National Cancer Institute

Needs and Challenges in the Field

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January 11, 2012

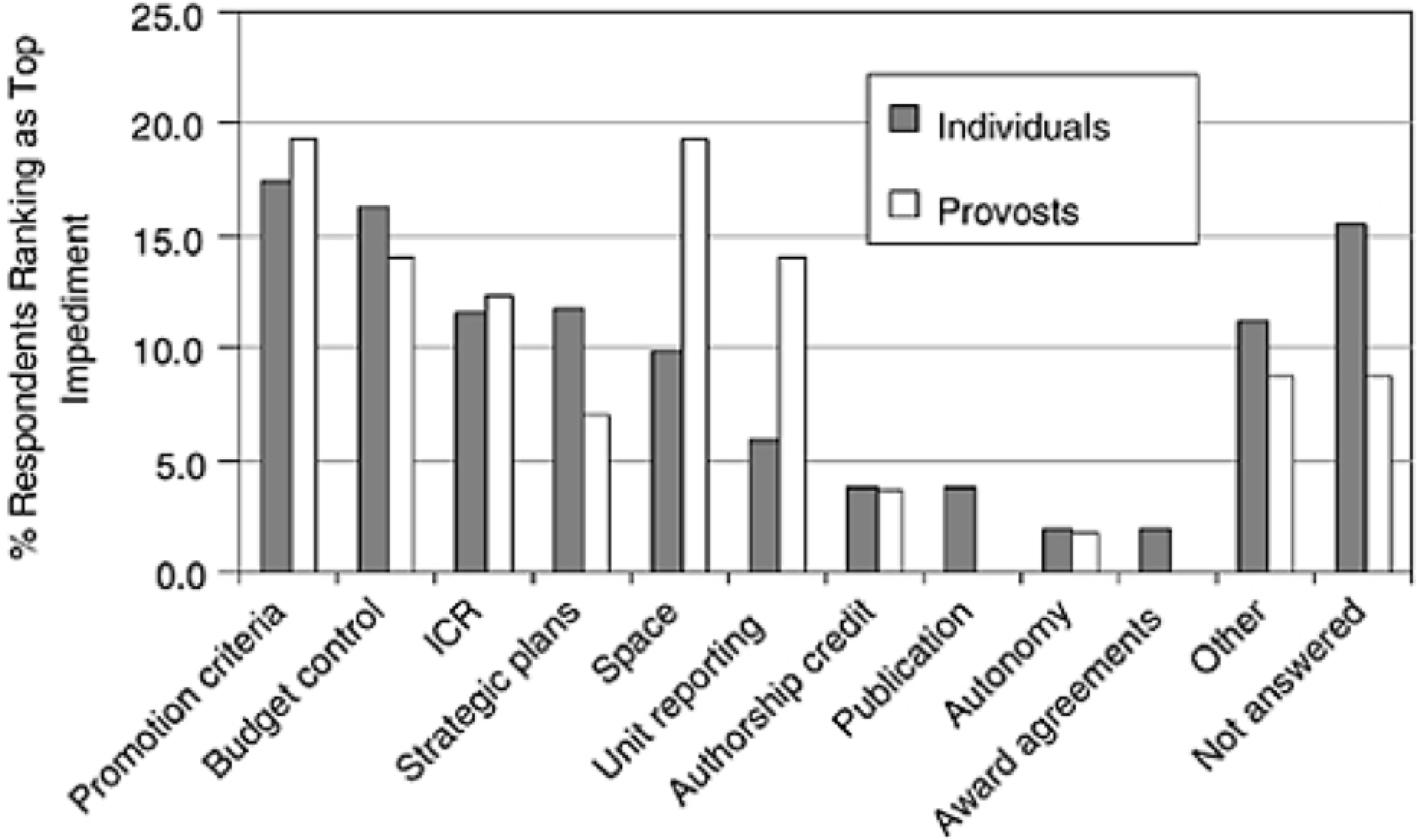
NRC Planning Meeting on Interdisciplinary Science Teams

Special thanks to Amanda Vogel and Brooke Stipelman

Overview Slide

- Pose some questions to consider
- Summarize the responses from Planning Meeting attendees related to needs and challenges in team science
- Share perspectives from NCI grantees on challenges of conducting transdisciplinary research
- Consider the need and role for the science of team science (SciTS)

