Chapter 3
Assessing Collaboration Within and Between Teams: A Multiteam Systems Perspective

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Abstract Developing assessment methods that capture an individual's capability to collaborate can look to the team and multiteam systems literature, which identifies six critical components of collaboration. These six include team affect/motivation, team interaction processes, and team cognition, as well as corresponding constructs at the system level, multiteam affect/motivation, between-team interaction, and multiteam cognition. This chapter defines and distinguishes teams and multiteam systems and discusses the importance of that distinction for assessing individual collaborative capacity in both small stand-alone teams and larger systems of teams working toward superordinate goals. Particularly, we describe confluent and countervailing forces—the notion that what enables team functioning and effectiveness may or may not also enable the multiteam system effectiveness. Assessments of individual contributions to team and multiteam dynamics must consider the implications to functioning both within and between teams.

Keywords Teams · Multiteam systems · Individual assessment · Confluent and countervailing forces

Teams are now one of the most basic units through which we accomplish tasks, and this reality has important implications for assessment. As many of the most pressing and complex problems are the province of specialized individuals working in teams, assessment methods are needed that enable the measurement of knowledge, skills, abilities, and other experiences (KSAOs) that enable an individual to effectively contribute to team effectiveness. Furthermore, there is mounting evidence that as knowledge becomes increasingly specialized, teams must rely on

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other teams in order to bring together a greater array of expertise. These larger collectives are called multiteam systems (MTSs), and consist of two or more teams. A defining feature of an MTS is that each team pursues its own proximal team goals, while also working as a larger system of teams, who are interdependent with regard to a more distal superordinate goal (DeChurch & Zaccaro, 2010). Thus, MTSs work in an environment that necessitates attention to both team and MTS functioning. However, although research in this area is still growing, the literature on MTSs is not currently considering the effectiveness of the teams and the MTS at the same time (DeChurch & Zaccaro, 2013). This chapter considers the multiteam structure and its implications for individual assessment.

The context of MTSs brings to light an important duality between the team and the system. On the one hand, individuals in the MTS must focus on team effectiveness. The structure of an MTS is such that teams pursue their own proximal goals. This requires interactions that promote team effectiveness (McGrath, 1984). In addition to a focus on team interactions, individuals must also manage intergroup relations that build the foundation for MTS-level interaction processes to develop, and thus aid with MTS effectiveness. Therefore, individuals are embedded in two groups (i.e., a team and an overarching multiteam system) that require their focused attention and efforts.

Ideally, what enables the effectiveness of the team would also enable the effectiveness of the MTS. However, this may not be the case. The processes that lead to effective teams may not be aligned with the processes that lead to an effective MTS. The notion of confluent and countervailing forces captures both of these situations in MTSs. *Confluent forces* are those in which processes and properties have the same consequence at the team and MTS level of analysis. *Countervailing forces* are those processes and properties that have divergent consequences at the team and MTS levels of analysis (DeChurch & Zaccaro, 2013).

Researchers must strive to incorporate a complete view of MTSs and consider the impact of team- and MTS-level properties on outcomes at multiple levels of analysis. The question then becomes the following: Which processes and properties are important to team and MTS functioning? Furthermore, how do individual KSAOs combine to impact these processes and properties?

In the current chapter we (a) define MTSs and describe the unique characteristics of these teamwork structures, (b) describe aspects of teamwork critical for team and MTS functioning, and (c) describe the notion of confluent and countervailing forces and the implications for individual assessment of collaboration within and between teams.

3.1 Defining Multiteam Systems

For years, organizations have seen the value of assembling teams to leverage the distinct expertise of individual members, who together can achieve optimal solutions. The study of teams and team dynamics has flourished in the fields of industrial organizational psychology and organizational behavior (DeChurch & Mesmer-Magnus, 2010; DeChurch, Mesmer-Magnus, & Doty, 2013; de Wit, Greer, & Jehn, 2012; Gully, Incalcaterra, Joshi, & Beaubien, 2002; LePine, Piccolo, Jackson, Mathieu, & Saul, 2008; Mesmer-Magnus & DeChurch, 2009; Mullen & Cooper, 1994; Stajkovic, Lee, & Nyberg, 2009). However, the increase in globalization has changed the landscape of organizational work. Global work has created a need for teams to reach across organizational and geographic boundaries to work with other teams to solve important environmental, social, technological, and medical issues.

