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Improving Virtual Science Team Effectiveness: What Can Be Learned from Virtual Organizational Teams Research?

National Research Council
Workshop on Team Dynamics and Effectiveness

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Objectives

- Outline the key research questions
- Describe the research framework used to guide the project
- Identify the key differences between virtual organizational teams and virtual science teams
- Highlight key practical recommendations for leading virtual science teams (pointing out modifications for recommendations for leading virtual organizational teams)
- Identify directions for future research on virtual science teams along with challenges for conducting such research

Yahoo's CEO Marisa Mayer's on Virtual Work

"To become the absolute best place to work, communication and collaboration will be important, so we need to be working side-by-side…That is why it is critical that we are all present in our offices."http://money.cnn.com/2013/02/25/technology/yahoo-work-from-home/index.html)

"People are more innovative when they're together."http://www.dailymail.co.uk/femail/article-2311875/People-innovative-theyre-Yahoo-CEO-Marissa-Mayer-finally-addresses-unpopular-work-home-ban.html)

Research Questions

- What factors at the team, center, or institute level (e.g., team size, team membership, geographic dispersion) influence the effectiveness of virtual science teams?
- How do different management approaches and leadership styles influence the effectiveness of virtual science teams?

Research Framework Guiding the Review

Kirkman, Gibson, and Kim (2012) *Falk-Krzesinski et al. (2011)*

Virtuality/Geographic dispersion ⟷ Structure and context for teams

Team development over time ⟷ Characteristics and dynamics of teams

Team leadership ⟷ Management and organization for teams

Levels of analysis ⟷ Measurement and evaluation of team science

Multidisciplinary approaches ⟷ Disciplinary dynamics and team science

Institutional support and professional development

Definitions and models of team science

Falk-Krzesinski, H.J., Contractor, N., Fiore, S.M., Hall, K.L., Kane, C., Keyton, J., Klein, J.T., Spring, B., Stokols, D., & Trochim, W. (2011). Mapping a research agenda for the science of team science. ***Research Evaluation***, 20, 145-158.

Kirkman, B.L., Gibson, C.B., & Kim, K. (2012). Across borders and technologies: Advancements in virtual teams research. In S.W.J. Kozlowski (Ed.), ***Oxford Handbook of Industrial and Organizational Psychology***, vol. 1 (pp. 789-858). New York: Oxford University Press.

Virtual Organizational vs. Science Teams

Dimension/Team Type	Virtual Organizational Team	Virtual Science Team
Time Horizon	Short	Long
Leadership	Formal, directive	Facilitative, shared
Membership	Stable boundaries	Permeable boundaries
Task Type	Problem solving, task-focused	Knowledge sharing, idea-focused
Task Interdependence	High	Low to moderate
Structure	Designed	Emergent
Accountability	External, formal sanctions	Internal, social sanctions
Disciplines	Low to moderate heterogeneity	Interdisciplinary

Outline of Practical Recommendations

- Leadership
  - Team design
  - Team building
  - Processes and emergent states
- Task and Organizational Structures
- Communication
  - Norms, protocols, and roles
  - Technology use
  - Distance meetings

Practical Recommendations

Recommendation/Team Type	Virtual Organizational Teams	Modifications Needed for Virtual Science Teams
Leadership – Team Design	Establish clear, engaging direction	Leaders need to do this but also involve members; have more direction setting meetings
	Structure tasks interdependently	Challenging due to multiple disciplines with high expertise; create smaller subsets of interdependent members and rotate members through the subsets
	Grant the proper authority to manage work	Little modification needed as virtual science team members typically embrace autonomy
	Set overall performance goals	Challenging due to members with different training, expertise, agenda, host organizational pressures; leaders will have to constantly reinforce goals with the team as a whole and individual members

Practical Recommendations

Recommendation/Team Type	Virtual Organizational Teams	Modifications Needed for Virtual Science Teams
Leadership – Team Design	Ensure that there is the right amount of skill and demographic diversity	Skill diversity in inherent in science teams but demographic diversity should also be emphasized
	Make sure the team is the right size (in general, 5-7 members)	Many virtual science teams will likely have more than 7 members; create core or parallel teams of smaller size to facilitate commitment and cohesion
	Strive for stable membership	More challenging with permeable membership boundaries, but stable membership is still desired
	Establish group rewards (i.e., something in it for the team as a whole)	More challenging because leaders may not have control over organization-specific reward systems; external funding may not be suitable for team-based rewards; leaders must get creative
	Ensure members have sufficient resources such as information, training, and materials	Little modification needed although some resources (i.e., financial) might be externally driven

Practical Recommendations

Recommendation/Team Type	Virtual Organizational Teams	Modifications Needed for Virtual Science Teams
Leadership – Team Building	Provide team-building opportunities, particularly with initial and periodic face-to-face interaction	Encourage team building during face-to-face meetings (if possible); electronic communication tools (i.e., videoconferencing) can be used to simulate face-to-face interaction and sharing
Leadership – Processes and Emergent States	Ensure high levels of psychological safety (e.g., be accessible, frequently ask for members' input, encourage members to discuss mistakes and ideas constructively), team empowerment (i.e., potency, meaningfulness, autonomy, and impact), and trust (e.g., reinforce timeliness and consistency of team interaction, ensure that members rapidly respond to one another when using electronic communication, and encourage members to exhibit high levels of performance and expertise to gain legitimacy)	Little modification needed although there may be higher barriers to psychological safety, empowerment, and trust due to interdisciplinarity; leaders will need to make consistent efforts in both team interactions as well as one-on-one, off-line interactions with members; leaders can use survey instruments designed specifically for collaboration in geographically-dispersed science teams (e.g., Collaboration Success Wizard, CSW; Beitz et al., 2012) or develop their own instruments capturing processes and emergent states