Impediments to Interdisciplinary Research Identified by Individuals and Provosts

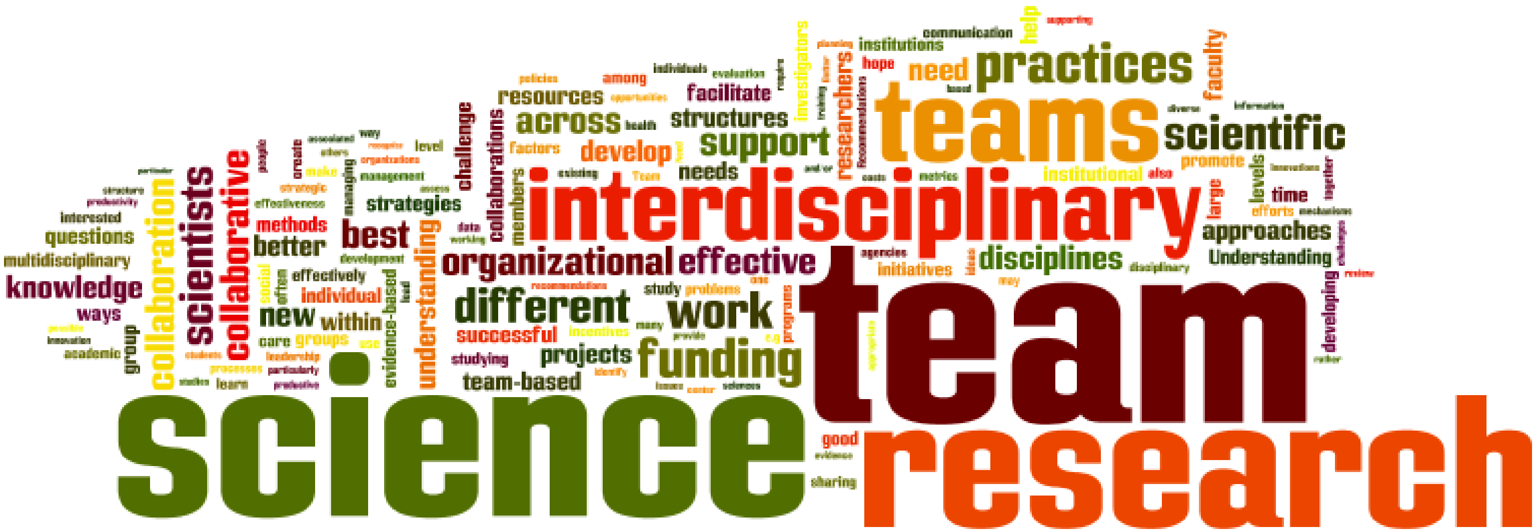


NAS Committee on Facilitating Interdisciplinary Research, 2004

Questions to Consider….

- Why have we not progressed as much as needed since efforts such as the 2004 NAS report on Facilitating Interdisciplinary Research?
- Do we have a lower standard for the methods/strategies we use to support and carry-out scientific endeavors than we do for our research methods and scientific products? Why?
- Why has there been resistance, even among scientists and critical thinkers, to the idea that we need systematic and rigorous research to generate evidence that will enhance the effectiveness and efficiency of our science?

NRC Planning Meeting Registration Survey



NRC Planning Meeting Registration Survey

- Number of registrants (in-person and webcast) = 193 (as of Jan 3)
  - Academia = 102
  - Government = 59
  - Industry = 4
  - Other = 27
- Question 1: What are your greatest needs and challenges related to team science? = 132
- Question 3: What new knowledge, or types of recommendations would you hope to derive from the answers to the study questions you selected? = 95

In a Word…

Evidence

Evidence-based Practice

- Nearly ¼ of the respondents specifically stated the need for "evidence-based", "best", or "effective" practice or strategies
- Nearly ¼ of the respondents specifically called for "recommendations", "policies", "guidance" or "guidelines"

Culture Change

- Collaborative products
  - New methods to handle collaborative data
  - Rethinking research products, venues, authorship
- Academic and disciplinary culture change
  - Breaking paradigm of solo scientist (and traditional hierarchy of roles)
  - Overcoming adherence to existing social structures (e.g., depts.) (structural)
  - Shifting away from ethnocentric disciplinary cultures (to collaborative knowledge creation) (epistemological)
  - Better align institutions (at behavioral, structural, strategic, and

    cultural levels)
- Make the case for and articulate the value of TS
  - Establishing evidence that is compelling across stakeholder groups