In the same way that individual expertise is brought to bear on a problem within a single team, these complex problems often require the effort of multiple teams that together have the requisite expertise necessary to tackle important issues (DeChurch & Zaccaro, 2010). Collectives composed of tightly coupled teams are called MTSs. MTSs are formally defined as the following:

> Two or more teams that interface directly and interdependently in response to environmental contingencies toward the accomplishment of 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. (Mathieu, Marks, & Zaccaro, 2001, p. 290)

There are five important key features of MTSs that are implied in the definition put forth by Mathieu et al. (2001). First, MTSs are composed of a minimum of two teams. These component teams are “non-reducible and distinguishable wholes” (p. 291), that have proximal goals and interdependent members. Second, in addition to proximal goals, component teams share a common superordinate goal for which all teams are collectively responsible. Third, the structure or configuration of the MTS is determined by the goals, performance requirements, and technologies adopted. The performance environment determines what goals need to be accomplished by both the component teams and the MTS. The goals for the system are organized into a hierarchy with proximal team goals at the lowest level and distal MTS goals at the highest level (Mathieu et al., 2001; Zaccaro, Marks, & DeChurch, 2012). Fourth, MTSs are larger than teams, but smaller than the embedding organization(s). While MTSs can be housed within the same organization (known as *internal MTSs*), an MTS may cross formal organizational boundaries (known as *cross-boundary MTSs*). The fifth key feature of MTSs is that component teams have input, process, or outcome interdependence with at least one other team in the MTS. The type of interdependence in an MTS is intensive, with component teams working in a reciprocal manner, or closely with one another (Zaccaro et al., 2012). By contrast, pooled interdependence, in which teams work in isolation and “pool” their outputs, or sequential interdependence, in which teams work in succession of one another, are not typically characteristic of a tightly coupled system of teams.

3.2 Boundary Issues in Multiteam Systems

Mathieu et al. (2001) conceptualized MTSs as entities that are larger than teams, but smaller than organizations. One contention about the MTS structure is that they could be simply considered as large teams, with at best, subunits that characterize different groups (DeChurch & Mathieu, 2009). However, in MTSs, component teams are loosely coupled so that, although tied to other teams through interdependence, the team boundary remains intact. Indeed, it is valuable to consider the reciprocal influence of component teams and the MTS, much in the same way that we consider the impact of individuals on a team, and vice versa (Chen & Kanfer, 2006; DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004). This suggests that component teams have their own *entitativity* (Campbell, 1958). The degree of entitativity is the extent to which a group can be considered to be a stand-alone entity. Campbell discussed three factors that determine the entitativity of a group: *proximity*, *similarity*, and *common fate*.

The principle of proximity states that elements that are close together are likely considered to be part of the same group (Campbell, 1958). A component team may be colocated in the same organization, establishing proximity among the members. An example of component teams with high proximity are those in an emergency response MTS. Each component team in the system (e.g., police, fire fighter, emergency medical technician) is colocated within its own brick-and-mortar organization. However, globalization has made virtual teams more prevalent and thus, component teams may also be spread across geographical boundaries. For example, in a large scientific MTS, a component team may be composed of members from different research institutions. Therefore, proximity may only be sufficient to establish entitativity for collocated teams.

The principle of similarity states that elements with similar qualities and characteristics are likely to considered part of the same group (Campbell, 1958). In an MTS this could translate into component teams having specialized roles or functions. For example, in a product development MTS, component teams carry out various functions, such as project management, research and design, programming, data analytics, and marketing. Within each team there are different priorities, languages, and frames of reference, helping to establish each team as a separate unit. However, similarity may not be sufficient to establish entitativity, as component teams in an MTS may serve very similar or overlapping functions. For example, DeChurch and Mathieu (2009) described a firefighting MTS composed of teams with various functions (e.g., fire suppression, ventilation, and search and rescue). In a multialarm fire, there may be several teams with the same function active at the same time (e.g., two search-and-rescue teams).

The principle of common fate states that elements with common processes and outcomes are likely to be considered as part of the same group (Campbell, 1958). Observing the covariation of activities within and across groups, we consider that entitativity is established when the covariation is greater within, rather than across teams (DeChurch & Zaccaro, 2013). In MTSs the goal hierarchy can establish common fate among members of the same team. Although component teams in the MTS share common fate through the accomplishment of an overarching goal, each team has its own team-level goals and priorities (Mathieu et al., 2001). Thus, the commonality of activities and goals within a team is greater than the commonality across teams. Common fate, therefore, is a defining characteristic that serves to differentiate the teams in a system (DeChurch & Zaccaro, 2013).

