# Human Factors: The Journal of the Human Factors and Ergonomics Society

http://hfs.sagepub.com/


## Perspectives: Teams Won't Solve This Problem

Leslie A. DeChurch and Stephen J. Zaccaro

*Human Factors: The Journal of the Human Factors and Ergonomics Society* 2010 52: 329 originally published online 23 July 2010
DOI: 10.1177/0018720810374736

The online version of this article can be found at:
http://hfs.sagepub.com/content/52/2/329

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
Human Factors and Ergonomics Society

SPECIAL ISSUE

# Perspective: Teams Won't Solve This Problem

**Leslie A. DeChurch,** University of Central Florida, Orlando,
and **Stephen J. Zaccaro,** George Mason University, Fairfax, Virginia

**Objective:** We link the problem of complex sociotechnical systems to a new unit-of-analysis and fruitful developing area of applied research, the multiteam system. **Background:** Teams are the dominant entity and theoretical lens being applied to understanding the performance of complex sociotechnical systems. We submit that such problems cannot be solved through the teams lens because complex sociotechnical systems exhibit features such as mixed-motive goal structures and complex, layered social identities that do not meet the definitional requirements of a team. **Method:** We present key findings from multiteam systems research and review the studies contained in the special issue on the basis of the focal constructs and unit of analysis. **Results:** Although progress is being made on understanding key constructs essential to understanding complex sociotechnical systems, the unit of analysis needs to be shifted upward from the team level to the system level. **Conclusion:** Progress on understanding the inner workings and leverage points for the success of complex sociotechnical systems requires a fundamental shift in the unit of analysis toward understanding the macrodynamics of larger systems of teams. **Application:** The multiteam system perspective offers a useful theoretical lens for future research on and tool development (e.g., training, information technology) for improving the functioning of complex sociotechnical systems.

## INTRODUCTION

When it comes to solving the problem of how complex sociotechnical systems tackle time-sensitive, multifaceted problems, the vast majority of organizational scientists have their microscopes set at the wrong magnification. They are looking too closely and are missing the macrolevel dynamics that explain why these systems fail, and so the problem goes unsolved. An awful lot is known about teams (Kozlowski & Ilgen, 2006; Mathieu, Maynard, Rapp, & Gilson, 2008). Findings on teams continue to be central in understanding the building blocks of the systems that *will* bring us closer to solving this problem: multiteam systems (MTSes; DeChurch & Mathieu, 2009; Mathieu, Marks, & Zaccaro, 2000). The key point of this commentary is not to stave off the study of teams but rather to engage, if not to challenge, the scientific community to approach this complex problem with an equally complex perspective better suited to generating actionable knowledge on collaboration, coordination, and adaptation in complex sociotechnical systems.

Let us consider some complex sociotechnical systems that could be considered failures: the slow response following Hurricane Katrina, the failed emergency communications at Virginia Tech, and friendly-fire incidents and medical errors associated with poor coordination. These systems did not fail because teams failed; they failed because teams were not externally aligned with one another. The subsystems were pulling against each other.

The problem of external alignment among teams comes clearly into focus when one considers the unit of analysis to be the MTS. Instead of puzzling about how individuals combine synergistically to perform as a team, one puzzles about how intact functioning teams often from multiple organizations combine synergistically to perform as a system. Mathieu et al., 2000 defined MTSes as

> two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of

Address correspondence to Leslie A. DeChurch, University of Central Florida–Psychology, P.O. Box 161390, Orlando, FL 32816-1390; ldechurc@mail.ucf.edu. ***HUMAN FACTORS*** Vol. 52, No. 2, April 2010, pp. 329–334. DOI: 10.1177/0018720810374736. 

> collective goals. MTS boundaries are defined by virtue of the fact that all teams within the system, while pursuing different proximal goals, share at least one common distal goal; and in doing so exhibit input, process and outcome interdependence with at least one other team in the system. (p. 290)

These systems have three key features that illustrate the practical value of shifting levels of analysis from the team up to the MTS. The first feature is the complex motive structure invoked by having teams working toward multiple goals existing at different levels and changing in relative importance over time. MTSes are composed (minimally) of individuals nested within teams nested within a system of teams. Individuals are allocating effort to at least three sets of goals: individual goals, team goals, and system goals. Much research on teams begins by defining a team as a set of individuals who share a common goal (Salas, Dickinson, Converse, & Tannenbaum, 1992). This definition then allows the research to proceed on the assumption that individual and team goals are in alignment.

