Excellence in Cancer Communication Research (CECCR) P50 & P20 - \$83,880,445



Centers for Population Health and Health Disparities (CPHHD) P50 - \$66,298,321

Transdisciplinary Tobacco Use Research Centers (TTURC) P50 - \$68,995,753



# HIGHLIGHTS FROM SCITS TEAM EVALUATIONS OF TD RESEARCH CENTERS



## Perspectives from Qualitative Study

- TREC I: Interview Study

## Findings from Quantitative Studies

- TREC, TTURC, CPHHD
- Survey Studies, Bibliometric Analyses, Science Mapping, Written Products Protocol, Social Network Analysis



# CHALLENGES IN TD TS



- **Conceptual and Scientific Challenges**
  - Lack of **clarity** about “what TD is” & “how you get there”
  - TD science “**stretches**” investigators’ intellectual “capacity” more than UD research
  - TD research is **more complex** than UD research
- **Different Disciplinary Cultures Among Collaborators**
  - Differences in **values, language, traditions**
  - Team members want to stay in their “**comfort zone**” (re: disciplinary culture)
- **Management Challenges**
  - TD research = **more** time, resources, planning, and management than UD research
  - **Compromise**, change in routines (e.g., data management)
  - Physical distance = communication challenges, slowed research process
- **Incentive and Recognition Systems and Academic Norms**
  - Academic incentives have **not yet “caught up”** to TD research (e.g., P&T criteria, limited funding opportunities, publishing venues)
  - Colleagues may be **unfamiliar with TD research** (e.g., IRB, grant/manuscript review)

