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# Perceived discontinuities and continuities in transdisciplinary scientific working groups

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## HIGHLIGHTS

- Studied DataONE, a transdisciplinary scientific team
- Evaluated strengths and weaknesses of working group model
- Success factors: Welcome diverse opinions and world views
- Success factors: Develop shared communication practices
- Success factors: Ensure active participation of bridge builders such as librarians

## ARTICLE INFO

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## ABSTRACT

We examine the DataONE (Data Observation Network for Earth) project, a transdisciplinary organization tasked with creating a cyberinfrastructure platform to ensure preservation of and access to environmental science and biological science data. Its objective was a difficult one to achieve, requiring innovative solutions. The DataONE project used a working group structure to organize its members. We use organizational discontinuity theory as our lens to understand the factors associated with success in such projects. Based on quantitative and qualitative data collected from DataONE members, we offer recommendations for the use of working groups in transdisciplinary synthesis. Recommendations include welcome diverse opinions and world views, establish shared communication practices, schedule periodic synchronous face-to-face meetings, and ensure the active participation of bridge builders or knowledge brokers such as librarians who know how to ask questions about disciplines not their own.



## 1. Introduction

Transdisciplinary scientific teams are created to advance innovative scientific endeavors when it is necessary to synthesize scientific information, whether to inform policy development or create infrastructure platforms to support continued advances in science. Research suggests that such teams can be more productive (Hall et al., 2012a) and creative (Kaufmann et al., 2009) than conventional research teams. However, to be successful, such teams must be able to draw on diverse bodies of expertise, knowledge and experiences (Edmondson, 2002).

One solution to staffing such a team is to hire a small number of full-time experts to address the problem. However, it can be difficult to find individuals with the necessary expertise who are willing and able to join what might be a short-term project. An alternative is to create a working group, that is, an *ad hoc* group of unpaid subject-matter experts who work together outside their main employment/jobs to achieve specified goals (Lee et al., 2006). For example, in an undirected manner, a working group model was used as the *modus operandi* at the Australian National Centre for Ecological Analysis and Synthesis (NCEAS) (Hampton and Parker, 2011). At NCEAS, groups of 8–15 collaborators from several scientific disciplines relevant to a research question they all wish to solve meet face-to-face several times a year over several years, linked by periods of remote collaboration. These working groups have proved to be successful in catalyzing publications with high citation rates (Hampton and Parker, 2011; Rodrigo et al., 2013).

The use of a voluntary collaborative model in this manner to achieve specified goals is full of risk, however, as its success as a team is dependent on shared vision, a willingness to collaborate, and outcomes that

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may not be anticipated by the organization using the working group as an organizational model. Team members are usually selected for their expertise, and this selection will necessarily bring many differences in organization, discipline and distance that may create boundaries between members. To be successful, team members must collaborate across these boundaries, often without the luxury of time to build consensus understandings (Lindkvist, 2005). A further complication is that working group members are often multi-teaming, as participation in the working group is not their only responsibility: they are concurrently members of the working group and members of teams in their home organizations (Mortensen et al., 2007).

Achieving integration across boundaries is problematic. Conflicts often increase (Griffin and Hauser, 1996; Hinds and Mortensen, 2005) and communication problems arise when transmitting information across the boundaries between different domains (Beverland, 2005; Carlile, 2002; Hauser et al., 2006). Perhaps as a result, findings from research on the link between integration in new product development teams (often organized as a kind of working group) and innovative outcomes have been equivocal, with the link found to be positive, negative or non-existent (Nakata and Im, 2010). We interpret this evidence as suggesting that some working groups are able to capitalize on the diverse knowledge and background of their members, but that others are not. Consideration of the apparent mixed success in addressing these inherent challenges raises several questions that we address in this paper:

1. What are the strengths and weaknesses of the working group model of organization for transdisciplinary scientific teams?
2. What do participants gain from being involved in a project as a member of a working group?
3. What does a project gain from member involvement (i.e. how effective is the working group model as a management tool)?

Past work on the working group model has identified a number of factors that may be relevant for their success. For example, Hampton and Parker (2011) found that the number of meetings, rather than duration of each meeting, was the most significant positive effect on productivity as measured by publications. Productivity was related not just to the duration of a meeting but also to more complex sociological within-group effects, such as group size (negative), cross-institutional representation (positive) and inclusion of dedicated sabbatical fellows (positive). Face-to-face meetings in a neutral location were instrumental in developing the trust and communication efficiency that accelerated idea generation.