Even more troubling, the ultimate criteria in teams research is some variant of "team effectiveness" devoid of any consideration of the extent to which the goals of a given team are accomplished in such a way as to be combinable with those of other teams so that higher-level goals are attained. This higher-level goal may be a timely response to a natural disaster, a functioning postwar province in Iraq, or the discovery of an HIV vaccine: All require synergies to occur among multiple teams working (a) cooperatively within the team and (b) both competitively and cooperatively across teams (Liu & Simaan, 2005).

This brings us to the second key point about the definition of a MTS: Teams are interdependent with one another toward the accomplishment of at least one distal goal. The concept of interdependence can be applied whenever units are mutually reliant on one another. Mutual reliance can be thought of in terms of inputs or resources, work processes, or outcomes (Saavedra, Earley, & Van Dyne, 1993; Wageman, 1995). In complex sociotechnical systems, these interdependencies exist among multiple units: (a) within teams (individuals within a given component team), (b) between teams (teams within the system), and (c) across the system boundary (between the system and external constituencies).

Research thus far has considered interdependence at one of the three levels at a time but not at all three simultaneously. In reality, when a system of teams springs into action to save lives and stabilize Haiti following a major earthquake, these interdependencies do not form at one level at a time; they operate at all three levels simultaneously. Interdependence in MTSes then, can be thought of as a four-dimensional construct defined by a system's orientation in terms of type, form, level, and phase.

The *type* of interdependence refers to the task-dictated manner in which individual contributions are combined; these can be pooled, sequential, intensive, or reciprocal (Saavedra et al., 1993). The *form* refers to what is being combined: information or behavioral inputs (Mesmer-Magnus & DeChurch, 2009). The *level* refers to the unit of analysis at which the components are mutually reliant: team, unit, multiteam system, external constituents. Last, the *phase* refers to how interdependence changes over time according to the multiple subgoal episodes that component teams cycle through in pursuing multiple goals over time (Marks, Mathieu, & Zaccaro, 2001). This multidimensional view of interdependence is critical because the dynamics that hold subsystems together may well threaten the viability of another part of the system.

The third aspect of MTSes, which illustrates their practical importance as a distinct unit of analysis, is their size and distribution (Zaccaro, Marks, & DeChurch, in press). This feature is inherent in the magnitude of goals MTSes are formed to accomplish, and it changes the nature of interactions in meaningful ways. When one thinks about coordination of information and coordination of behavioral inputs, one must think about how such coordination is created and sustained in very large systems of individuals. One must also think about how this coordination is sustained when people are not colocated. These are not virtual teams; they are virtual organizations, the whole of whose communication commences through technology.

Some provocative findings clearly underscore the importance of examining the larger systems as nonreducible entities. First, Marks, DeChurch, Mathieu, Panzer, and Alonso (2005) found that the level of interdependence (e.g., team, cross-team) dictates the most impactful level of coordinative process. Team process affects team performance; cross-team process affects multiteam performance. Most importantly, when the interdependence between teams is high, cross-team process is more predictive of system-level performance than when interdependence across teams is low. The bottom line is that the location of the strongest interdependencies is the same location where process dynamics are most important. This location is sometimes within a team, but often in complex sociotechnical systems, this location is at the intersection between teams.

Second, interventions need to be aimed at the appropriate level of analysis that needs to be changed. DeChurch and Marks (2006) provide strong evidence of this. Leaders who built effective teams did not improve the functioning of the multiteam system; leaders who focused their behavior at bridging distinct teams did. Cobb and Mathieu (2003) found support for this principle with process training, finding that these systems performed better when training was focused on cross-team processes than when training was focused on team processes.

Third, DeChurch et al. (in press) found that systems fail more often because of between-team breakdowns than because of within-team breakdowns. Archival historiometric analysis of provincial reconstruction and hurricane response MTSes clearly shows that the problems that cause these systems to fail are more often in the failure to synchronize effort across teams than in the failure to synchronize effort within a given team.

Fourth, teams can be too cohesive, efficacious, cognitively coherent, and effective. Team processes and states can detract from system-level performance. The explanation for this phenomenon can be understood in terms of two theoretical perspectives: resource allocation (Kanfer, Ackerman, Murtha, Dugdale, & Nelson, 1994) and intergroup relations (Tajfel, 1982). MTSes are composed of teams that are themselves composed of individuals. The basic unit of work—whether it be thinking about something or doing something—is the individual. Thus, individuals have finite resources to allocate to team and MTS tasks, and so there are ultimately trade-offs. One cannot afford to ignore this reality and assume that building successful teams will translate into successful systems of teams.