## TD “INTERVENTION” COMPONENTS TO ADDRESS CONSTRAINTS

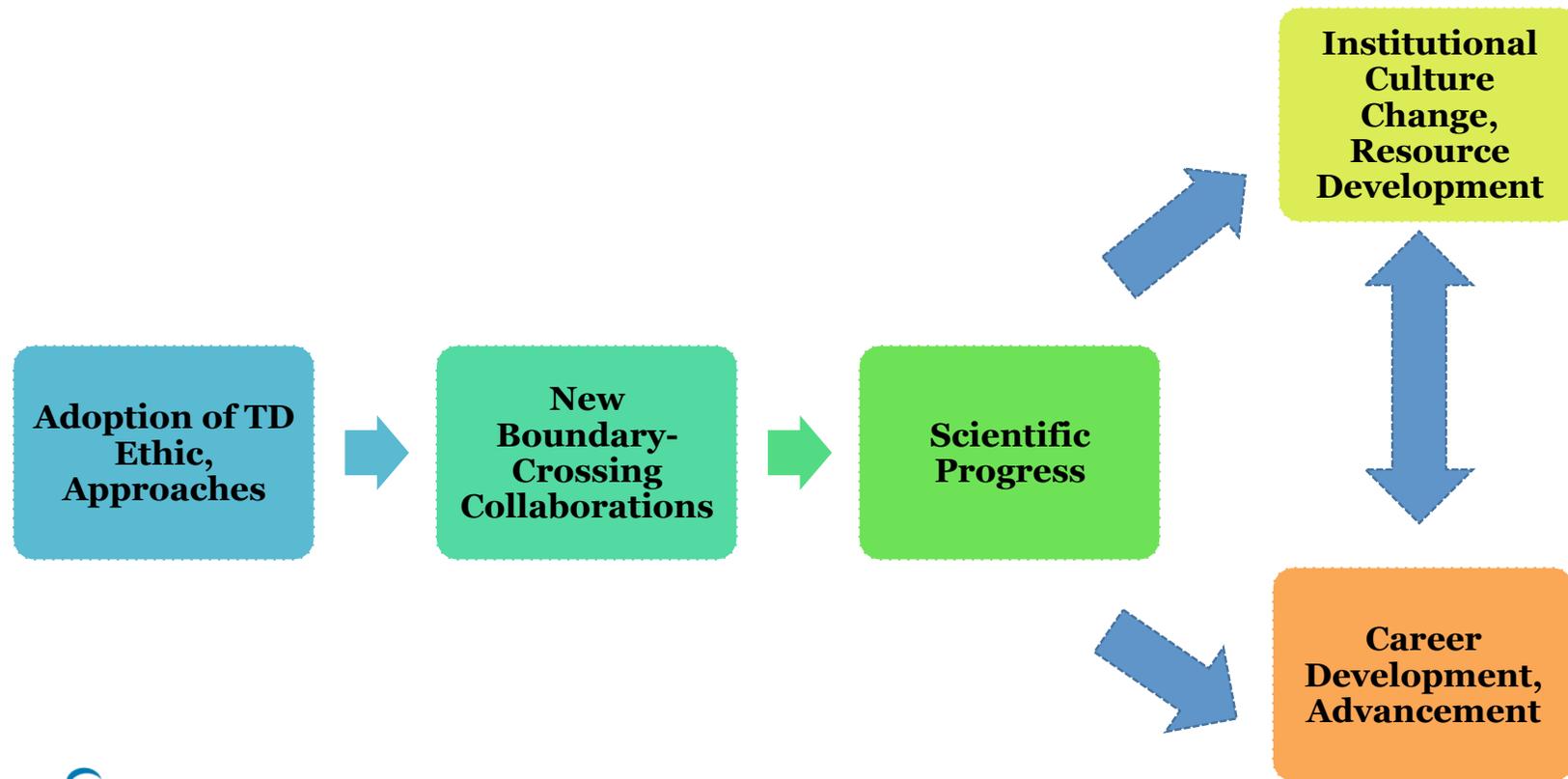


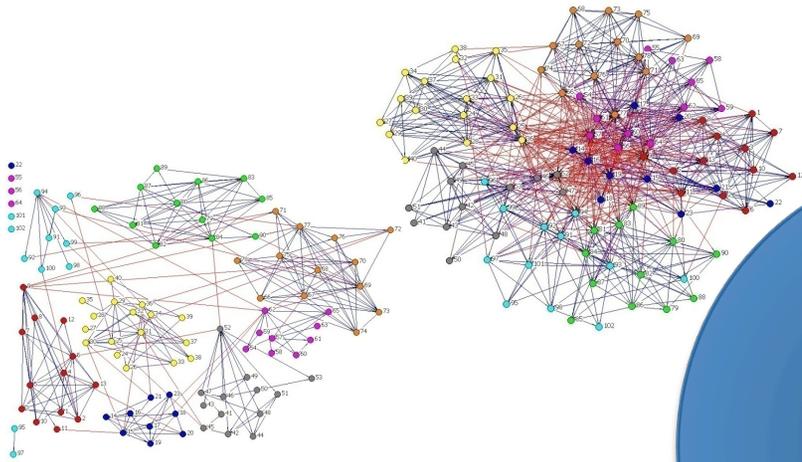
**Goal:** Foster transdisciplinary collaborations to produce science that contributes to reducing the cancer burden

### **Strategies include:**

- ❑ **Funding** – provide incentive; ensure special review; FOA language emphasizes TD TS
- ❑ **Multiple linked projects/centers** – facilitate within/across center integration
- ❑ **Cores/Coordination Center** – provide some “institutional”/administrative support; maximize diverse collaboration; bridging mechanism
- ❑ **Steering Committee** – consistent messaging and reinforce TD goals
- ❑ **Developmental pilot project funds** – address scientific readiness issues; support “unanticipated” integrative ideas; propel emerging areas of TD research
- ❑ **Semi-annual meetings** – foster new collaborations
- ❑ **Training** – address needed TD competencies for investigators at multiple career stages
- ❑ **Evaluation** – highlight NCI's interest in/focus on collaboration and TD; feedback on progress

# IMPACT OF PARTICIPATING IN A TD RESEARCH INITIATIVE

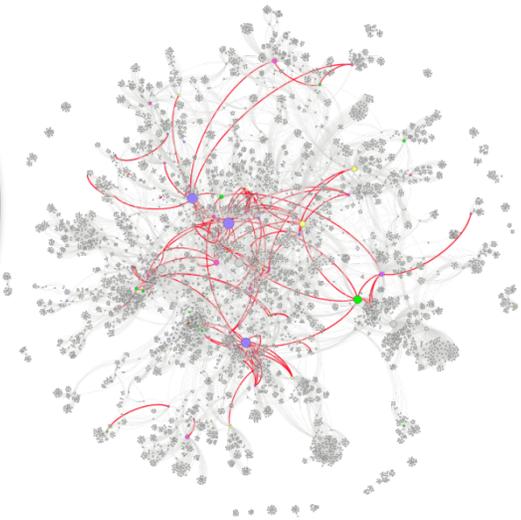




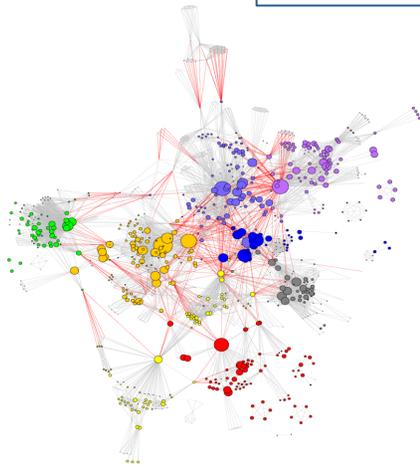
INDIVIDUALS

Increased Collaboration

LEVELS OF ANALYSIS

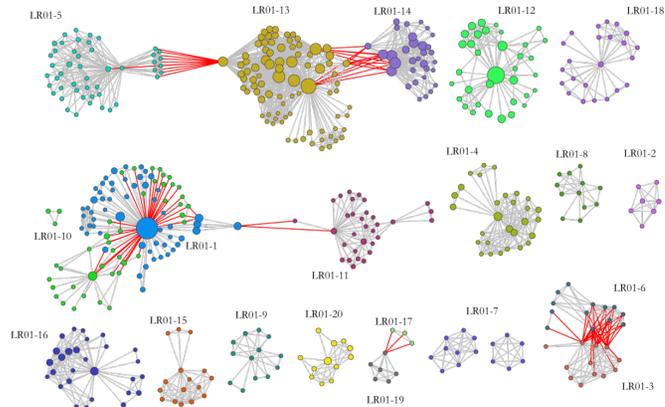


PROJECTS AND CENTERS



1999-2009

Longitudinal R01 Co-Authorship Network



the initiative  
*“transformed”* their  
 attitudes about TD  
 research, and the ways  
 they conduct their  
 research

