National Cancer Institute

The Science of Team Science: An Overview of the Field

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

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Overview

- Present working definitions of key terms: the science of team science (STS), team science (TS) initiatives
- Describe diverse attributes of TS initiatives and scientific teams with respect to their size, organizational complexity, disciplinary composition, major goals, and geographic scope
- Focus on large research, training, and translational initiatives that are intended to promote cross-disciplinary integration
- Outline major conceptual, methodological, and translational concerns of the STS field and research questions that warrant further study

What is The Science of Team Science?

- The science of team science (STS) is a rapidly emerging field concerned with understanding and managing circumstances that facilitate or hinder the effectiveness of large-scale research, training, and translational initiatives

- The STS field has grown steadily in recent years, partly in response to societal concerns about the cost-effectiveness and accountability of public and private sector investments in team-based initiatives

- The STS literature encompasses diverse conceptual models and methodologies that have been used to assess the antecedents, processes, and outcomes of cross-disciplinary research programs

- There is a need to characterize the STS field more clearly in terms of its major theoretical, methodological, and translational concerns

Team Science Initiatives--Key Features

- Team science (TS) initiatives are the principal units of analysis in STS studies--they include large research, training, and translational programs implemented by public agencies and non-public organizations

- TS initiatives are designed to promote collaborative and often cross-disciplinary approaches to analyzing research questions about particular phenomena