Furthermore, intergroup relations research has clearly documented that strong group boundaries induce negative perceptions of outsiders (Brewer & Pierce, 2005; Tajfel, 1982). The implication for MTSes is that as team boundaries strengthen by training, leadership, and cognition, so do the negative perceptions of other teams and the boundaries that inhibit the permeation of information and knowledge to other teams. When teams are interdependent toward a larger system goal (as in the classic study by Sherif, Harvey, White, Hood, & Sherif, 1961), such as averting mass casualties, discovering a lifesaving vaccine, or rebuilding a war-torn province, it is the distal goal that is ultimately more important, and there are serious consequences from building, training, and leading internally cohesive teams.

Since MTS's original formulation, a number of empirical and conceptual articles on MTSes have been published. Papers on MTSes have been burgeoning at several recent conferences, including those hosted by the Society for Industrial and Organizational Psychology, Human Factors and Ergonomics Society, Academy of Management, and the Interdisciplinary Network for Group Research. An edited volume is in press with multidisciplinary and international perspectives on core aspects of the compositional, linkage, and developmental attributes of MTSes applied to a wide variety of problems in the public and private sectors (Zaccaro et al., in press). We hope this commentary sparks integrative thinking about sociotechnical systems from the MTS perspective. We offer the following five suggestions for the next generation of research on complex sociotechnical systems.

## Four Research Needs Going Forward

*Affective emergent states.* Interestingly, this special issue seeks to understand complex sociotechnical systems with a focus largely on behavioral synchronization (e.g., coordination) and functional cognitive architecture. In our conversations with emergency managers, military scientists, and corporate alliance managers engaged in this problem, a discrepancy between research and practice comes into focus. The research community is largely focusing on behavioral and cognitive processes, whereas the practice community is talking about issues of distrust, a lack of overall cohesion at the system level, and competitive dynamics between teams. There is a sentiment that if the affective states are patterned in a way that gels the system together, synchronization will follow. A clear need for future research is to examine the impact of affective emergent states, such as trust (Jarvenpaa & Leidner, 1999), social identity (Hogg & Terry, 2000), and motivation on the functioning of MTSes.

One particularly critical emergent state is motivation. Goal conflict is inherent in MTSes. Because of the embedding of teams within larger units, the functional differentiation present across different sets of teams, and the reality that each team is simultaneously motivated by multiple goals at any given time, there is a complex motive structure governing behavior in these systems. The assumption of alignment across all goals, functions, and levels is probably too simplistic. Research is needed to understand how these systems can be structured to function effectively given this complex goal structure.

As a starting point, one might think of effort allocation within MTSes as a variant of the "tragedy of the commons" (Hardin, 1968). When individuals and teams are deciding where to allocate their available resources (e.g., time, effort, expertise), the relative commitment to team versus MTS goals will be a critical determining factor. Similarly, the relative identification with the team versus the system will drive the foci of effort allocation. Agarwal, Croson, and Mahoney (2010) drew a similar connection to decision making in strategic alliances performing an experimental simulation. Their findings showed that the proportion of common to private benefits affected resources allocated to the alliance and the likelihood that the alliance would succeed. On the basis of this logic, we propose the following:

- *Proposition 1:* MTSes wherein members' goal commitment to the system goal is stronger than goal commitment to either team or subunit goals will perform better than systems wherein goal commitment to team or subunit goals is stronger than commitment to system goals.
- *Proposition 2:* MTSes wherein members' social identity is more closely tied to the system than to the team or subunit will perform better than systems wherein social identify is more closely tied to the team or subunit than to the system.

*Technology-mediated communication.* Most MTSes operate virtually. Because of the complex nature and sizeable scope of the tasks for which MTSes are formed, they are never performing tasks in a fully face-to-face open communication format. Teams are dispersed, teams communicate through information technology (IT), and so research is needed to carefully understand the nuances of how aspects of the distribution and virtual communication affect MTS functioning.

*Leadership.* Leadership is not optional. Because of the complexity of the task, distribution of teams, communication through IT, and inherently mixed-motive goal structure, leadership is required to direct and regulate collective effort in MTSes. Researchers have recognized the imperative nature of leadership in these systems, and a stream of theoretical and empirical work is progressing in this area (Davison & Hollenbeck, in press; DeChurch et al., in press; DeChurch & Marks, 2006; Zaccaro & DeChurch, in press). The complexity of collective effort creates new challenges for leadership that may well require us to think very differently about the nature of leadership.