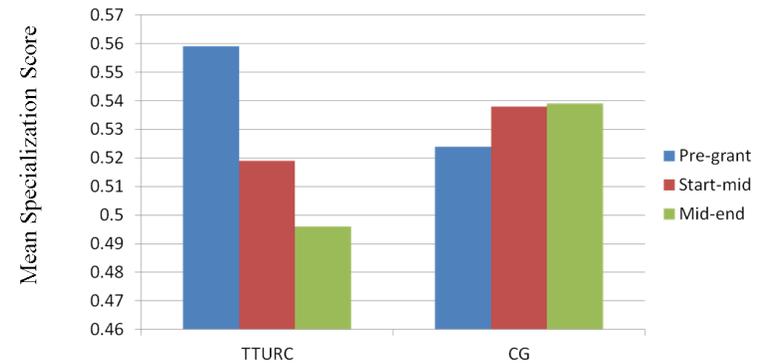
TD ETHIC

Increased  
 Integration

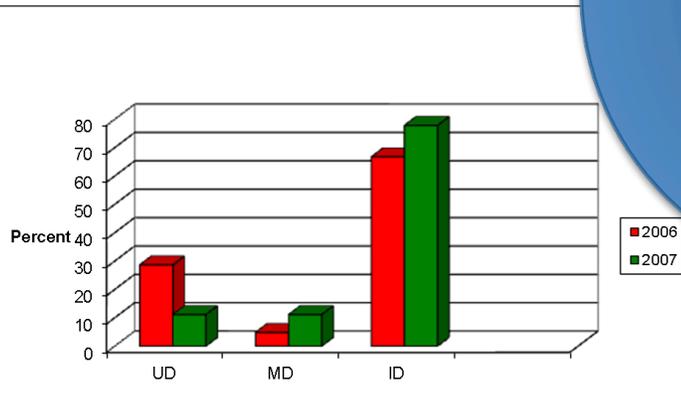
LESS SPECIALIZATION

research is more  
 sophisticated,  
 complex, and  
*“holistic”* than their  
 pre-TD initiative research

COMPLEX & HOLISTIC



- Demonstrates decreases in specialization for TTURCs (increase in diversity of where work is published)



**Key finding:** Increase in cross-disciplinary integration of proposals from year 2 to 3

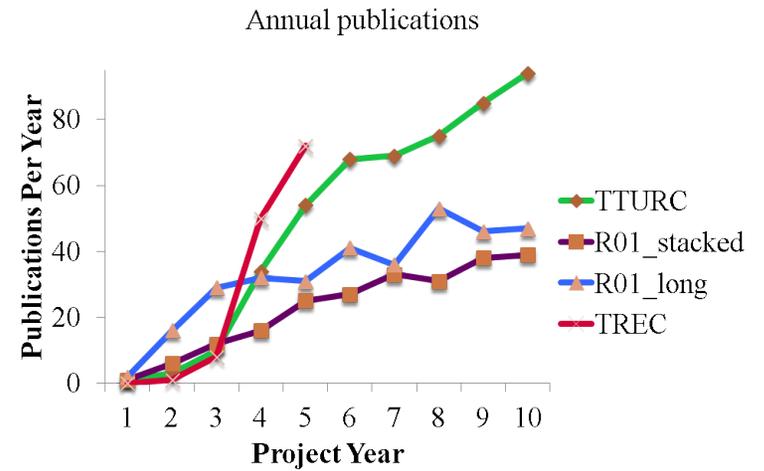
**Method:** Content analysis of pilot grant proposals developed during initiative

MORE INTERDISCIPLINARITY

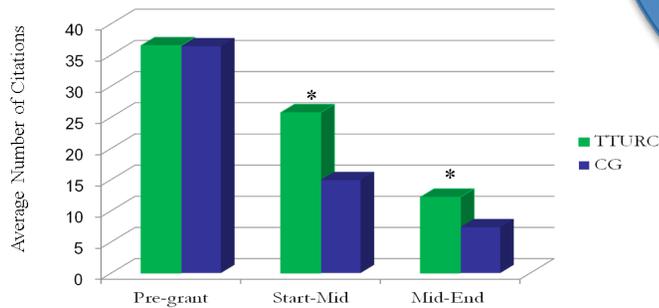
Led to important findings in previously unexplored areas of science