Assuming that entitativity is established for each component team in the MTS, members must deal with the draw of two foci: the team and the system. Each will have pull on an individual's attention and direct efforts. Managing the team and MTS boundary requires a focus on team and MTS effectiveness, as well as team- and MTS-level goals, making the MTS a complex environment within which members must interact and function. Thus, individual assessments aimed at uncovering an individual's capacity for teamwork must account for these two levels of collaboration.

3.3 Tripartite Taxonomy of Team and MTS Functioning

To clearly establish an understanding of an individual's capacity for collaboration in the context of MTSs, assessments should explore how individual KSAOs contribute to critical facets of teamwork at both the team and MTS levels. While there are many models and taxonomies of teamwork, there is substantial convergence on the notion of three core mechanisms of teamwork: *affect/motivation*, *behavior*, and *cognition* (Kozlowski & Ilgen, 2006; Salas, Rosen, Burke, & Goodwin, 2009).

Team affect/motivation captures aspects of the team or MTS that stem from members' emotions, attachment, and/or motivation. Team cohesion, the result of all of the forces acting upon the individual to remain in the group (Cartwright, 1968; Festinger, Schacter, & Back, 1950), is perhaps the quintessential aspect of team affect. Other affective/motivational constructs include team potency, collective efficacy, and team goal commitment (Gully et al., 2002; Stajkovic et al., 2009). Whereas most studies of team affect/motivation have focused on affect or motivation within relatively small teams, these constructs are meaningful at the larger MTS level as well. Recent dissertations have explored cohesion (DiRosa, 2013) and efficacy (Jimenez-Rodriguez, 2012) at the MTS level.

Team behavior reflects "what teams do" (Kozlowski & Ilgen, 2006, p. 95). Team processes are the verbal and behavioral mechanisms through which individuals combine their effort to accomplish a team task (Cohen & Bailey, 1997). A validated (LePine et al., 2008) taxonomy of team process behaviors was advanced by Marks et al. (2001). This taxonomy details 10 interaction processes needed by individuals as they pursue collective goals. Three preparatory processes include setting goals, analyzing the task, and setting up plans and contingency plans. Four action processes include monitoring progress, monitoring and backing up teammates, monitoring the performance environment, and coordination. Whereas the first two sets of processes meet the task needs of the group, a third set of interpersonal processes allow the group to manage the social context of the team. These interpersonal processes include motivating and confidence building, conflict management, and affect/emotion management.

Whereas the taxonomy was developed for application to small teams, it has been extended to MTSs, and it provides a useful framework for understanding the between-team processes needed when teams share goals with other teams and must collaborate externally. Two initial studies of MTSs adapted several of these processes, such as coordination (DeChurch & Marks, 2006), to the between-team level. Each of the 10 (Marks et al., 2001) processes can be defined at the intra- and inter-team levels, both of which are useful criteria on which to validate individual assessment metrics.

Team cognition captures a team's (or MTS's) organized knowledge (Klimoski & Mohammed, 1994). Interest in the notion of team cognition began in earnest in the 1980s, and progressed in two relatively orthogonal lines of thought. The first observed that individuals who work together develop differentiated systems of encoding and retrieving information. Termed *team transactive memory systems* (TMS; Liang, Moreland, & Argote, 1995; Moreland, 1999; Moreland, Argote, & Krishnan, 1996), this form of team cognition involves two components. First, team members distribute who knows what information so that the team can increase its collective working memory capacity. The second component of TMS is a shared awareness of who knows what. This latter aspect of the construct enables team members to be efficient in their retrieval and allocation of information within the team. The TMS construct has been shown into be a strong mechanism of team effectiveness (Austin, 2003; DeChurch & Marks, 2006; Lewis, Lange, & Gillis, 2005; Littlepage et al. 2008).

The second line of inquiry on team cognition is the concept of a *team mental model*. Team mental models were discovered while observing that expert teams were able to seamlessly coordinate their actions, anticipating one another's needs without the need for communication (Cannon-Bowers, Salas, & Converse, 1993). Subsequent team mental model research has examined a variety of content domains and forms (Klimoski & Mohammed, 1994). Two popular content domains are task work models and teamwork models. The former details the critical aspects of the task and their interrelation; the latter details aspects of needed member interaction and social functioning. Regardless of the content domain, this research generally distinguishes between the similarity and accuracy of team mental models. Interestingly, research finds both similarity and accuracy contribute uniquely to team performance (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Thus, even a shared but inaccurate mental model provides some benefit to team performance.

