The SAGE Handbook of Industrial, Work & Organizational Psychology

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Book Title: The SAGE Handbook of Industrial, Work & Organizational Psychology
Chapter Title: "Multiteam Systems: The Next Chapter"
Pub. Date: 2018
Access Date: February 8, 2018
Publishing Company: SAGE Publications Ltd
City: 55 City Road
Print ISBN: 9781446207222
Online ISBN: 9781473914957
DOI: http://dx.doi.org/10.4135/9781473914957.n16
Print pages: 333-353

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INTRODUCTION

In the inaugural version of this handbook, Mathieu, Marks, and Zaccaro (2001) advanced the concept of multiteam systems as a new unit of inquiry and analysis, in which teams-of-teams needed to coordinate their efforts to achieve one or more goals that were beyond the individual team goals. They suggested that these systems of teams sometimes came from a single organization, but in many other instances involved teams from different organizations; public and private, civilian and military, volunteer and paid, competitors and collaborators, foreign and nationals, and other nontraditional pairings. In some ways, these systems operated like ‘big teams’ – yet in other respects, they were more like traditional organizations. However, Mathieu et al. (2001) submitted that these systems were a bit different and defied conventional logic and labels. They coined the term multiteam systems (MTSs) to refer to these entities, distinguished them from other forms of organizations, and outlined their unique properties as well as potential levers for influencing effectiveness.

It has been over fifteen years since Mathieu et al. (2001) advanced this notion of MTSs. In that time, numerous conference sessions and dedicated meetings have been held, empirical investigations have been conducted, and edited volumes (e.g., Salas, Shuffler, & Rico, 2014; Zaccaro, Marks, & DeChurch, 2012) have been published on the topic. The MTS concept has taken root in a wide variety of disciplines including Industrial/Organizational Psychology (e.g., Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005), Organizational Behavior (e.g., Gibson & Dibble, 2013), Communications (e.g., Keyton, Ford, & Smith, 2012), Network Science (e.g., Kratzer, Gemünden, & Lettl, 2008), Software Design (e.g., Scheerer, Hildenbrand, & Kude, 2014), Civil Emergencies (e.g., Healey, Hodgkinson, & Teo, 2009), Product Design (e.g., O'Sullivan, 2003), System Optimization (e.g., Liu & Simaan, 2004), Space Operations (e.g., Caldwell, 2005), and Healthcare (e.g., Taplin, Foster, & Shortell, 2013). The insights gained from this work are numerous and varied, but in desperate need of synthesis. Moreover, there have been few attempts to advance theoretical frameworks to unify the MTS domain (cf., Luciano, DeChurch, & Mathieu, 2015; and Zaccaro et al., 2012 for exceptions). Accordingly, the time is right to revisit some of the fundamental tenets of MTSs. Therefore, in this chapter we have two primary objectives: 1) to update the conceptual understanding of MTSs; and 2) to consider the most fruitful directions for future investigations. To address our first primary objective, we revisit the definition and nature of MTSs, discuss MTS effectiveness criteria from a multiple-constituencies perspective, and chronicle some recent organizing frameworks that have distilled important properties of MTSs. In so doing, we feature MTS structure, coordination, and leadership-related issues. Although we review some of the more prominent studies from the industrial/organizational psychology and management domains that have been conducted over the past 15 years, our review is selective and not intended to comprehensively review all of the work that has been done to date. In our final two sections we address our second primary objective and outline ‘the road forward’ for the MTS domain. We consider the advantages and disadvantages of some alternative research methodologies that may be used to study MTSs, and conclude with recommendations for future theory, research, and application in the domain of MTSs.

MTS CONSTRUCT REFINEMENTS AND ADVANCEMENTS

Defining the nature and boundaries of MTSs has been a challenging task and the subject of some debate. Mathieu et al. (2001) acknowledged that demarcating the system boundaries would be a difficult enterprise, similar to defining the boundaries of teams or organizations. In this section, we take inventory of what is known about MTSs and update the conceptual understanding of their properties.