SCIENTIFIC PROGRESS

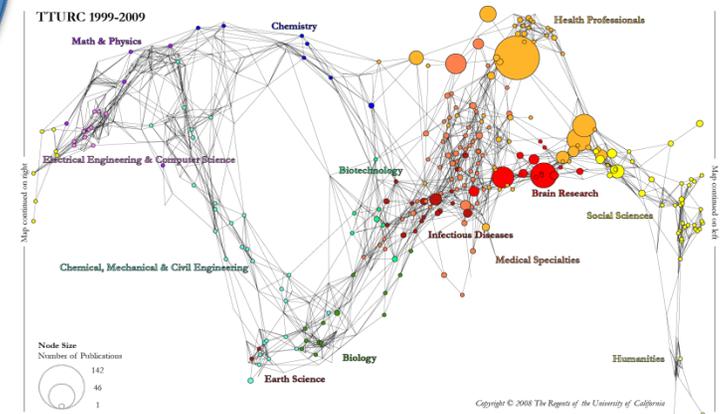
Increased Productivity and Progress



MORE PUBLICATIONS



INCREASED CITATIONS



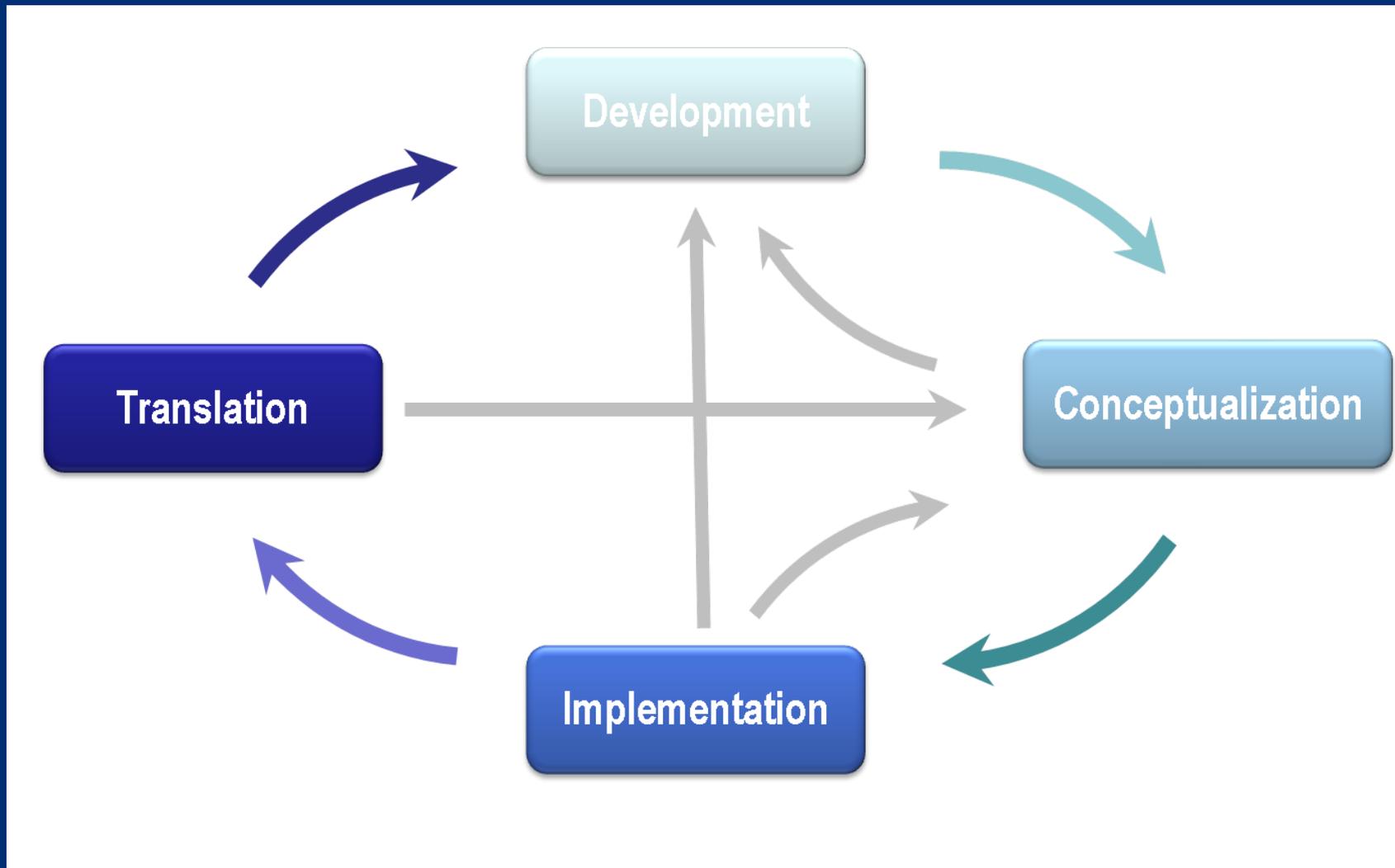
WIDER REACH/BREADTH

# ENHANCING TEAM SCIENCE

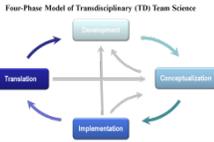


- **Overall we found increases in:**
  - **Integration** (e.g., TD ethic, orientation, and approaches; decrease in specialization)
  - **Collaboration** (i.e., across individuals, projects/centers, levels of analysis)
  - **Productivity** – (number of publications over time)
  - **Reach** - (e.g., spread across map of science, new journals and conferences)
  - **Impact** (e.g., impact factor, citations)
- **We believe these findings help to illustrate:**
  - Added value of TD research (e.g., based on above)
  - With structures in place to help mitigate cultural and structural barriers, we can enhance the way investigators conduct research, engage in collaboration, and advance science
- **Build on emerging evidence and lessons learned** to most effectively and efficiently advance our science
  - There are conceptual models, practical strategies, and resources to help guide and support the conduct of research at the team, center, and initiative levels

# Four Phase Model of Transdisciplinary Research



Source: Hall, KL, Vogel, AL, Stipelman, B, Stokols, D, Morgan, G, & Gehlert, S. (2012). A four-phase model of transdisciplinary research: goals, processes and strategies. *Translational Behavioral Medicine*, 2, 4, 415-430.