In sum, decades of team effectiveness research have revealed how teams can be most effective. The general belief is that teams need strong affective/motivational and cognitive states, and behavioral processes in order to function at an optimal level (Kozlowski & Ilgen, 2006; McGrath, 1984). Indeed, meta-analyses confirm the importance of information sharing (Mesmer-Magnus & DeChurch, 2009), cognition (DeChurch & Mesmer-Magnus, 2010), cohesion (Beal, Cohen, Burke, and McLendon, 2003), team processes (LePine et al., 2008), and conflict (De Dreu & Weingart, 2003; DeChurch et al., 2013) for performance as well as other aspects of team functioning. Research has also indicated the importance of some of these aspects of teamwork for MTS effectiveness, thereby revealing those aspects of teamwork (i.e., affect/motivation, behavior, and cognition) that are important for the success of the team and the MTS, respectively.

These extensions are important when addressing teams in the context of MTSs. However, still missing are individual assessments that predict which aspects of the individual contribute to the functioning of both the team and the MTS. Thus, there are two level of complexity to address. First, there is the possibility that factors that contribute to individual performance may be different from those that contribute performance in a team (von Davier & Halpin, 2013). Individual assessment therefore, must account for the team context when determining what individual-level factors contribute to the success of a team. Second, the factors that contribute to team performance may be different from those that contribute to MTS performance (DeChurch & Zaccaro, 2013). It is not enough to simply consider how individual KSAOs impact team functioning or MTS functioning, respectively. Indeed, to get a more complete picture of collaboration within and between teams, assessments must consider the impact that individual KSAOs have on team and MTS functioning simultaneously.

3.4 Confluent and Countervailing Forces

Countervailing forces occur when a process or property manifested at one level (i.e., team or MTS) has opposing consequences at different levels of analysis (DeChurch & Zaccaro, 2013). For example, teams that engage all members in the planning and strategizing phases of a task may encourage participation, empowerment, and buy-in (Lanaj, Hollenbeck, Ilgen, Barnes, & Harmon, 2013), but this type of decentralization across teams may result in coordination failures when there are too many members engaged in cross-team planning. Thus, a team process may have a positive (or negative) effect on an outcome at the team level, and the opposite effect with an outcome at the system level (DeChurch & Zaccaro, 2013). This point is critical for assessment, because validating metrics on one level or the other is deficient in capturing the ways that individuals contribute to collaboration in modern organizations. However, while MTS researchers have acknowledged the potential for countervailing forces in MTSs, virtually none have empirically examined these relationships. Instead, MTS researchers have mainly focused on assessing the homology of team-level relationships at the MTS level, uncovering processes and properties that are helpful or harmful to MTS effectiveness (ignoring team effectiveness). Thus, most hypotheses tested in extant research on MTSs give only part of the story.

Countervailing forces are different from confluent forces, in which a process or property manifested at one level has the same effect on outcomes at both the team and MTS levels. For example, planning activities across teams helps the system to establish a strategy for achieving MTS level goals, but when team and MTS goals are closely aligned, planning between teams can also aid individual teams in developing a strategy for moving forward with team goals. When team and MTS processes are confluent, assessment efforts can validate assessment methods against the consequences at either level.

Table 3.1 summarizes the empirical studies of MTSs. The table lists the various studies conducted on MTSs and the relationships examined. We categorize the nature of the relationships reported in the research. Single-level studies include predictors and criteria at the MTS level of analysis. Multilevel homology studies include predictors and criteria at least two levels of analysis, but hypothesize and test only single-level relations at each level with the aim of discovering the degree to which these relations (e.g., the relation between coordination and performance) are the same at multiple levels of analysis. Confluent and countervailing relationships are specific types of cross-level relations (DeChurch & Zaccaro, 2013). These cross-level relations are relevant to assessment efforts because they can reveal cases where a process has opposite consequences at two levels of analysis. In particular, where an individual characteristic may contribute to a process or property that benefits the team (or MTS), it may do so at the cost of MTS (or team) progress.

As an illustration, imagine that team cohesion exhibits a countervailing effect. Decades of primary studies on a wide variety of teams have shown a strong positive link between cohesion and performance (Beal et al., 2003). While the direction of the relationship has been widely debated, we can generally conclude that teams whose members are emotionally connected to the team tend to be the high performing teams (and vice versa). DiRosa (2013) posited and tested the idea that team cohesion, while generally good for team outcomes, may have detrimental effects at the system level. When teams become insular, it can activate social categorization processes and suppress information sharing and collaboration across teams, effectively undermining MTS performance. Hence, it is important that measures that assess collaboration consider individual contributions to both team- and system-level functioning. Using the example of team cohesion, an individual that contributes to very strong team cohesion may inadvertently set up the perfect conditions for intense intergroup competition. In terms of collaborative capability, such individuals may ultimately lead the team to victory while simultaneously leading the MTS to defeat.