Past perspectives on leadership have focused on leadership as enacted formally and hierarchically (vertical) and on leadership enacted simultaneously from multiple individuals (horizontal), yet the complex structures of MTSes require systems of leadership enacted both vertically and horizontally, forming a leadership "system." These leadership systems may well exhibit synergies and process losses not unlike the systems whose effort they direct and manage (Zaccaro & DeChurch, in press). This represents a critical new area in need of exploration.

*"Complexify" view of processes and emergent states.* Research in this special issue mirrors that of research in teams broadly, in that the synergies captured by emergent states (e.g., cognition,

**TABLE 1:** Units of Analysis and Focal Construct(s) Represented in the Special Issue

| First Author | Unit of Analysis | Focal Construct(s) |
|---|---|---|
| Bearman | Multiteam system | Cognition |
| Burtscher | Team | Coordination, context (nonroutine events) |
| de Vreede | Multiteam system | Structure |
| Driskell | Team | Composition (collective orientation) |
| Fiore | Team | Cognition |
| Gorman | Team | Training, cognition, adaptation |
| Guastello | Team | Size |
| Lewis | Individual | Autonomy |
| Marquardt | Individual | Training |
| McComb | Team | Cognition |
| Miller | Team | Communication, coordination |
| Shah | Dyad | Coordination |
| Strauch | Team | Culture |

cohesion, trust) and behavioral processes (e.g., coordination, communication) are largely examined as compositionally emergent phenomena (Kozlowski & Klein, 2000). This reflects a thought process patterned by isomorphism, whereby similar individual content combines in an additive fashion to constitute team-level cognition. Similar individual behavioral inputs combine additively to constitute team-level coordination. This thinking is reflected both in the conceptualization and in the operationalization of constructs such as coordination and cognition.

We submit that complex sociotechnical systems may be better understood through consideration of compilationally emergent processes, whereby nonlinear combinations of the building blocks (e.g., cognition, coordinative behavior) combine in a patterned way, and only by thinking about the impact of meaningful patterns and operationalizing constructs in this manner can one really understand the complex dynamics of MTSes. We offer the following metaproposition to spawn future work in this area:

- *Proposition 3:* The relative impact of emergent constructs changes across levels of complex systems. At lower system levels, compositionally emergent states and processes will be more impactful, whereas when one moves up in the system, the synchronization of subsystems will be increasingly affected by compilationally emergent phenomena.

The articles in this special issue represent cutting-edge thinking on teams and, as a set, clearly move the science forward. Table 1 presents an overview of two key aspects of the articles in the special issue: unit of analysis and focal construct(s). The focal constructs represent a rich array of factors known to affect system functioning: composition, cognition, coordination, context, structure, autonomy, and training. We submit that, as a field, we are studying the right constructs. The problem is that we may well be studying them at the wrong level of abstraction and using an overly reductionist approach. The focal units of analysis include individual, dyad, team, and multiteam system. Herein lies a potential breakthrough in the understanding of complex systems: We need to capture the dynamics that play out simultaneously across multiple layers of the system. Processes that glue together subsystems may well pull apart the overall system. Thus, teams will not solve this problem unless we "complexify" our unit of analysis.

## ACKNOWLEDGMENT

This work was supported by funding from the Army Research Institute for the Behavioral and Social Sciences (Contract No. W91WAW-08-C-0028). The views expressed in this work are those of the authors and do not necessarily reflect official Army policy. Portions of the ideas presented in this manuscript were inspired by our participation in the workshop, "Applying the Science of Teams to Inform Policy and Research on Team Science," funded by Grant 0915602 from the National Science Foundation to Stephen M. Fiore and Joann Keyton.

## REFERENCES


Agarwal, R., Croson, R., & Mahoney, J. T. (2010). The role of incentives and communication in strategic alliances: An experimental investigation. *Strategic Management Journal*, *31*, 413–437.

Brewer, M. B., & Pierce, K. P. (2005). Social identity complexity and outgroup tolerance. *Personality and Social Psychology Bulletin*, *31*, 428-437.

Cobb, M. G., & Mathieu, J. E. (2003, April). The impact of training and environmental complexity on the effectiveness of multi-team systems. In J. E. Mathieu (Chair), *Investigations of multi-team systems*. A symposium presented at the 18th Annual Conference of the Society for Industrial and Organizational Psychology, Orlando, FL.