15 % of participants provided a response in this area

Organizational Level Issues

- **Incentives** (50%)
  - Promotion and tenure policies for team science (25%)
  - General—mechanisms or policies for promoting collaboration
    - High risk research , integration across experts, recruitment of new investigators
  - Valuing teamwork
  - Leadership embracing and rewarding TS
- **Share credit/resources**
  - Human resources (indiv.), grants, direct/indirect funds, recognition, authorship
  - Get credit for sharing credit
- **Make the case/show the value**
  - Benefits and value of team-based science over other research activities
  - Establish buy-in
- **Promote TS**
  - Best practices/ strategies/examples of how to promote ID /TS

30 % of participants provided a response in this area

Organizational Level Issues

- **Best Practices** (30%) (ideally evidence-based)
  - General – for supporting TS – policies, guidelines, administrative procedures
  - Organizational structure
    - Facilitate effective TS
    - Application/understanding of other models
  - Strategic Planning Strategies
    - Optimizing design of ID research environment
    - Integrating, ideas, projects, programs of research, centers
  - *Guidelines and policies for implementing and disseminating best practices*

Team Phases and Processes

- **Better understanding of and effective methods for addressing phases of team science**
  - Team formation
    - Creating/engineering successful teams
    - Engaging “solo” or reluctant faculty
    - Team composition – e.g., intra-/inter-personal characteristics
  - Conceptual/developmental phases
    - Knowledge sharing/communication
    - Optimizing creative theorizing
    - Cognitive integration
    - Generating/integrating conceptual frameworks
  - Implementation phase
    - Team cohesion
    - Active engagement of all team members
  - Sustainability
    - Maintaining long-term collaborations and teams
- **The relationship of team processes to scientific effectiveness**

25 % of participants provided a response in this area

Team Level – Macro Issues

- Better understanding and evidence-based guidance for:
  - Management
    - Facilitating innovation, team processes
  - Leadership
    - Facilitating knowledge integration
    - Intra/interpersonal skills
    - Training
  - Coordination
    - Coordination centers to reduce collaborative burden
  - Distance collaborations
    - Virtual communication strategies
    - Building relationships
  - Team's scientific effectiveness

35 % of respondents indicated a challenge or need in this area

Cross–disciplinary Collaboration Issues

- **Crossing the disciplinary divide** (50%)
  - Overcoming communication challenges
    - Facilitating an communicating across disciplines /"language" (training and support)
    - Creating common language
  - Addressing culture clashes
    - Managing epistemological differences
    - Achieving respect and cooperation across disciplines
    - Need for critical awareness
    - Understanding dynamics and incentives
    - Navigating differences in rewards (e.g. authorship)
    - Strategies for overcoming organizational constraints – crossing organizational boundaries

25 % of participants provided a response in this area

Cross-disciplinary Collaboration Issues

- **Integration across disciplines**
  - Identifying overlapping areas of interest
  - Maximizing divergent paradigms
  - Creating unified vision
  - Integrating methods, conceptual frameworks (need for/understanding how)
  - Understanding dynamics of collaboration and knowledge sharing
- **Facilitating ID (and TD) research**
  - Understanding the unique characteristics and process of ID research
  - Strategies and tactics to facilitate innovation
  - Increasing engagement of divergent disciplines
- **Training**
  - Addressed in training slide…

Training

- **Training to facilitate team science**
  - Across levels – graduate, postdoc, junior faculty, scientists
  - Interdisciplinary science teams
    - Improve cohesion/effectiveness/innovation
    - Communication across disciplines
    - Managing ID teams
- **Training in additional areas**
  - Management for team/center leaders
  - Leadership/leading teams (across levels)
  - Development of curriculum for transfer of learning across departments

15% of participants provided a response in this area

Funding Agencies

- **Developing/Using/Reviewing Funding Mechanisms** (50%)
  - Create funding opportunities across phases of TS research
  - Provide funding for small team science (not just large initiatives)
  - Develop guidance for TS/collaboration to include in funding announcements
  - Identify review criteria/strategies for reviewing TS applications
- **Facilitate TS**
  - Develop effective structures, policies, resources
  - Facilitate TS across institutions and individuals
  - Support culture change
  - Identify incentives funders can provide for more effective research teams
- **Support SciTS field**
  - Develop research agenda / roadmap
  - Fund SciTS research

15% of participants provided a response in this area

Science of Team Science

- **Models/definitions**
  - Application of the theories/models/frameworks from other disciplines
- **Measurement/metrics**
- **Methods**
  - Multi-level, system science
  - Comparative evaluations
  - Modeling techniques
- **Assessment of processes and outcomes**
  - Demonstrating value add
  - Understanding collaborative process, individual, team, organizational factors (as related to effectiveness, innovation, creativity)
  - Developing and assessing interventions, policies
- **Developing SciTS field**
  - Establishing research agenda
  - Integration and application of related fields/disciplines to advance SciTS
  - Integration of SciTS literature