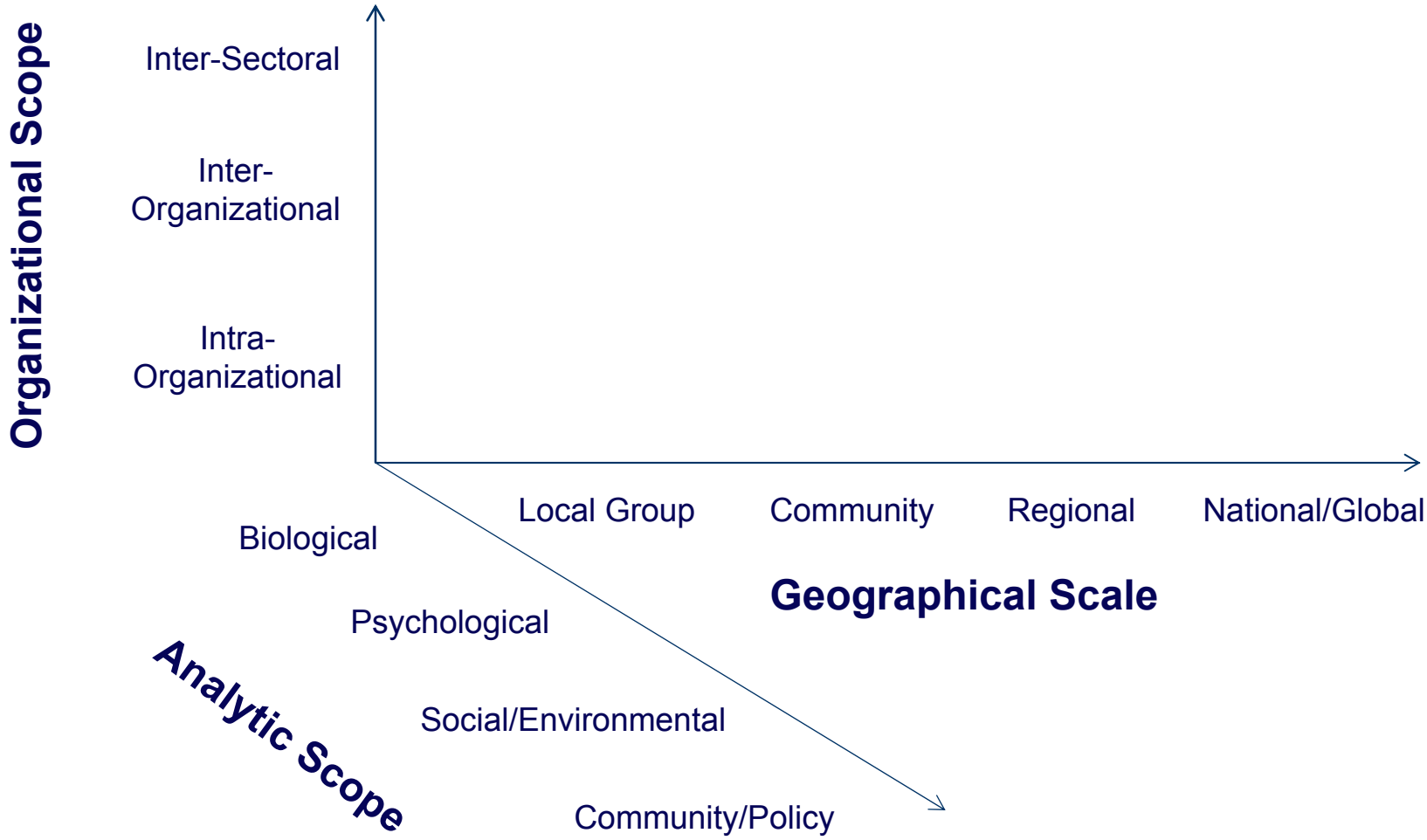
Diverse Attributes of Scientific Teams

- Research teams may be comprised of investigators drawn from the same or different fields (unidisciplinary vs. cross-disciplinary teams)

- Teams also vary by size, organizational complexity, and geographic scope ranging from a few participants working at the same site to scores of investigators dispersed across multiple geographic and organizational venues

- Research teams have diverse goals spanning scientific discovery, training, clinical translation, public health, and policy-related goals; the relative priorities among these goals vary from one initiative to the next

Organizational, Geographic, and Analytic Scope of Team Science Initiatives



(Stokols, 2006)

Present Focus on Large Research Initiatives

- TS projects can include a handful of scientists working together at a single site, but we focus here on larger and more complex initiatives comprised of several investigators who work collaboratively on multiple projects and may be dispersed across different departments, institutions, and geographic locations

- Large research initiatives are solicited through specific requests for applications (RFAs), each with an average annual expenditure of $5M and a duration of five or more years (Trochim et al., 2005)

- Large research initiatives often incorporate training, clinical translation, and community health components or "cores"

Emphasis on Cross-Disciplinary Initiatives

- This discussion focuses on initiatives intended to promote cross-disciplinary (CD) collaboration. CD teams strive to combine and in some cases integrate concepts, methods, and theories drawn from two or more fields

- Three different approaches to CD collaboration have been described by Rosenfield (1992):
  - *multidisciplinarity* (MD)
  - *interdisciplinarity* (ID)
  - *transdisciplinarity* (TD)

Conceptual Concerns Within the STS Field

- Defining Key Terms
  - Team science (TS) initiatives
  - The science of team science (STS)
  - Types of cross-disciplinary (CD) collaboration (UD, MD, ID, TD research, training, translation)
  - Criteria of program effectiveness (e.g., quality and scope of ID and TD integration)
  - Readiness and capacity for scientific collaboration
- Developing Theoretical Frameworks
  - Antecedent-process-outcome models of scientific collaboration
  - Typology of contextual influences on collaboration
  - Identifying “high-leverage” determinants of collaboration readiness and capacity

Defining Qualities of Cross-Disciplinary Collaboration

- Multidisciplinary - researchers in different disciplines work independently or sequentially, each from his or her own disciplinary-specific perspective, to address a common problem

- Interdisciplinary - researchers work jointly, but from each of their respective disciplinary perspectives, to address a common problem

- Transdisciplinary - researchers work jointly to develop a shared conceptual framework and methodological approach that integrates and transcends their respective disciplinary perspectives to address a common problem

(Rosenfield, 1992)