# DEVELOPMENT PHASE: GOALS & KEY PROCESSES

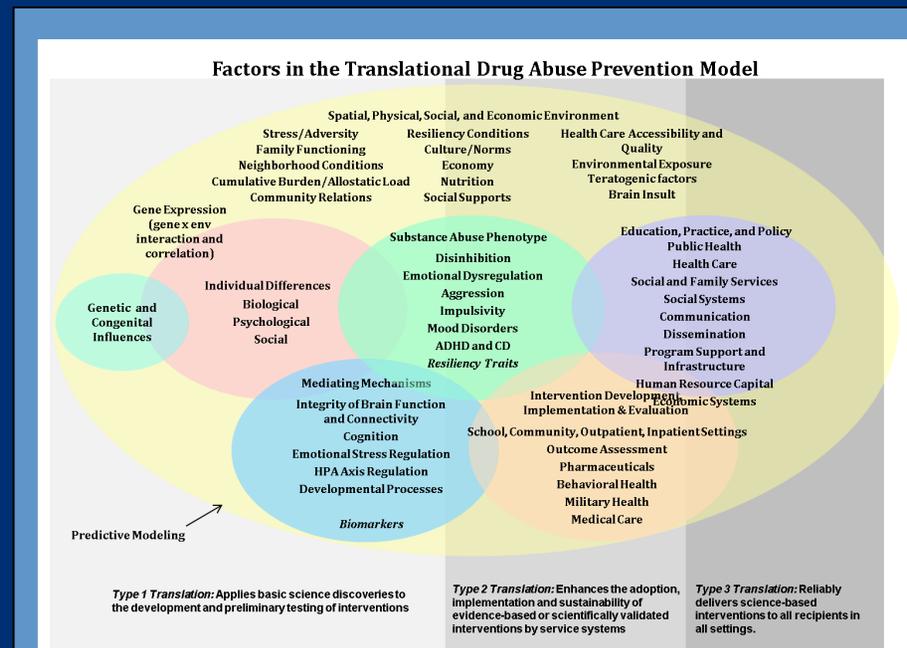
**Goal:** Define the scientific or societal **problem space** of interest, including identifying the intricacies & interconnections of concepts that fall within the problem space & establishing the boundaries of the problem space to be addressed

**Key Processes:** Encourage information sharing & integrative knowledge creation among diverse participants

- Generate shared mission & goals
- Develop critical awareness
- Externalize group cognition
- Developing group environment of psychological safety

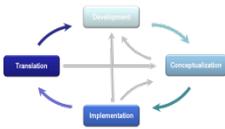
## Team Type:

Network, working group, advisory group, emerging team



Transdisciplinary Science and Translational Prevention Program at RTI International

Engage in a group process to define a TD problem space by collaboratively generating a cognitive artifact that helps to articulate the complexities of the problem space & the wide variety of relevant disciplines & fields



# CONCEPTUALIZATION PHASE: GOALS & KEY PROCESSES

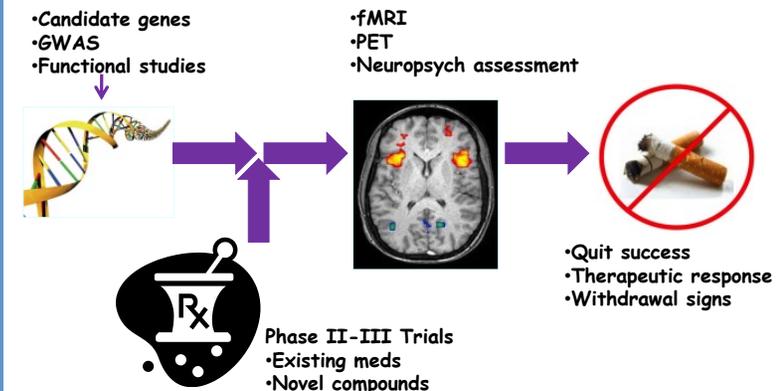
**Goal:** Develop novel research questions, hypotheses, & a conceptual framework & research design that integrate collaborators' disciplinary perspectives & knowledge domains to address the target problem in innovative ways

**Key Processes:** Facilitate integrative knowledge creation among team members & development of a research plan

- Create shared mental models
- Generate shared language
- Develop compilational transactive memory
- Develop team TD ethic

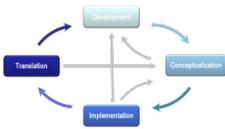
**Team Type:**

Emerging team, evolving team



Lerman, 2012

Use public seminars among collaborators to help develop compilational transactive memory, shared language for a TD research collaboration, team TD ethic, & shared mental model of research collaboration



# IMPLEMENTATION PHASE: GOAL & KEY PROCESSES

**Goal:** Launch, conduct, & refine the planned TD research

## Key Processes:

Developing a shared understanding of...