40% of participants provided a response in this area

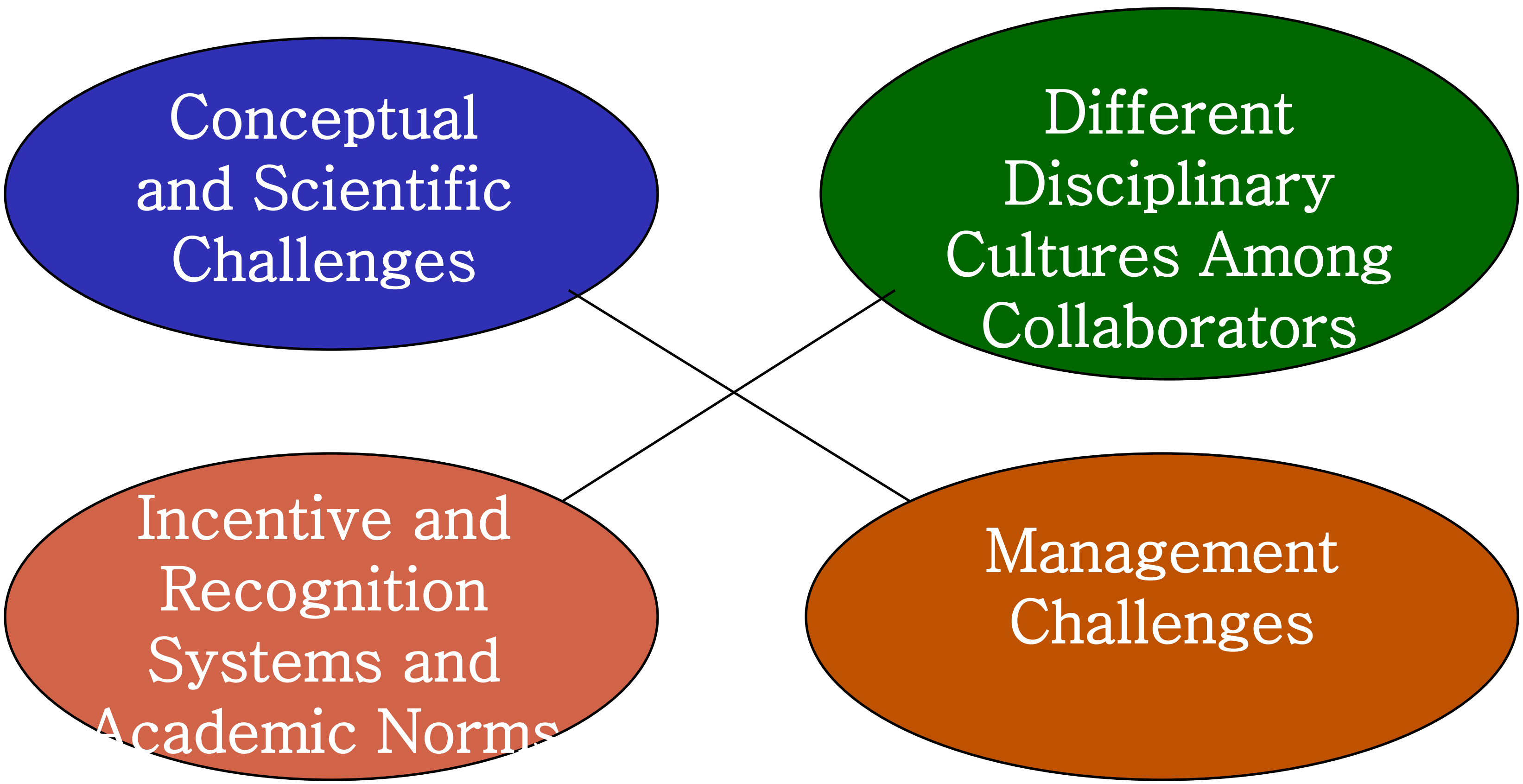
Collaborative Transdisciplinary Research

- **One-on-one qualitative semi-structured interviews with 31 TREC I grantees with the following roles:**
  - Research Center Directors (n = 4)
  - Primary Research Project PIs (n = 7)
  - Developmental Project PIs (n = 8)
  - Biostatistics Core Staff (n = 4)
  - Training Core Directors (n=3)
  - Trainees (n = 9)
  - Coordination Center Staff (n = 3)*