Definition of Interdisciplinary Research in The NIH Roadmap Initiative

- "Interdisciplinary research integrates the analytical strengths of two or more often disparate scientific disciplines to create a new hybrid discipline. By engaging seemingly unrelated disciplines, traditional gaps in terminology, approach, and methodology might be gradually eliminated"
- Examples of interdisciplinary hybrid fields:
  - Genomics
  - Bioinformatics
  - Proteomics
  - Populomics
  - Psychoneuroimmunology

(Nihroadmap.nih.gov/interdisciplinary)

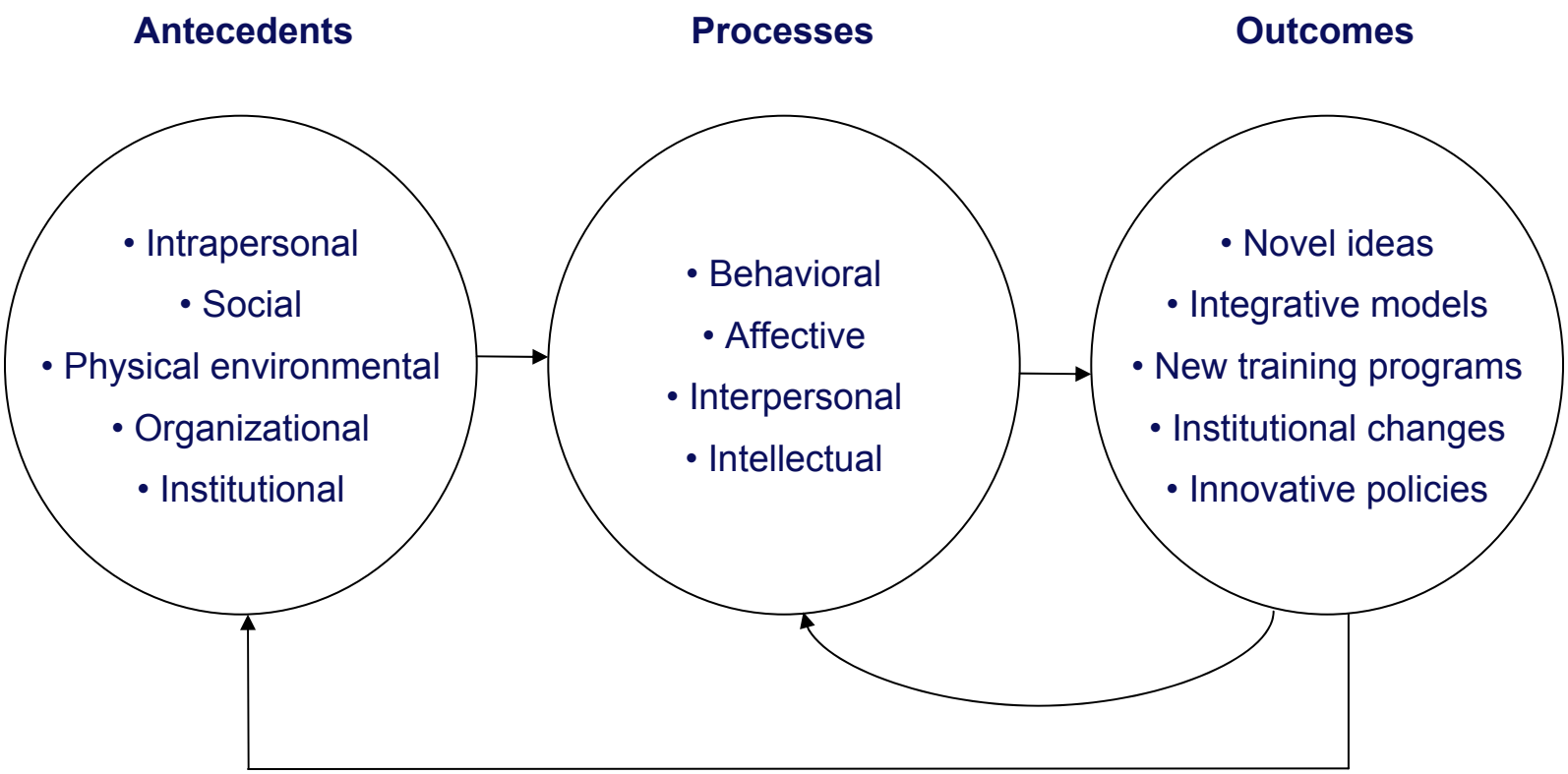
Defining and Measuring Program Effectiveness

