An Evidence-Based Assessment of Research Collaboration and Team Science: Patterns in Industry and University-Industry Partnerships

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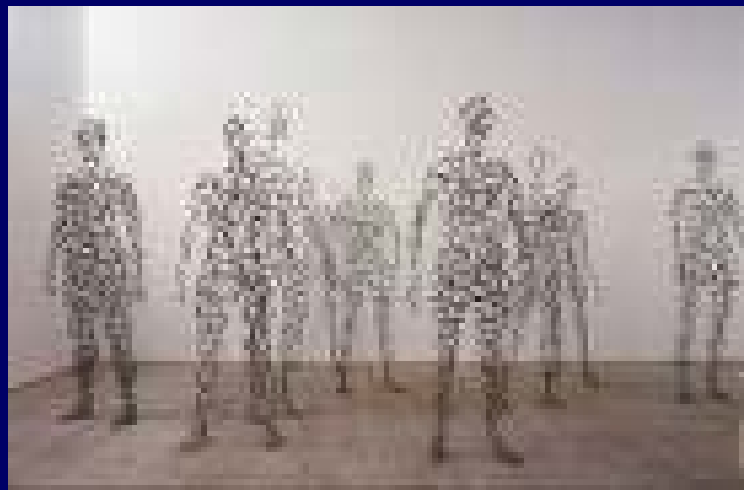
Organization of Scientific Work

- Old Science
  - Brilliant Solitary Researcher

- Modern Science
  - 90% of research in STEM fields
    - Collaboration
    - Teams
    - Networks
    - Co-authorship
  - Specialized Training
  - Complex problems
  - Collaborative Technologies
  - Shared Resources
  - Public Policies

Collaboration

- Definition
  - Social processes
  - Pool human beings' experience, knowledge and social skills
  - Objective is to produce new knowledge
- Collaborators may never meet or interact with one another



Collaboration

- Levels of Analysis
  - Individuals
  - Groups and Teams
  - Organizations
- Study Approaches/Methods Are Diverse
- Sector Differences
- Setting
  - Industry
    - Most Research Collaboration is Here
  - Academia
    - Most Studies of Research Collaboration are Here

Study Focus

- Boundary-Spanning Research Collaborations
  - University-Based
  - University-Industry Partnerships
  - Industry Interdisciplinary Research Collaborations

- Forms
  - Multi-Discipline, Multi-Purpose University Research Centers
  - R&D Alliances
  - Consortia
  - Joint Ventures

SCEC

an NSF + USGS center

Study Questions

- Influences on research organization productivity and effectiveness
  - Needed organizational structures, policies, practices and resources
    - Human resource management
    - Cyberinfrastructure
  - Effective research management approaches, partnership models and leadership styles
  - Incentives for academics
  - Intellectual property and conflict of interest issues
- Reasons for failure
- Implications for practice

Sampling Frame

- Empirical Evidence
  - Quantitative
  - Qualitative
- Not
  - Conceptual Models
  - Unverifiable Personal Insights
  - Unsupported Anecdotes or Opinions

Theoretical Frame

- Scientific and Technical Human Capital (STHC)
  - Social Knowledge, Skills and Resources
  - Formal Education, Training, Social Relations
  - Network Ties
    - Other Scientists, Funding Agents, Vendors, Entrepreneurs, Equipment Developers, Technicians, Public Officials, etc

- Collaboration
  - Is Driven By the Need to Pool STHC to Address Challenges
  - Develops STHC

Organizing the Literature

- Inputs and Resources
  - People and Groups
  - Materiel
  - Organizational Capital
- Processes and Activities
  - Project Level Management and Leadership
  - Organization Level Management

Organizing the Literature

- Outputs, Outcomes, Impacts
  - Enhanced Outputs and Impacts
    - Knowledge-Focused, Property-Focuses
  - Enhanced Scientific and Technical Human Capital
  - Negative Impacts of Collaboration