*Does not sum to 31 because some individuals held multiple roles

Conceptual & Scientific	Disciplinary	Management	Incentives & Norms

Challenges to TD Research



Vogel, Stipelman, Hall et al, 2011

Conceptual and Scientific Challenges of TD Research

- **Lack of clarity about "what TD is" & "how you get there"**
  - TREC grantees were TD pioneers – they had limited exposure to prior examples of TD research to serve as models, and there was still debate among scholars about the definition of TD research, creating a lack of clarity

- **TD science "stretches" investigators' intellectual "capacity" more than usual scientific endeavors (more distinct disciplines = more challenging)**
  - Participants described this work as: "challenging", "head-scratching", and "somewhat painful", though ultimately enriching to the science and the scientist

- **TD research is more complex vs. UD research**
  - More variables, more assays, a larger sample size, multiple endpoints, or a longitudinal design to capture the TD interplay of variables

Vogel, Stipelman, Hall et al, 2011

Different Disciplinary Cultures among Collaborators

Different disciplinary cultures among collaborators --

- Values – Different epistemological values and assumptions re: what research questions are valued, variables are of interest, methods are legitimate
- Language – Different terminology, or the same terminology with different meanings
- Traditions – Different work styles: team based vs. individual-based research; statistical methods

Team members want to stay in their "comfort zone" with respect to their disciplinary culture

- Concepts, theories, variables, methods, language, work yle

Vogel, Stipelman, Hall et al, 2011

Management Challenges

- Because it is **more complex**, scientifically, TD research can be **more expensive and time consuming compared to UD** research because it includes more research activities in a single study
  - Staff time and costs
  - Research time and direct costs

- While a large team of varied collaborators created more opportunity for innovation, project planning and management are more complex, and therefore time consuming and expensive–
  - It took more time to create a team and develop a unified vision that integrated all team members' perspectives
  - More effort to manage the team-based research process
  - These activities required more funding

Vogel, Stipelman, Hall et al, 2011

Management Challenges – Distributed Collaborations

- **Collaborators at different institutions have routines for the ways they conduct research** (e.g. data management systems, labs) **and there are challenges to changing these routines** (e.g. IT infrastructure funding, contracts with labs)

- Physical distance created communication challenges, slowed research process

- **The products need to have the potential to be important enough scientifically to justify the costs of new cross-institutional collaborations** (learning curve, uncertainty, effort, time, money)