- who *knows* what (compilational)
- who *does* what (compositional)
- how things get done (taskwork)
- how interactions occur among the research team (teamwork)
  - Compositional, Taskwork, & Teamwork Transactive Memory
  - Conflict Management
  - Team Learning (e.g., reflection, action, feedback, discussion)

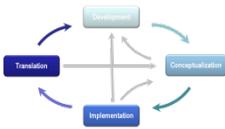
## Team Type:

Real team

“Real” vs “Pseudo” team characteristics that lead to increased performance & innovation:

- Interdependence
- Iterative reflection (systematic consideration of team performance & participation in related adaptation to team goals & processes)
- Demonstrated clear understanding of team membership

Source: West et al, 2011; West & Lyubovikova, 2012



# TRANSLATION PHASE: GOALS & KEY PROCESSES

**Goal:** Apply research findings to **advance progress along the discovery–development–delivery pathway** to ultimately provide innovative solutions to real-world problems

## Key Processes:

- The evolution of the team, as needed, to identify & pursue translational goals
- Development of shared goals for the translational endeavor
- Development of shared understandings of how these goals will be pursued

## Team Type:

Adapted team, new team



# STRATEGIES TO ADDRESS TEAM SCIENCE COMPETENCIES VIA PROFESSIONAL DEVELOPMENT

**Short-term training tools and programs** designed to bring the members of newly formed and ongoing scientific teams up to speed quickly on key competencies for cross-disciplinary collaboration (e.g., increase team knowledge, skills, and attitudes) – For example:

- **Retreats and Workshops**

- *Toolbox for Philosophical Dialogue* (cf. Eigenbrode, et al., 2007; O'Rourke & Crowley, 2013)
- UC Team Science Retreats ( <http://www.news.ucsb.edu/2014/014340/science-team-science> )

- **Online modules and guidebooks**

- *Collaboration and Team Science: A Field Guide* (Bennett, Gadlin, and Levine-Finley, 2010)
- *Teamscience..net* (COALESCE, 2010;).
- *Collaboration Planning Guidance* (Hall, Crowston, Vogel, 2015)

**Source:** Hall, K. L., Stipelman, B. A., Vogel, A. L., & Stokols, D. (2015). Understanding cross-disciplinary team-based research: Concepts and conceptual models from the Science of Team Science. In Frodeman, R., Klein, J. T., & Mitcham, C. (Eds). *Oxford Handbook on Interdisciplinarity, 2<sup>nd</sup> Edition*. Oxford, UK: Oxford University Press



# DEVELOPING SKILLS FOR TEAM SCIENCE

Team Science Online Learning Modules

The screenshot shows a website interface for 'TEAMSCIENCE'. At the top left is the 'COALESCE' logo with the text 'CTSA Online Assistance for Leveraging the Science of Collaborative Effort'. The main title 'TEAMSCIENCE' is displayed in large, blue, 3D-style letters. Below the title are four navigation tabs: 'ABOUT', 'MODULE DESCRIPTIONS', 'MESSAGE BOARDS', and 'RESOURCES'. The 'MODULE DESCRIPTIONS' tab is active, showing five module cards with icons and titles: 1. 'Introduction START HERE' (icon of people), 2. 'The Science of Team Science' (icon of people holding hands), 3. 'Team Science Research Process in Behavioral Science' (icon of a head with gears), 4. 'Team Science Research Process in Basic Biomedical Science' (icon of a microscope), and 5. 'Team Science Research Process in Clinical Medical Science' (icon of a caduceus). Below the cards is a red text prompt: 'Please disable your pop-up blockers before launching the modules' and a blue link: 'To view the Team Science Commercial video, click here!'. At the bottom of the interface is a Facebook 'Like' button and a social media share bar for 'Team Science Online Learning Modules'.

**NUCATS**  
CLINICAL AND TRANSLATIONAL SCIENCES INSTITUTE

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N01-LM-6-3512 from the Office of  
Behavioral & Social Sciences  
Research, (PI: Bonnie Spring)



<http://www.teamsciencetoolkit.cancer.gov/public/TSResourceTool.aspx?tid=1&rid=395/>

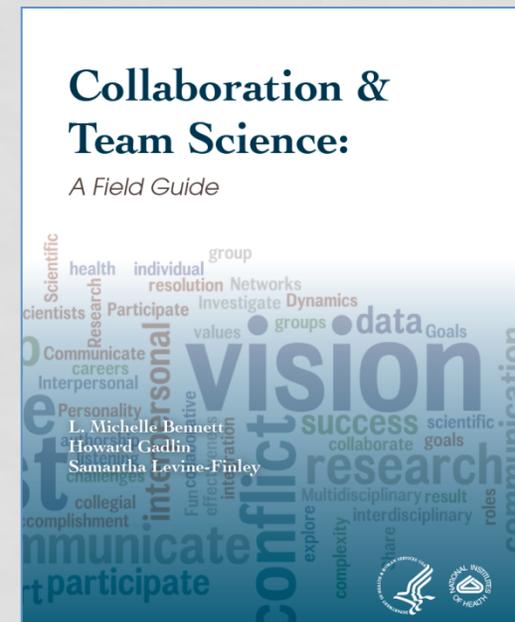


# ENHANCING THE TEAM SCIENCE PROCESS

## **Collaboration and Team Science: A Field Guide** **Bennett L.M., Gadlin H., and Levine-Finley S. (2010)**

### Partial Table of Contents --

- ....Building a Research Team
- Fostering Trust
- Developing a Shared Vision
- Communicating About Science
- Sharing Recognition & Credit
- Handling Conflict
- Strengthening Team Dynamics
- Navigating & Leveraging Networks & Systems
- Challenges.....
- References & Additional Resources
- Appendix: Collaborative Agreement Template





# REDUCING CONFLICT

## “PRENUPTIAL AGREEMENT” FOR SCIENTISTS

- Offers discussion questions to help collaborators commence a project by anticipating, discussing, and resolving possible areas of disagreement common to many collaborations.
- Helps them define expectations related to goals, roles, products, authorship, etc.