- Contextual Factors
  - Sector
  - Function
  - External Resources Environment

Findings

- Engineering Disciplines Most Likely to Collaborate with Industry
- Disciplinary Heterogeneity
  - Increased Productivity
  - Heterogeneity of Incentives and Motivations
  - Hierarchical and More Formalized Organizationally
- **Little Research Has Considered Past Productivity as an Antecedent to Collaboration**
  - **Measurement Issues with Pubs and Patents**

Findings

- Heterogeneous Research Experiences
  - **Findings are Mixed**
- Prior Acquaintance and Trust
  - Very Important
  - Easiest with High Similarity
  - Can Compensate with Formal Structures and Authorities

Findings

- Tangible Capital
  - Collaborate to Gain Access to Resources and Capabilities
- Intangible Organizational Capital
  - Ability to Coordinate and Manage Diverse Resources
  - Induces Coordinated Problem Solving
  - **Most Important Resource and Input to Collaboration**

Management and Leadership

- Project Level Teams Well Studied
  - Best Local Practices May Not Be Robust Across Situations
  - Equifinality (Multiple Possible Practices) So Successful Collaborations Can Differ

Management and Leadership

- Organizational Level
  - Levers for Coordinating Inputs and Resources
    - Goal Congruence, Resource Interdependence, Formal Authorities

- **Center Management Underdeveloped**
  - **Little Research on Effective Responses**

Collaboration Assessment

- Products
  - Knowledge Focused
    - Publications, Citations
  - Property Focused
    - Patents, Patent Citations, Commercial Products
  - Capacity Building
- **Measurement Weaknesses Abound**
- **Baseline Data N/A**
  - Productivity When Not Collaborating

Who Benefits?

- Increased Science and Technology Human Capital
  - Additive so Improved Individual, Group, Lab, Firm and Research Center STHC
  - **Mediated by Ability to Deploy the STHC (Intangible Organizational Capital)**

Study Questions

- Effective research management approaches, partnership models and leadership styles
  - **Evidence Base Is Minimal**
  - Importance of
    - Monitoring of Terms of Contracts
    - Trust
    - Alliance Management
    - Proximity
  - **Management Practices of Collaboration Organizations Often Poorly Thought Out**

Reasons for Failure

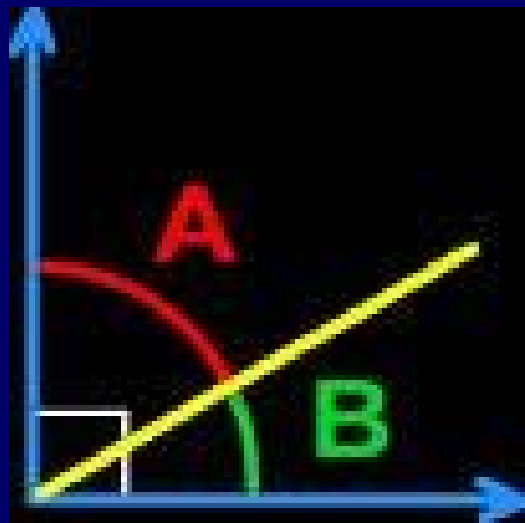
- **Poorly Understood**
  - Threshold Effects
  - Interactions Among Variables
- Inherent Instability?
- Intellectual property and conflict of interest issues
  - Alliance Management Skills

Recommendations

- Much Is Well-studied Already
  - Dyads, Triads, Small Groups
  - Co-authorship and Patenting Patterns

More Research Needed

- How Choose Among Available Collaborative Institutions and Modalities
- Institutional Failures and the “Dark Side”
- Science and Technology Human Capital Aspects



More Research Needed

- Management of University-Based Centers
  - Scientists Expected to Become Managers
  - Inadequate Professional Managerial Training
- Field Experiments/Find Patterns Across Instances
- Impact-Focused Research
  - Multiple Informants, Longitudinal

Thank You