Vogel, Stipelman, Hall et al, 2011

Incentive and Recognition Systems and Academic Norms Slow to Evolve

Academic incentives have not yet "caught up" to TD research –

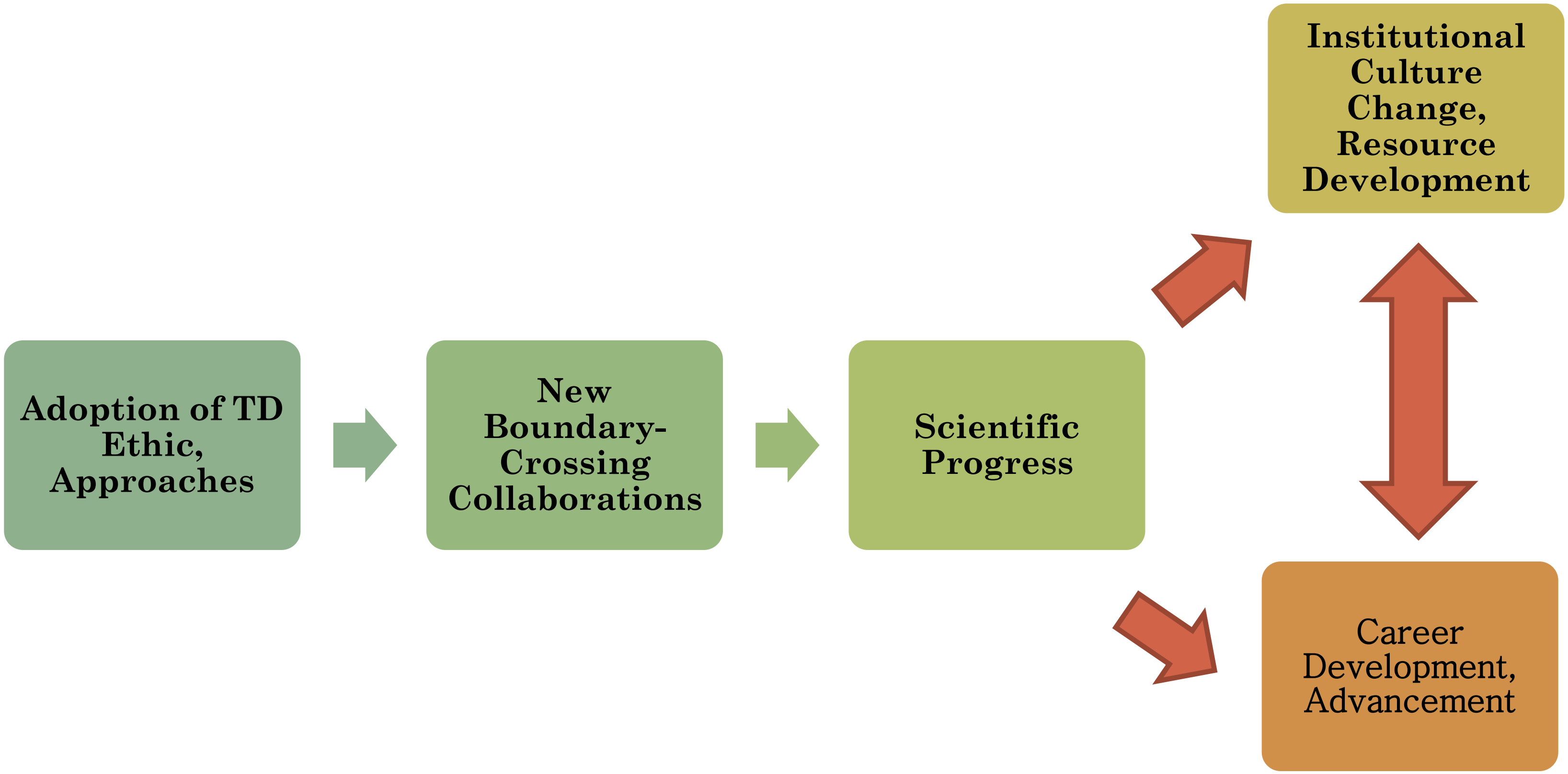
- Lack of systems for cross-school/-department collaborations, and there may be incentives against them
- P&T criteria may reward individual UD research, rather than team-based TD research
  - As a result, scientists may prioritize individual projects, be protective of data and funding, focus on UD work
- Limited TD funding opportunities, unclear where to publish

Colleagues may be unfamiliar with TD research --

- IRB members, grant application and article reviewers, other colleagues
- impact multiple areas involved in career advancement