- Traditional evaluative criteria of scientific quality emphasize conceptual validity, originality, methodological rigor, and the quantity of research outputs such as peer-reviewed publications
- Criteria for evaluating TD team science add the following considerations:

  (1) the quality and scope of cross-disciplinary integration reflected in new conceptual models and methodological strategies

  (2) the impact of integrative intellectual products in forging new avenues of scientific research, training, clinical applications, health policy, and improved health outcomes

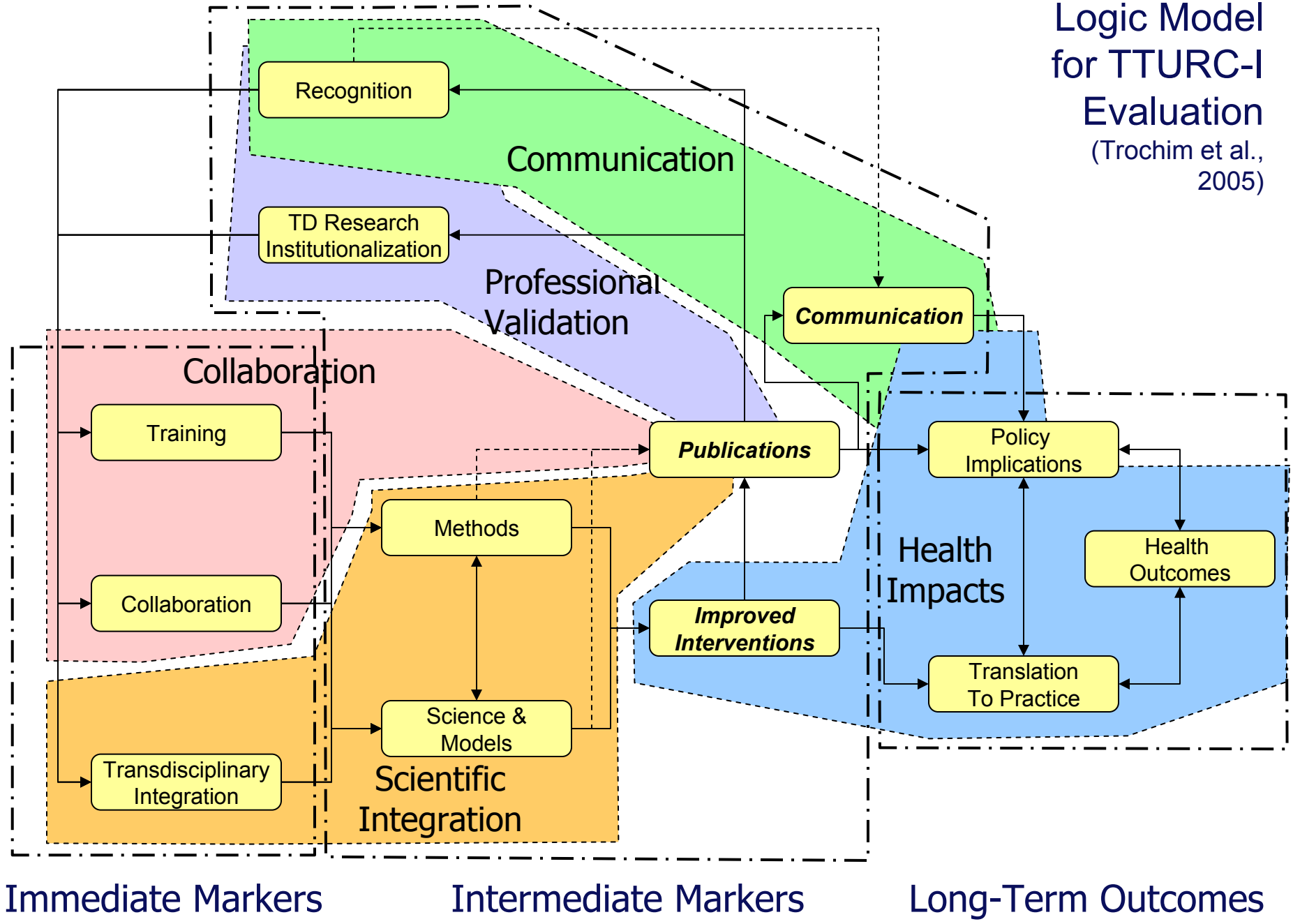
Conceptual Model of Transdisciplinary Scientific Collaboration