In this paper, we further explore these factors and provide an integrative model by applying organizational discontinuity theory, a model proposed by Watson-Manheim et al. (2012) concerning the effects of boundaries on work. As noted above, boundaries between team members are usually seen as a source of difficulties, but this model suggests that they need not always be problematic. The model suggests that boundaries are problematic only to the extent that members experience difficulty in communication and accomplishing their work, an outcome the theory calls a 'discontinuity'. Contrariwise, if members of the team recognize a problem with communication or a work process, they may adapt their actions to create shared routines and mental models (a continuity) and thus mitigate the problems. Adapting processes and practices across boundaries to integrate the varied knowledge and experience of team members is likely to maximize the speed and productivity of the process to create desired outcomes.

To illuminate the role of discontinuities and continuities in the success of working groups for transdisciplinary integration, we examine DataONE, a transdisciplinary scientific team tasked with creating a 'cyberinfrastructure platform to support rapid data discovery and access across diverse data centers distributed worldwide and to provide scientists with an integrated set of familiar tools that support all elements of the data life cycle' (Michener et al., 2012). Its objective was a difficult one to achieve, requiring innovative solutions. The DataONE project used a working group structure to organize input from a wide range of experts.

The paper is organized as follows. We begin by briefly reviewing the literature on management of scientific teams, drawing on the emerging literature on the 'science of team science'. We then describe organizational discontinuity theory, the theoretical lens we use to focus our investigation. In the following section, we describe DataONE and its working group structure, a structure often used by transdisciplinary scientific groups. We then present our study approach, followed by the results of participant observation, quantitative and qualitative data. Finally, we offer recommended best practices for other transdisciplinary scientific groups.

## 2. Theory development: organizational discontinuities and the problems of transdisciplinary research

There is an extensive and growing body of research on the 'science of team science' (e.g. Stokols et al., 2010) that examines how research groups form, work and succeed. Börner et al. (2010) state that the 'field is concerned with understanding and managing circumstances that facilitate or hinder a range of collaborative research efforts'. Research on science of team science covers a wide range of topics, with research conducted at multiple levels of analysis, from the individual member to the group to the organizational and institutional setting. Falk-Krzesinski et al. (2011) solicited team science research topics from researchers and practitioners to identify clusters of research topics comprising a science of team science research agenda. Their analysis identified clusters around measurement and evaluation of team science; structure and context for teams; characteristics and dynamics of teams; management and organization for teams; institutional support and professional development for teams; disciplinary dynamics and team science; and definitions and models of team science.

Research teams can include members from different disciplinary configurations, but much of the research on the science of team science has examined multidisciplinary or interdisciplinary teams, often with the goal of developing a transdisciplinary approach to a complex research topic. Such teams can be particularly problematic to manage since they often involve multiple nested goals (e.g. scientific inquiry, educational goals, translation to practice, translation to policies) with divergent logics of action (Winter and Berente, 2012). Teams may be situated in one or more organizations with full-time participants, or more comparable to the part-time participation of working groups.

Much of the research has come from organizations that sponsor science teams and as such has been pragmatically driven, aiming at identifying factors for team success (e.g. Vogel et al., 2014). For example, Lotrecchiano (2013) took a social psychological perspective on team performance, looking at interaction of micro and meso-behaviors, identifying issues such as team familiarity and social cohesion; leadership traits and behaviors; goal setting; and dynamism in reciprocal interdependence. Based on a grounded theory analysis, Lotrecchiano (2013) identified four social mechanisms that dominated the analysis of social dynamics and mechanisms within a transdisciplinary team—change, kinship, tension, and heritage. Stokols et al. (2008) identified a range of factors including team members' familiarity and social cohesiveness; team size and physical environmental conditions; leadership traits and behaviors; participatory goal setting and communication patterns; and task and outcome interdependence. For distributed teams they identified additional factors such as the availability of adequate infrastructure, the difficulty of working across time zones, as well as socio-cognitive and emotional factors such as trust.

To address these factors, researchers have developed a range of advice for those managing or involved in science teams, e.g. tools for assessing potential team members' readiness for collaboration (Hall et al., 2008), a toolkit of advice on team science (Vogel et al., 2013), scales for measuring collaboration and integration (Mâsse et al.,