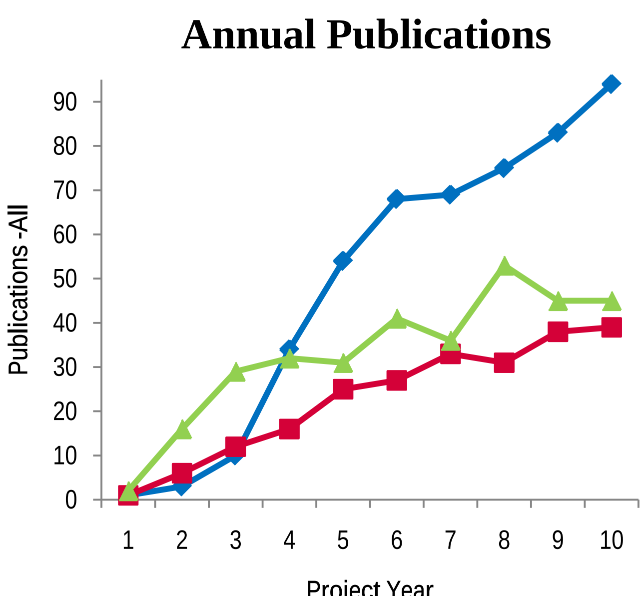
Vogel, Stipelman, Hall et al, 2011

Impact of Participating in TD Research in TREC

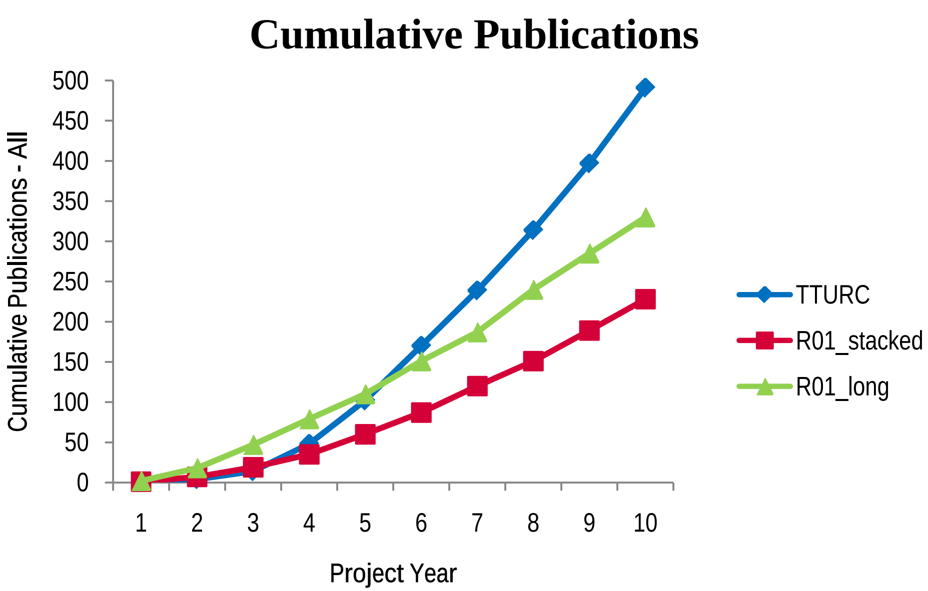


Vogel, Stipelman, Hall et al, 2011

Productivity of Transdisciplinary (TD) Center Grants and R01 Investigator-Initiated Grants



TD center publications have longer start up period compared to R01s but become more productive over time



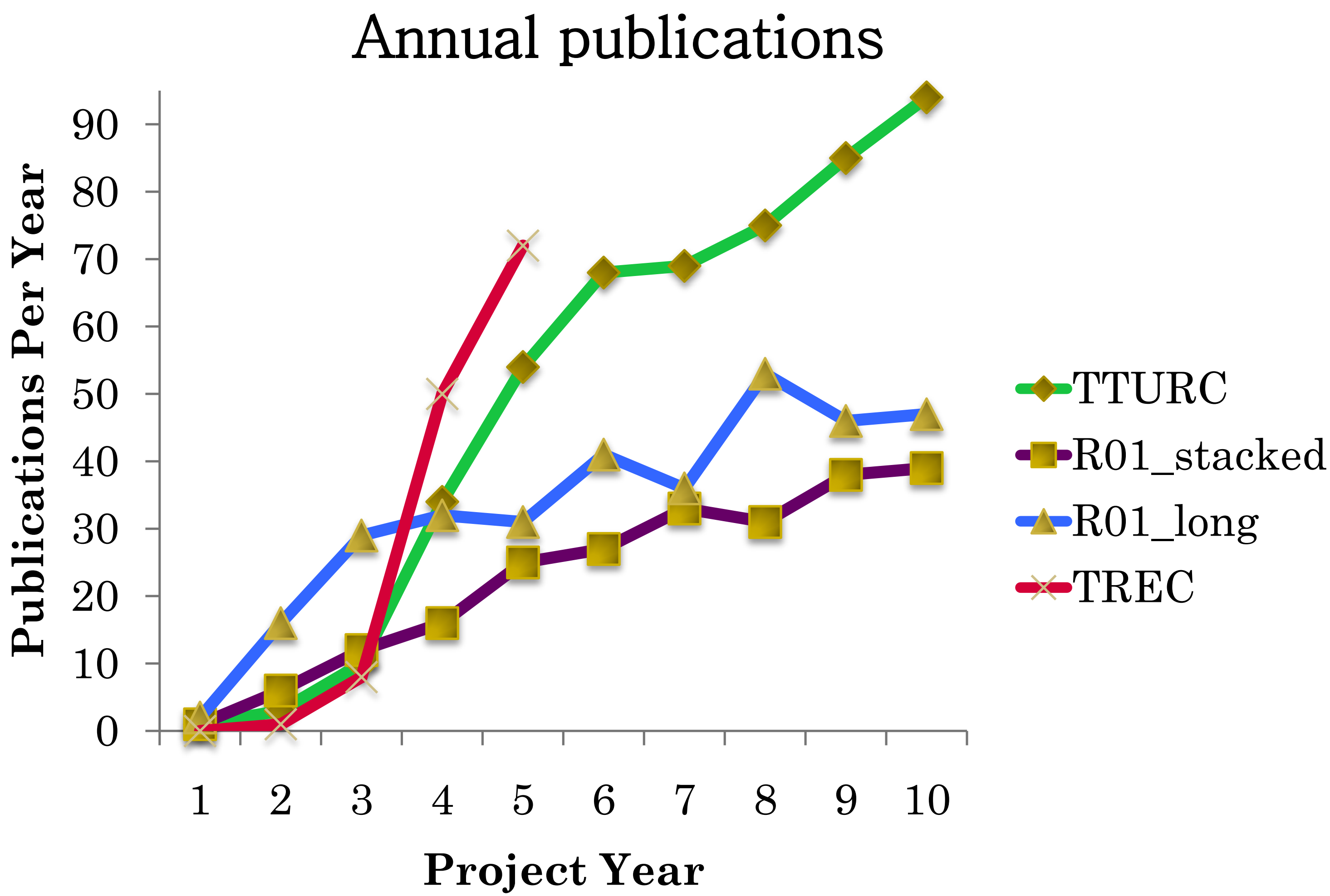
Centers initial lag in number of publications is eliminated around Project Year 4.