### Example Questions:

- What are the expected contributions of each participant?
- What will be your **mechanism for routine communications** among members of the research team (to ensure that all appropriate members of the team are kept fully informed of relevant issues)?
- What will be the **criteria and the process for assigning authorship** and credit?
- When and **how will you handle intellectual property and patent applications?**
- How and by whom will data be managed? How will access to data be managed? How will you handle storage and access to data after the project is complete

# IMPROVING CROSS-DISCIPLINARY COMMUNICATION



The Toolbox Project is intended to provide a philosophical yet practical enhancement to cross-disciplinary, collaborative science. Rooted in philosophical analysis, Toolbox workshops **enable cross-disciplinary collaborators to engage in a structured dialogue about their research assumptions**. This yields both self-awareness and mutual understanding, supplying CDR collaborators with the robust foundation needed for effective collaborative research. Based on the principles set forth in Eigenbrode et al (2007) and other sources, we offer facilitated workshops based on the Toolbox to help your team examine the dimensions of its collaboration and communication from a philosophical perspective.

# ENGAGING COMMUNITY STAKEHOLDERS ("REAL WORLD ACTORS")

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News

Topics

Service

Organisations

Research live

> Homepage > Topics > Co-producing Knowledge > About



## About td-net's toolbox for co-producing knowledge

### Why a toolbox for co-producing knowledge?

At a conference in transdisciplinary research ten years ago, sooner or later somebody would have asked for a definition of transdisciplinarity and for concrete examples of transdisciplinary projects. Over the recent years, to the observation of [td-net](#), this question has become less urgent: Today, scholars agree on a certain variety of understandings and conceptualisations of [transdisciplinarity](#). Furthermore, ever [more project examples](#) are published. The question today is less what transdisciplinary research is, but more how it can be done. By td-net's toolbox for co-producing knowledge we provide some answers to that question.

### What is the purpose of the toolbox?

The purpose of the toolbox is to help inter- and transdisciplinary researchers finding the adequate (mix of) methods for addressing the challenges of co-producing knowledge that they face. For that purpose, td-net provides a series of short method profiles, complemented by information on further reading and reports on how the method is being applied.

### What does co-producing knowledge mean?

According to td-net's understanding, transdisciplinary research involves different perspectives on an issue. Borrowing ideas of [Ludwik Fleck](#), these perspectives can be understood as thought styles held by specific groups of people, i.e. thought collectives. Such thought collectives are for instance biologists, philosophers, farmers or midwives. Processes that involve representatives of different thought collectives jointly coming up with new knowledge are called here processes of knowledge co-production. Such co-

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Topics

Service

Organisations

Research live

> Homepage > Topics > Co-producing Knowledge > Methods



## Overview of methods

### Actor constellation

A role-play for jointly sorting out the relevance of various involved actors for tackling a specific research question

### Delphi

A poll for consolidating expert views on an issue using ratings and arguments.

### Emancipatory boundary critique

A set of questions supporting non-experts in critically challenging an expert's suggested solution to a problem and the solution's social and ecological implications.

### Give-and-take matrix

A tool for identifying pieces of knowledge to be shared between subparts of inter- and transdisciplinary projects

### Most significant change

A story-based, qualitative method for uncovering most significant project impacts experienced by individuals.

### Nomadic concepts

A heuristic tool for exchanging understandings of concepts across disciplinary, professional and cultural boundaries.

### Research marketplace

A tool to initiate bilateral and small group exchange between (sub)projects that need to be linked.

# DIAGNOSTICS TO ENHANCE TEAM COLLABORATION

## “Team Diagnostics” Survey

- Online survey. Free to access, data belong to developers.
- Completed by all team members. Generates a summary report diagnosing team’s strengths and weaknesses.
- Based on five-factor model of team effectiveness in Richard Hackman’s authoritative book, “Leading Teams” (2002), the survey assesses teams on five “conditions of effectiveness”.

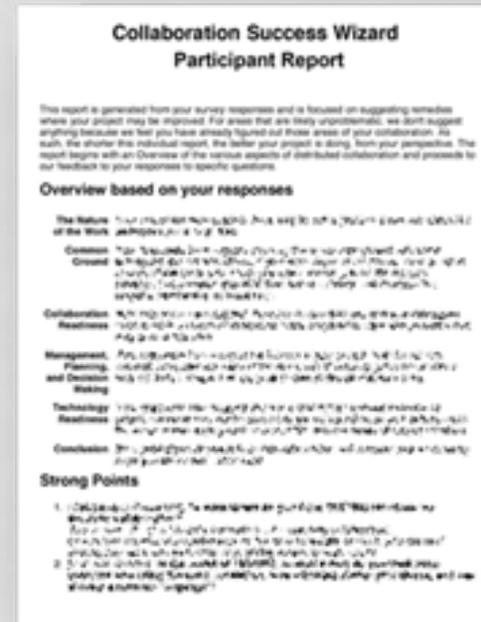


# DIAGNOSTICS FOR ENHANCING DISTANCE COLLABORATION



Online **diagnostic survey** for geographically distributed collaborations.