The Definition and Nature of MTSs

Mathieu et al. (2001) specified that the basic building blocks of MTSs were teams – which they referred to as *component teams*. They were not suggesting that individual members of those teams and their associated features – states, reaction, behaviors, and so forth – were unimportant, simply that the focal entities of MTSs were the teams that were included. Mathieu and colleagues went on to argue that, for an MTS to exist, those component teams need to be linked in some fashion. In other words, to be functionally 'tightly coupled' with one another. Specifically, they offered the following definition:

> 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 et al., 2001, p. 290)

Their definition was an attempt to identify the nature of MTS boundaries, while not limiting the types of MTSs that might exist. The definition was functionally grounded in the sense that they emphasized the existence of a superordinate goal as the reason 'why' the teams were included in the system. Mathieu et al. (2001) noted that the component teams might perform quite similar activities or markedly different activities directed toward their proximal goals. However, the component teams' actions toward their respective proximal goals need to be linked through a goal hierarchy and thereby to the realization of the overall system (superordinate) goal. The achievement of a superordinate goal(s) is the reason that MTSs exist and is a core defining feature of them. Superordinate goal achievement serves to align motives, provide a common identity, help to prioritize actions, and otherwise chart out common ground for the component teams and their members.

In later work, Marks et al. (2005) and Zaccaro et al. (2012) made the point that MTSs are not simply large teams. Their component teams are distinguishable entities capable of independent actions that may pursue different proximal goals. That is, the relative interdependence of team members is *higher within component teams than between component teams* comprising an MTS. Although the component teams are distinguishable entities, what defines the boundary for inclusion in an MTS is the fact that they share input, process, and outcome interdependence with at least another team in the MTS. It is the existence of the superordinate goal and the nature of team interdependencies that defines MTS membership, not organizational boundaries (Mathieu, 2012).

Mathieu (2012) noted that the interdependence portion of the MTS definition was an attempt to operationalize a 'tightly coupled' network of teams. He went on to suggest that:

> it is debatable whether component teams must have all three forms of input, process, and outcome interdependence to be included in a MTS, or what the thresholds for those judgments might exactly be. I certainly believe that if all three

> forms of interdependence do exist to moderate or high degrees, a MTS exists. But there may be other ways to define 'tightly coupled' besides this operationalization. What is clear, however, is that component teams must be tightly coupled on some basis in order to constitute a MTS. (Mathieu, 2012, p. 514)

In sum, the defining features of MTSs hinge on the existence of a superordinate goal, and teams that are highly interdependent – tightly coupled – in order to achieve that goal. Other subtleties of MTSs aside, those two features are key distinguishing characteristics of MTSs.

Lanaj, Hollenbeck, Ilgen, Barnes, and Harmon (2013) offer an important insight regarding MTS characteristics, by highlighting that MTS size may be an important boundary condition or moderator variable. The original definition of MTSs advanced by Mathieu et al. (2001) sets the minimum threshold at two component teams such that there can be both within- and between-team processes. Naturally, however, cross-team coordination processes become qualitatively different when a third team is added to the system. The inclusion of the third component team creates the potential for alliances and other multi-group dynamics, as well as challenges component teams to determine which other component team(s) are appropriate to coordinate with at different points in time. Add even more teams into the MTS, and system coordination requirements become exceedingly more challenging (Lanaj et al., 2013). While recognizing this phenomenon, we maintain that MTSs are defined as two or more tightly coupled, interdependent teams in pursuit of a superordinate goal (Mathieu et al., 2001) that necessitate both within- and between-team processes. However, we appreciate that the functioning of these MTSs may become qualitatively different under certain conditions, one of which is increased size.

MTS Effectiveness

The concept of MTS effectiveness is alluded to by many authors, but there has been little detailed explanation as to what it is. In fact, the concept of MTS effectiveness was mentioned only twice in the entire Zaccaro et al. (2012) edited volume. As originally conceived, MTS component teams are linked through a goal hierarchy (Mathieu et al., 2001). The notion was that individual component teams in an MTS pursue their own unique goals which, at some point, align with those of others to realize higher-level goals in the goal hierarchy. Ultimately, given the nature of the interdependencies between different teams in the systems at different times, the superordinate or highest level goal is reached (or not) with varying degrees of success. Mathieu et al. (2001) argued that 'Effectiveness of the MTS, then, is defined not only in terms of how well each team accomplishes its proximal goals, but more importantly on how well they collectively accomplish shared goals at the higher levels of the goal hierarchy' (p. 291). Thus, embracing this hierarchical network of goals framework, the effectiveness of an MTS can be assessed on a macro level by superordinate goal accomplishment, as well as at a more micro level by evaluating the goal accomplishment of component teams and nestings of teams.