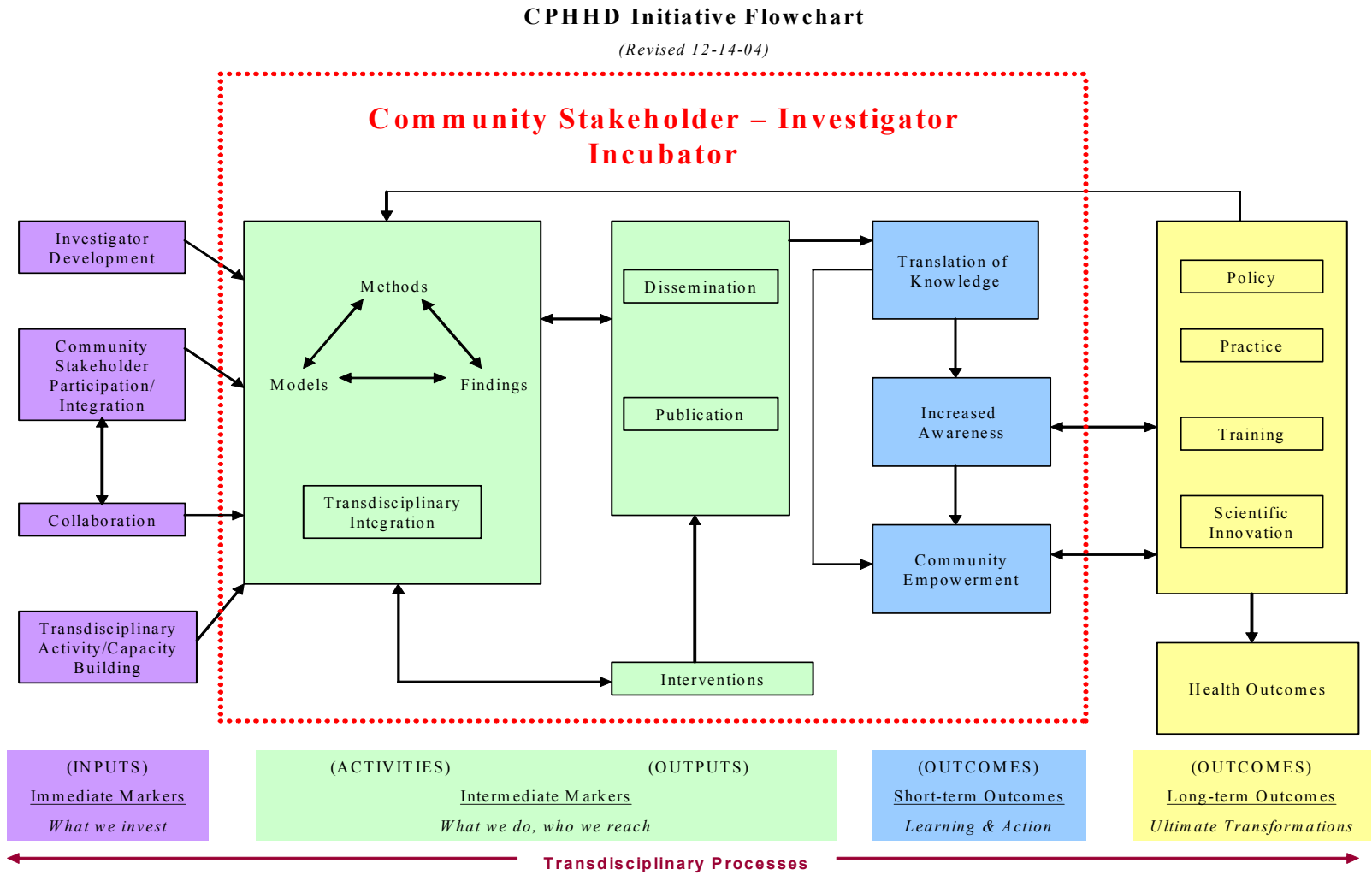
(Fuqua et al., 2002; Stokols et al., 2003)

