Composition of Scientific Teams and Publication Productivity

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ABSTRACT

The production of scientific knowledge has evolved from a process of inquiry largely based on the activities of individual scientists to one grounded in the collaborative efforts of highly specialized research teams, which have become an increasingly prominent means of knowledge production. This study examines data from 1,415 experiments conducted by scientific teams at the National High Magnetic Field Laboratory (NHMFL) to examine how the diversity of science teams along several key variables—including institutional diversity, disciplinary diversity, gender, seniority, and the network position—impacts overall team productivity as measured by peer reviewed journal publication. The results from correlation and quantile regression analysis indicate high productivity in teams is associated with high disciplinary diversity and low seniority diversity in team membership; team cohesion also positively related to productivity. Teams with members in central structural positions performed better than other teams. A better understanding of the factors that impact scientific teams, as determined by this and future research, may enable key stakeholders to facilitate more effective and efficient team operations and increase overall scientific productivity.

Keywords

Scientific teams, publications, productivity, collaboration, diversity, gender, seniority, social network analysis

PURPOSE

The production of scientific knowledge has evolved from a process of inquiry largely based on the activities of individual scientists to one grounded in the collaborative efforts of highly specialized research teams. In such environments, teams have become an increasingly prominent means of knowledge production. Not only is the size of research teams themselves growing, but so are the knowledge outputs of such collaborations, with multi-authored publications now cited more frequently than single-authored publications (Wuchty, Jones, & Uzzi, 2007). The shift in how science is conducted brings to light a new subject of inquiry, how the composition of scientific teams impacts their production of scientific knowledge. As teams form and work together to employ specialized scientific instruments, technologies, and researchers located within the labs themselves, the relationships between team characteristics and knowledge production become important phenomena of inquiry themselves (Lee & Bozeman, 2005; Thorsteinsdóttir, 2000). This study examines scientific teams at the National High Magnetic Field Laboratory (NHMFL) to examine how the diversity of science teams along several key variables—including institutional diversity, disciplinary diversity, gender, seniority, and the network position—impacts overall team productivity as measured by peer reviewed journal publication.

DESIGN/METHODOLOGY/APPROACH

This study examines data from 1,415 experiments conducted at the NHMFL between 2005 and 2008 to examine whether team diversity and structural network characteristics impacts productivity. Data was collected from internal documents and analyzed using both correlation analysis and quantile regression techniques.

FINDINGS

The results from correlation and quantile regression analysis indicate several diversity measures are associated with network position and team productivity. Results indicate that teams with mixed institutional associations were more central to the overall network compared to teams composed almost solely of the NHMFL's own scientists. The level of team cohesion as measured by the number of

experiments in which the same team members participated was positively related to productivity.

Likewise, disciplinary diversity was positively related to productivity. This finding matches findings of some earlier studies (Cummings & Kiesler, 2005; Porac et al., 2004). However, diversity in regards to team members was negatively related to productivity. Overall, the study indicates that high productivity in teams is associated with high disciplinary diversity and low seniority diversity of team membership. Finally, an increase in the share of senior members renders a negative effect on productivity and teams with members in central structural positions performed better than other teams. Prior research has provided mixed evidence in regards to the impact of seniority. Some studies show a negative relationship between tenure diversity and team success (e.g., Ancona & Caldwell, 1992; Bunderson & Sutcliffe, 2002), other studies have found that teams with higher tenure diversity are more successful (e.g., Guimera et al., 2005).

RESEARCH LIMITATIONS/IMPLICATIONS
While the study does link several team diversity measures to productivity, data was obtained from internal documents such as annual reports and publication logs. Collecting additional types of data through observations, interviews or surveys of team members and key institutional stakeholders may provide additional information regarding the factors that impact the productivity of scientific teams. While this study did control for team size and the number of experiments conducted, future research may find it helpful to control for team longevity since the longevity of teams may influence the development of work norms and relationships, which in turn may impact their productivity levels.

PRACTICAL IMPLICATIONS
Teams have become increasingly important in carrying out modern scientific inquiry. A better understanding of the factors that impact scientific teams may enable key participants such as scientists, engineers, and administrators to facilitate more effective and efficient team operations and increase overall scientific productivity.

ORIGINALITY/VALUE
The study examines 1,415 scientific experiments at a national science lab to examine how team diversity characteristics and network position impact scientific productivity as measured by number of publications. The study's findings not only provide valuable information for the management of individual scientific teams but also to how national laboratories manage large-scale science programs involving on-site staff and visiting scientists.

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