Practical Recommendations

Recommendation/Team Type	Virtual Organizational Teams	Modifications Needed for Virtual Science Teams
Task and Organizational Structures	Deal with divided loyalties caused by simultaneous membership on a virtual team and one's formal job responsibilities	Can involve each member's formal, organizational leader or supervisor as a high level sponsor of the team
	Assign and rotate various leadership tasks to avoid leader and member burnout	Little modification needed, leaders can rotate tasks in virtual science teams such as agenda creation, meeting facilitation, knowledge management activities, leading electronic discussions, keeping track of schedules, and making external presentations
	Can "pair up" members into dyads for special projects and assignments and rotate dyads	Little modification needed; leaders can use such dyadic structures and rotation to achieve high levels of cohesion and trust among members
	Ensure high levels of transactive memory (i.e., knowing who knows what on the team)	Little modification needed although with members with very high (and different) levels of expertise, more time will have to spent establishing transactive memory

Practical Recommendations

Recommendation/Team Type	Virtual Organizational Teams	Modifications Needed for Virtual Science Teams
Communication – Norms, Protocols, and Roles	Build trust through the establishing of communication norms, protocols, and roles; questions that need answering include: -How will members work together both in and out of team meetings? -Who will be responsible for capturing and sharing knowledge? -When will knowledge be gathered? -How will decisions get made and by whom? -What are the generally accepted norms of behavior in the team?	No modification needed
	Establish team charters to formalize and answer the important questions above.	No modification needed

Practical Recommendations

Recommendation/Team Type	Virtual Organizational Teams	Modifications Needed for Virtual Science Teams
Communication – Technology Use	Ensure that the right technology is used for the right tasks (rule of thumb: the more complex the message, the richer the media needed)	Because virtual science team tasks are oftentimes complex, ambiguous, and require innovation, leaders will need to make sure their teams have sufficient face-to-face, video-, and audio-conferencing available; this is particularly true for highly diverse (i.e., interdisciplinary teams)
	Encourage the use of electronic discussion boards and virtual meeting spaces, rather than relying on email, for virtual team communication	While email can be used effectively for one-to-one member communication, it is less efficient for complex, team-oriented discussions

Practical Recommendations

Recommendation/Team Type	Virtual Organizational Teams	Modifications Needed for Virtual Science Teams
Communication – Distance Meetings	Engage in healthy meeting management behavior before, at the beginning of, during, after, and between meetings by: -Before meetings, making sure agenda items are assigned, conflicts are surfaced, and timelines are very visible -At the beginning of meetings, leaders should take 5-10 minutes to re-create the team feeling by discussing more personal events or significant accomplishments -During the meeting, leaders should ensure inclusiveness using innovative techniques such as electronic voting tools -At the end of meetings, leaders should make sure there is a clear allocation of action items and meeting minutes are posted rapidly in knowledge repositories -Between meetings, leaders should initiate and facilitate electronic discussion threads, track progress on a timeline, and follow up with one-on-one discussions with team members	No modification needed

Future Research Directions for Virtual Science Teams

- Examine virtual science teams “in the wild.”
  - Warning: safeguarding anonymity of scientists (Borner et al., 2010); heterogeneity of types of researchers, research settings, materials, technologies and institutions involved (Jirotka et al., 2013); ethnography methodology will have to be significantly adapted in order to handle the spatial complexity of virtual science teams and the distributed nature of work (Hine, 2007)
- Employ multidisciplinary approaches to study virtual science teams
  - Warning: different goals, publication outlets, approaches of different disciplines will have to be negotiated
- Focus on how virtual science teams develop over time
  - Warning: will necessitate rich, qualitative data gathering over time (Olson et al., 2008), necessitating multi-year research programs

Future Research Directions for Virtual Science Teams

- Investigate effective external/internal leadership behaviors
  - Warning: research on virtual science team leaders will rely more heavily on related leadership areas such as power, influence, and leading without formal authority and will necessitate a longitudinal approach and qualitative, observational research (Olson et al., 2008).
- Identify key emergent states and team processes
  - Warning: it remains an empirical question as to the exact array of critical emergent states and team processes relevant to virtual science teams and, perhaps as important, how these choices differ from (or overlap with) virtual organizational teams
- Highlight key institutional support mechanisms
  - Warning: any research program for examining virtual science teams must include an investigation into the key institutional support mechanisms undergirding virtual science team activity

Future Research Directions for Virtual Science Teams

- Define measurable performance metrics
  - Warning: once the different dimensions and sub-dimensions of virtual science team effectiveness have been fully elucidated, researchers will need to identify those specific levers of effectiveness that can be, in turn, used selectively by virtual science team leaders to maximize the specific area of performance in question

Key Takeaways

- Virtual science teams represent a more unique, complex, and challenging form of virtual teaming compared to most virtual organizational teams
- Many of the practical recommendations for leading virtual organizational teams can be applied with little modification to virtual science teams (i.e., team “truths”)
- Some of the practical recommendations do need modifying for the unique elements of virtual science teams and the contexts within which they operate
- Future research on virtual science teams will require ethnographic, qualitative, observational approaches (i.e., it will be “messy”)