Collaboration Readiness Factors

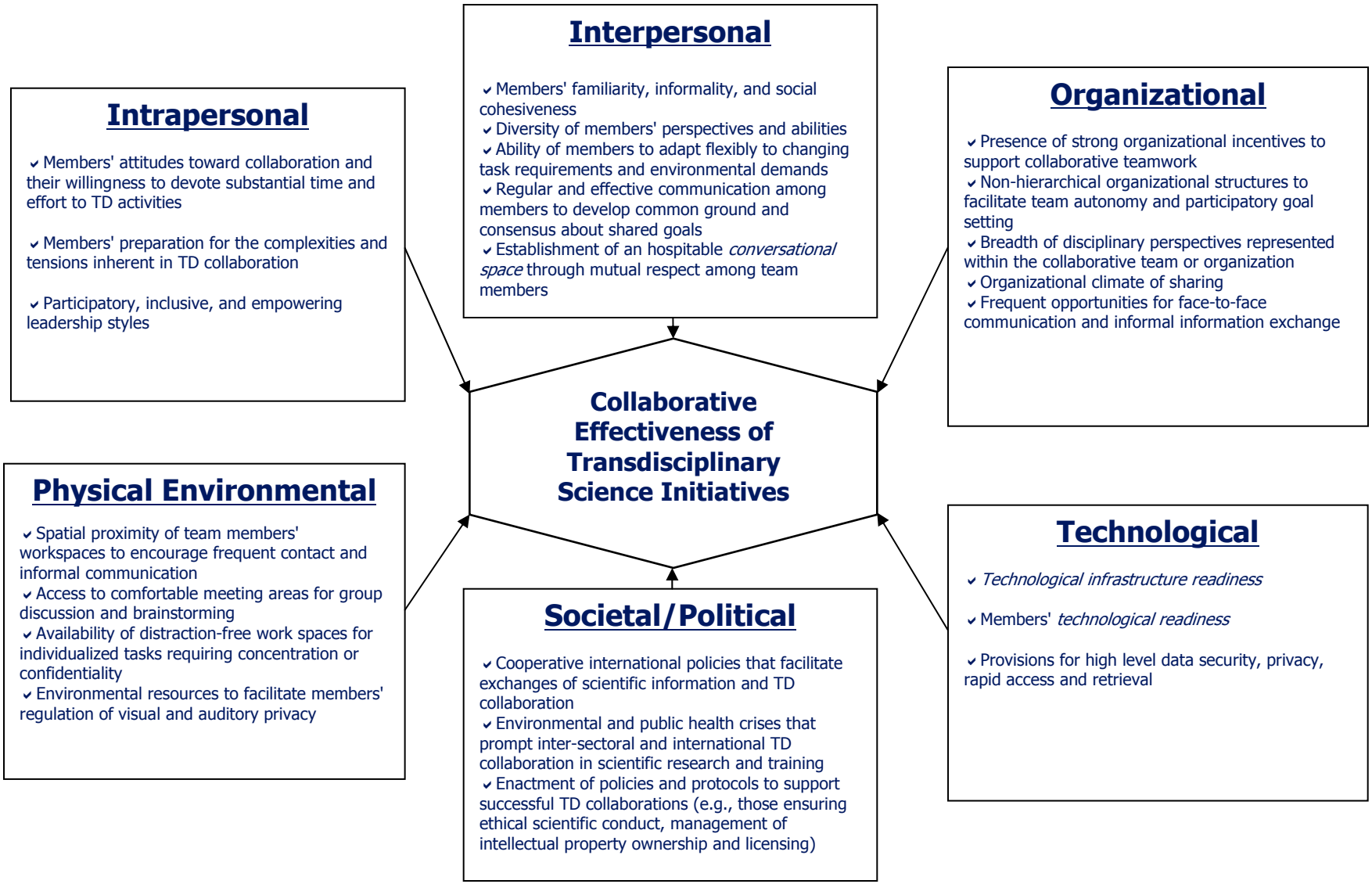
- Team members' history of collaboration on prior projects
- Institutional support for cross-disciplinary collaboration
- Leaders with collaborative orientation and experience
- Members share a strong commitment CD collaboration
- Spatial proximity of investigators' offices and laboratories
- Similarity of researchers' scientific worldviews
- Overlapping departmental identities of team members