Given the definition of MTS effectiveness hinges on goal accomplishment, the concept is necessarily context dependent. For example, goals may be in terms of points earned in a simulation (e.g., Marks et al., 2005), the creativity of R&D MTSs (e.g., Kratzer et al., 2008), saving lives and property (e.g., Healey et al., 2009), and successful space exploration and return to earth (e.g., Caldwell, 2005). Moreover, an MTS may be responsible for different superordinate goals under different circumstances, such as coalition forces shifting from combat to peacekeeping or humanitarian aid operations. Elsewhere, Resick, Burke, and Doty (2012) noted that the factors that underlie the effectiveness of MTSs in laboratory investigations hinge, in large part, on the effectiveness metrics that are built into the simulations. Regardless of the particular context, however, the ultimate criterion for MTS effectiveness is the extent to which the superordinate goal is realized. Naturally goals include several attributes including their level, quality standards, a temporal window, and resources expended to accomplish them – all of which factor into the equation of the extent to which they were successfully accomplished. But the raison d'être of MTSs is to accomplish the superordinate goal through collective efforts, so it is only appropriate that their effectiveness is gauged, first and foremost, in terms of the extent to which that is achieved.

Whereas the accomplishment of the superordinate goal is the primary criterion for MTSs, it is valuable to adopt a multiple constituency framework. Multiple constituency frameworks suggest that numerous parties may have a valued stake in the operations of some organization, or in this case, MTS. Those parties would include, for instance, the members of various component teams as well as their host organizations. Achieving an MTS superordinate goal while burning out participating members or leaving ill-feelings between teams that need to coordinate their efforts in the future will, in the long run, undermine MTS effectiveness. A joint venture can facilitate relations between contentious competitors or nations, or serve to drive them apart. In short, anyone who has a vested interest in MTS function represents a measure of effectiveness to be considered.

One can quickly see how this multiple constituency framework also foretells certain pressures on MTSs. For example, as Luciano et al. (2015) detail, when component teams have incompatible proximal goals (goal discordancy) or allegiances and obligations beyond the focal MTSs (diversion of attention), it can undermine MTS functioning. At issue is that another constituency, beyond the focal MTS, is vying for their attention. To the extent that maximizing the effectiveness of the focal MTS runs counter to the achievement of these other goals, component teams and their host organizations may conclude that the overall effectiveness of their efforts is less than optimal. Of course many other constituencies have vested interests in the operations of an MTS. For example, disaster relief MTSs have as their superordinate goals the preservation of life and property. However, how they go about their activities have both environmental consequences and costs to taxpayers which need to be considered. In short, whereas the superordinate goal achievement is the focus of an MTS, it is not the sole criterion upon which their effectiveness will be gauged. At some level, MTS effectiveness is akin to a balanced scorecard approach where different accomplishments are valued differently by different constituencies. On balance, to the extent that the MTS maximizes the overall value of its activities across its important constituencies, represents the ultimate effectiveness criterion.

MTS Frameworks

Zaccaro and colleagues (2012) advanced a framework that featured three aspects of MTSs: 1) *compositional*; 2) *linkage*; and 3) *developmental* attributes. *Compositional* attributes include categories pertaining to number of component teams, size, boundary status, organizational diversity, proportional membership, functional diversity, geographic dispersion, cultural diversity, motive structure, and temporal orientation. *Linkage* attributes include interdependence, hierarchical arrangement, power distance, and communication structure. *Developmental* attributes include characteristics related to the genesis of the MTS, direction of development, tenure, stage, and transformation of system composition. They suggest that MTS compositional, linkage, and developmental attributes are antecedents of intrateam and interteam processes, which in turn influence system effectiveness (Zaccaro et al., 2012).