Davison, R. B., & Hollenbeck, J. R. (in press). Boundary spanning in MTSs. In S. J. Zaccaro, M.A. Marks, & L. A. DeChurch (Eds.), *Multiteam systems: An organizational form for dynamic and complex environments.* New York: Taylor & Francis.

DeChurch, L. A., Burke, C. S., Shuffler, M., Lyons, R., Doty, D., & Salas, E. (in press). A historiometric analysis of leadership in mission critical multiteam environments. *Leadership Quarterly.*

DeChurch, L. A. & Marks, M. A. (2006). Leadership in multiteam systems. *Journal of Applied Psychology*, *91*, 311–329.

DeChurch, L. A., & Mathieu, J. E. (2009). Thinking in terms of multiteam systems. In E. Salas, G. F. Goodwin, & C. S. Burke (eds.), *Team Effectiveness in Complex Organizations: Cross-disciplinary Perspectives and Approaches*, pp. 267-292. New York: Taylor & Francis.

Hardin, G. (1968). The tragedy of the commons. *Science*, *162*, 1243–1248.

Hogg, M. A., & Terry, D. J. (2000). Social identity and self-categorization processes in organizational contexts. *Academy of Management Review*, *25*, 121–140.

Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and trust in global virtual teams. *Organization Science*, *10*, 791–815.

Kanfer, R., Ackerman, P., Murtha, T. C., Dugdale, B., & Nelson, L. (1994). Goal setting, conditions of practice, and task performance: A resource allocation perspective. *Journal of Applied Psychology*, *79*, 826–835.

Kozlowski, S. W. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest*, *7*, 77–124.

Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 3–90). San Francisco, CA: Jossey-Bass.

Liu, Y., & Simaan, M. A. (2005). Non-inferior Nash strategies for routing control in parallel-link communication networks. *International Journal of Communications Systems*, *18*, 347–361.

Marks, M. A., DeChurch, L. A., Mathieu, J. E., Panzer, F. J., & Alonso, A. A. (2005). Teamwork in multi-team systems. *Journal of Applied Psychology*, *90*, 964–971.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, *26*, 356–376.

Mathieu, J. E., Marks, M. A., & Zaccaro, S. J. (2000). Multiteam systems. In N. Anderson, D. Ones, H. K. Sinangil, & C. Viswesvaran (Eds.), *International handbook of work and organizational psychology* (pp. 289–313). London, England: Sage.

Mathieu, J., Maynard, M. T., Rapp, T. L., & Gilson, L. (2008). Team effectiveness 1997–2007: A review of recent advancements and a glimpse into the future. *Journal of Management*, *34*, 410–476.

Mesmer-Magnus, J. R., & DeChurch, L. A. (2009). Information sharing and team performance: A meta-analysis. *Journal of Applied Psychology*, *94*, 535–546.

Saavedra, R., Earley, P. C., & Van Dyne, L. (1993). Complex interdependence in task-performing groups. *Journal of Applied Psychology*, *78*, 61–72.

Salas, E., Dickinson, T. L., Converse, S. A., & Tannenbaum, S. L. (1992). Toward an understanding of team performance and training. In R. W. Swezey & E. Salas (Eds.), *Teams: Their training and performance* (pp. 3-29). Stamford, CT: Ablex.

Sherif, M., Harvey, O. J., White, B. J., Hood, W. R., & Sherif, C. W. (1961). *Intergroup conflict and cooperation: The robbers cave experiment*. Norman: University of Oklahoma Book Exchange.

Tajfel, H. (1982). Social psychology of intergroup relations. *Annual Review of Psychology*, *33*, 1–39.

Wageman, R. (1995). Interdependence and group effectiveness. *Administrative Science Quarterly*, *40*, 145–180.

Zaccaro, S. J., & DeChurch, L. A. (in press). Leadership forms and functions in multiteam systems. In S. J. Zaccaro, M. A. Marks, & L. A. DeChurch (Eds.), *Multiteam systems: An organizational form for dynamic and complex environments.* New York: Taylor & Francis.

Zaccaro, S. J., Marks, M. A., & DeChurch, L. A. (Eds.). (in press). *Multiteam systems: An organizational form for dynamic and complex environments.* New York: Taylor & Francis.



Leslie A. DeChurch is an assistant professor in the Department of Psychology at the University of Central Florida in Orlando. She received her PhD in psychology at Florida International University in 2002.

Stephen J. Zaccaro is a professor in the Department of Psychology at George Mason University in Fairfax, Virginia. He received his PhD in social psychology at the University of Connecticut in 1981.



*Date received: April 29, 2010*
*Date accepted: May 3, 2010*