Probes **factors that may strengthen or weaken the collaboration**. The Wizard provides both personal and project-level reports to help **build successful and productive collaborative projects**.



# COLLABORATION PLANNING

1. Rationale for Team Approach & Configuration
2. Collaboration Readiness
3. Technological Readiness
4. Team Functioning
5. Communication & Coordination
6. Leadership, Management, & Administration
7. Conflict Prevention & Management
8. Training
9. Quality Improvement Activities
10. Budget & Resource Allocation

*NOTFOR DISTRIBUTION without Permission: Working Draft Document Written by:  
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## **How to Write a Collaboration Plan**

### **Why Plan for Collaborations?**

Science is becoming increasingly collaborative, and frequently involves multiple investigators, institutions, disciplines, and fields. Such collaborations often are able to address more complex and sophisticated research problems, by integrating the expertise and resources of multiple collaborators. But they also involve a number of costs, most particularly management complexities, including additional attention to planning for and facilitating effective team functioning, and preventing or addressing challenges specific to teamwork that can threaten the success of the initiative. Poorly managed collaboration may negatively impact the quality of the science, whereas well managed collaborations have the potential to foster innovation, creativity, and productivity.

To help enhance the success in scientific collaborations, funding agencies may ask investigators to submit “collaboration plans” as part of their funding applications, just as they ask investigators to submit research plans. Collaboration plans may benefit any scientific endeavor that includes two or more investigators working together. Though as a proposed scientific collaboration grows in scope and size, such plans become increasingly important.

# STRATEGIES TO ADDRESS TEAM SCIENCE COMPETENCIES VIA EDUCATION

- **Problem-based learning**
  - Problem vs disciplinary focus
  - “in situ” courses - in relevant contexts to gain experiential learning, through faculty supervision and field applications (Lawlor et al., 2015)
- **Team-based learning**
  - Emphasizes preparation outside of class and application during class
  - Small group projects
  - Collaborative theses/dissertations
- **Studio learning**
  - Design studio work focuses on time-limited projects (usually one semester) addressing “complex and open-ended problems” through “rapid iteration of design solutions.” (lawlor et al., 2015)
  - Enables iterative feedback, peer-to-peer learning
- **Team teaching**
  - Experts from relevant areas working together; guest lectures, etc.
  - Enable content from multiple domains, disciplines to be addressed
- **Multi-mentorship model**
  - Students formally (or informally) engaging with mentors from different disciplines, units, organizations
  - Provides scientific and career guidance from multiple perspectives

# CLOSING

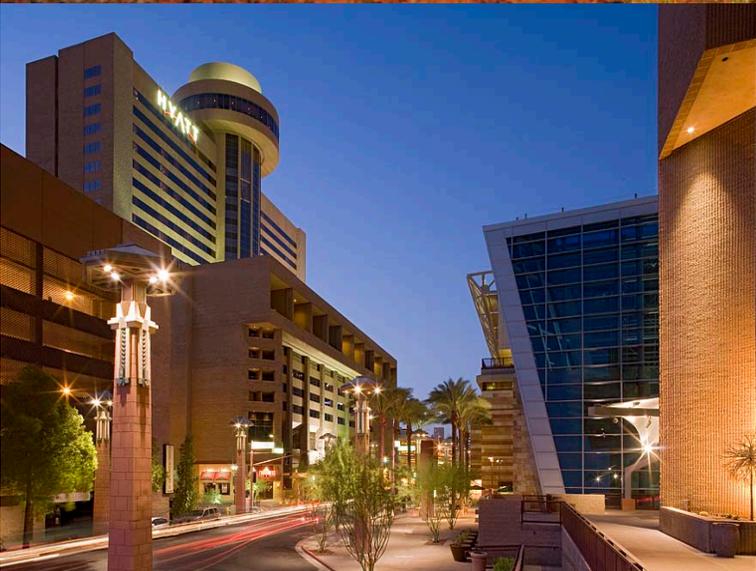
- **Team science trends**
  - Cross-disciplinary, multi-institutional teams generally produce higher impact publications among other outcomes, though coordination and support is critical as the size and complexity of collaborations increase
- **NCI's strategies to advance team science**
  - With structures in place to help mitigate cultural and structural barriers, we can enhance the way investigators conduct science, increase collaboration, and advance science
- **Maximizing the effectiveness of TD collaborations**
  - There are conceptual models, practical strategies, and resources to help guide and support the conduct of research at the team, center, and initiative levels



SciTS  
2016

Building the knowledge base  
for effective team science

SciTS 2016 Conference | May 16-19, 2016 | Phoenix, Arizona



The conference will bring together thought leaders in the SciTS field, researchers engaged in team-based science, and institutional leaders, policy makers, and federal agency representatives who support collaborative research. This year's event will highlight current hot topics and emerging trends, including diversity in science teams, big data, citizen science, open data, and research networking.

To learn more, go to: [www.scienceofteams.org](http://www.scienceofteams.org)

## FOR MORE INFORMATION

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- **SciTSlist listserv, hosted by NIH. Subscribe in one click: [www.teamsciencetoolkit.cancer.gov/Public/RegisterListserv.aspx](http://www.teamsciencetoolkit.cancer.gov/Public/RegisterListserv.aspx)**