Logic Model for TTURC-I Evaluation
(Trochim et al., 2005)
Recognition
Communication
TD Research Institutionalization
Professional Validation
Communication
Collaboration
Training
Publications
Policy Implications
Methods
Health Impacts
Health Outcomes
Collaboration
Improved Interventions
Translation To Practice
Science & Models
Transdisciplinary Integration
Scientific Integration
Immediate Markers
Intermediate Markers
Long-Term Outcomes

Centers for Population Health and Health Disparities Conceptual Framework



Typology of Contextual Factors Influencing TD Scientific Collaboration at Each Level of Analysis



(Stokols, Misra, Hall, Taylor, & Moser, 2006)

Methodological and Measurement Issues

- Strategic Evaluations of TS Initiatives - those that apply evaluation resources efficiently to yield information about major contributions and limitations of particular programs, in a manner that is responsive to the needs of multiple stake-holder groups:
  - scientists and trainees
  - funding organizations
  - policy makers
  - translational partners

Methodological and Measurement Issues (cont.)

- Guidelines for Strategic Evaluations of TS Initiatives
  - Specify program theory underlying the evaluation
  - Use weighted measures of program success
  - Incorporate multiple methods of evaluation
  - Temporally sequence evaluative measures
  - Work toward convergent validation of evaluation data
  - Account for research design and sampling limitations

Translational Concerns Within the STS Field

- Translating research findings from TS initiatives into clinical and preventive practices
- Translating research findings from TS evaluation studies to enhance future collaborative initiatives
- Strategies for building greater capacity for scientific collaboration in TS initiatives
  - *Collaboration readiness audits*
  - *Workshops and training modules*
  - *Formative evaluation for continuous quality improvement*

Directions for Future STS Research

- Empirically assess assumptions and hypotheses of conceptual models (e.g., links between collaboration readiness factors and TS outcomes)
- Assess the impact of interpersonal processes and leadership styles on scientific collaboration
- Evaluate cyber-infrastructures and other institutional resources designed to support scientific collaboration
- Implement and evaluate strategies for enhancing scientific collaboration (e.g., collaboration readiness audits, training modules, formative evaluations of ongoing initiatives)
- Assess processes and outcomes of cross-disciplinary training (including ID and TD mentorship models)
- Facilitate the translation of TS research findings into effective clinical, community health, and policy innovations
- Enhance the transfer of knowledge across TS initiatives and evaluations and maximize potential synergies among multiple initiatives

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