Method: Quasi-experimental design comparing number of publications of TTURC initiative with matched R01 projects from the tobacco field over 10-year period

Hall, K.L., Stokols, D., Stipelman, B.A., Vogel, A.L., Feng, A., et al (2012). Assessing the Value of Team Science: A Study Comparing Center- and Investigator-Initiated Grants. American Journal of Preventive Medicine *42*, 157-163.

Comparison Publications TREC I to TTURCs

(Preliminary Findings)



Adapted from:
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NIH Criteria for the Evaluation of All Research Applications

- **1. Significance** . Does this study address an important problem? If the aims of the application are achieved, how will scientific knowledge or clinical practice be advanced? What will be the effect of these studies on the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field?
- **2. Approach** **. Are the conceptual or clinical framework, design, methods, and analyses adequately developed**, well integrated, well reasoned, and appropriate to the aims of the project? Does the applicant acknowledge potential problem areas and consider alternative tactics?
- **3. Innovation** . Is the project original and innovative? For example: Does the project challenge existing paradigms or clinical practice; address an innovative hypothesis or critical barrier to progress in the field? Does the project develop or employ novel concepts, approaches, methodologies, tools, or technologies for this area?
- **4. Investigators** . Are the **investigators appropriately trained** and well suited to carry out this work? Is the work proposed appropriate to the experience level of the principal investigator and other researchers? **Does the investigative team bring complementary and integrated expertise to the project** (if applicable)?
- **5. Environment** . Does the scientific environment in which the work will be done contribute to the probability of success? **Do the proposed studies benefit from unique features of the scientific environment, or subject populations, or employ useful collaborative arrangements? Is there evidence of institutional support?**

Model Results Controlling for NIH Institutional Factors

Criterion	Impact Model
Approach	6.27*
Significance	2.78*
Innovation	1.38*
Investigator	1.10*
Environment	-0.02

* Indicates significance at the 99% confidence level

Impact Model: Coefficients should be interpreted as the increase in overall Impact score due to a one point increase in the given criterion for an average application, all else equal

Wagner, R., Eblen, M. (2010) How Criterion Scores Influence the Overall Impact Score and Funding Outcomes for NIH Peer-Reviewed Applications. Presentation to the Extramural Policy Management Committee.

Needs, Challenges, and the Consensus Study

- Developing evidence-based strategies to enhance the effectiveness and efficiency across all areas of science is of vital importance, so we must forge a path forward.

- We need to :
  - Clearly identify our needs and challenges
  - Synthesize what we already know that can help us understand these needs and challenges
  - Double/redouble/figure out a way to support efforts to strengthen, expand and deepen evidence base
  - Develop evidence-based strategies to address evolving needs
  - Disseminate and implement these radical solutions or practical strategies

- This consensus study is an acknowledgement of the importance of these issues and a call to action to more systematically and seriously address them.

Questions to Consider….

- Why have we not progressed as much as needed since efforts such as the 2004 NAS report on Facilitating Interdisciplinary Research?
- Do we have a lower standard for the methods/strategies we use to support and carry-out scientific endeavors than we do for our research methods and scientific products? Why?
- Why has there been resistance, even among scientists and critical thinkers, to the idea that we need systematic and rigorous research to generate evidence that will enhance the effectiveness and efficiency of our science?
- **What can we do to ensure that this consensus study moves the field forward, so that in 10 years from now we have evidence-based actions that reduce the needs and challenges and markedly increase the effectiveness and efficiency of our science?**