Table 3.1 shows under a dozen empirical studies of MTSs (published at the time of writing this chapter). Whereas most examine both team and multiteam processes as predictors of MTS effectiveness, four of these did not include team-level predictors—meaning they cannot account for the incremental validity of MTS functioning beyond that predicted at the team level. Also relevant to assessment, only one of these studies (Davison, 2012) predicted criteria at both the team and MTS level. Such dual-level studies are needed to properly inform assessment research that will ultimately need to validate predictors on these multilevel criteria. Meta-analytic accumulation across studies can partially compensate for these blind spots in the primary literature.

Table 3.1 Relationships examined in previous MTS research

Study	Predictor level	Predictors examined	Criterion level	Criteria examined	Relationships examined			
					Single level	Multilevel homology	Confluent	Countervailing
Davison, Hollenbeck, Barnes, Sleesman, & Ilgen (2012)	Team; MTS	Coordinated action	MTS	Performance	X			
Davison (2012)	Team; MTS	Roles; goal commitment; identity	Team; MTS	Performance	X	X		X
DeChurch and Marks (2006)	Team; MTS	Strategy and coordination training; coordination; team performance	MTS	Functional leadership; coordination; performance	X			
de Vries, Walter, Van der Vegt, &, Essens (2014)	MTS	Coordination	Team	Performance	X			
DiRosa (2013)	Team; MTS	Interdependence; boundary spanning; goal alignment; cohesion	MTS	Cohesion; goal alignment; readiness	X			
Firth, Hollenbeck, Miles, Ilgen, & Barnes (2015)	Team; MTS	Frame-of-reference training; coordination	MTS	Performance	X			
Jimenez-Rodriguez (2012)	MTS	Efficacy; information sharing uniqueness and openness; transactive memory; trust; shared mental model; communication retrievability; media richness	MTS	Information sharing uniqueness and openness; performance; transactive memory; shared mental models	X			

(continued)

Table 3.1 (continued)

Study	Predictor level	Predictors examined	Criterion level	Criteria examined	Relationships examined			
					Single level	Multilevel homology	Confluent	Countervailing
Lanaj et al. (2013)	MTS	Decentralized planning; planned and actual proactivity, aspirations, and risk-seeking; coordination failures	MTS	Planned and actual proactivity, aspirations, and risk-seeking; coordination failures; performance	X			
Marks, DeChurch, Mathieu, Panzer, & Alonso (2005)	Team; MTS	Action and transition process; interdependence	MTS	Performance; action process	X		X	
Mathieu, Maynard, Taylor, Gilson, & Ruddy (2007)	Team; MTS	MTS coordination; openness climate; team interdependence, team processes	Team	Team process; performance	X		X	
Murase, Carter, DeChurch, & Marks (2014)	MTS	Interaction mental model accuracy; coordination; strategic communication	MTS	Coordination; performance	X			

However, traditional ways of thinking about team and MTS effectiveness preclude us from considering the inherent complexity of teamwork in MTSs, and how individual characteristics play a role in shaping the process of teamwork. The confluence and countervailance perspective provides a more complete understanding of the forces at play that impact both team and multiteam outcomes, both of which need to be considered in developing useful assessment methods.

3.5 Implications

As research on MTSs continues to grow, it is important that researchers begin to take on a more complex view of MTSs. To better enable the success of both team and MTS goals, research should use the confluence/countervailance lens to understand what factors facilitate and impede team and MTS effectiveness. The role of individual assessment in this cause is twofold. First, individual assessment needs to determine what individual-level factors shape an individual's collaborative capacity. For example, researchers may explore the collaborative interactions and the features of successful collaboration (von Davier & Halpin, 2013). Second, individual assessment needs to determine how individuals not only contribute to and shape team-level interactions, but also how individual-level factors may in also influence interactions in the MTS. Further, it is important to consider team and MTS outcomes simultaneously.

3.6 Conclusion

For many teams, MTSs represent a context that imposes new challenges in teamwork. The growing body of literature on MTSs has examined factors that may improve or hinder MTS performance. However, as MTSs are composed of entitative teams with their own local goals, it stands to reason that research should explore the factors that may mutually impact both team and system effectiveness. The present manuscript lays out this framework as a way to validate measures of individual collaborative capability.

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