In this section, we focus on the interplay of MTS attributes and integration mechanisms to facilitate system effectiveness. We will review new theory on MTS functioning, and consider how variations in structural elements affect functioning. We then review work on two key integration mechanisms, coordination and leadership, and consider how they can mitigate the structural factors and forces that create rifts or divisions in the system.

MTSs are a distinct organizational form. Similar to other entities (e.g., organizations, alliances, teams), in order to comprehensively understand how to build and manage effective MTSs it is critically important to understand their structures. Structure captures the totality of how an organizational form is: 1) divided; and 2) integrated. Numerous examples from both academic journals and popular press point to the interactions between teams as the weak point in MTSs during which errors and issues occur. MTSs seem to present a paradox; how does one simultaneously structure strong component teams that also function well as a part of a system.

To help resolve this paradox we highlight the macro-level dynamics associated with the division and integration of multiteam systems. Drawing from the MTS literature, for division we focus on system differentiation and dynamism and for integration we focus on coordination and leadership. Our focus on more macro-level dynamics is consistent with the suggestion of DeChurch and Zaccaro (2010) who submitted: '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' (p. 329). Essentially, they suggest that organizational scientists cannot see the forest for the trees, and argue that progress on understanding MTS functioning and leverage points for effectiveness requires a shift from an inward focus on intrateam dynamics, to an understanding of the macro-level dynamics governing the whole.

Division – The Rifts between Teams

MTSs are complex forms that are difficult to study. The development of a science of MTSs has further been hindered by the absence of a unifying framework to characterize different forms. Luciano and her colleagues (2015) address the complexity of MTSs by answering the questions: 1) what about the system is complex; and 2) why does it matter? They develop a multi-dimensional framework of MTS structural features, describe the structural forces emanating from those features, then advance a meso-theory of MTS functioning linking relationships across levels of analysis. The structural features and forces describe various forms of divisions in the system.

Luciano and colleagues (2015) highlight two overarching dimensions of MTS structural features, differentiation and dynamism. *Differentiation* characterizes the degree of difference and separation between MTS component teams at a particular point in time, whereas *dynamism* describes the variability and instability of the system over time. Luciano and colleagues identified five subdimensions of both dimensions. As detailed in Table 15.1, differentiation includes: 1) goal discordancy; 2) competency separation; 3) norm diversity; 4) work process dissonance; and 5) information opacity. Dynamism includes: 1) change in goal hierarchy; 2) uncertainty of task requirements; 3) fluidity of system structural configuration; 4) fluidity of system composition; and 5) diversion of attention. The overarching point of the framework is that MTSs of different forms will function differently. The patterns across subdimensions provides a useful schematic or template for understanding the critical fractures or rifts, as well as points of leverage, which may exist within the system. The different subdimensions may combine in complex fashions with some patterns being synergistic and others antagonistic. Generally speaking, however, MTSs that are high on different aspects of differentiation and dynamism will be more prone to fractionation from forces that drive teams apart and destabilize the system, respectively.

Table 15.1 A multi-dimensional framework of multiteam system structural features

	Differentiation dimension
Subdimension	Description
Goal discordancy	Captures differences in goals and goal priority across MTS component teams, ranging from similar goal priorities and compatible goals at lower levels to dissimilar goal priorities and incompatible goals at higher levels.
Competency separation	Captures differences in knowledge and capabilities across MTS component teams, ranging from component teams containing very similar knowledge and parallel capabilities at lower levels to vastly different knowledge and disparate capabilities at higher levels.
Norm diversity	Captures differences in policies and expectations across MTS component teams, ranging from similar policies and compatible expectations at lower levels to dissimilar policies and incompatible expectations at higher levels.
Work process dissonance	Captures differences in work processes across MTS component teams, ranging from congruent work processes conducted concurrently at lower levels to incongruent work processes conducted independently at higher levels.
Information opacity	Captures differences in information about MTS component team activities, ranging from real-time information being available and interpretable at lower levels to information being generally unavailable or uninterpretable at higher levels.
	Dynamism dimension
Subdimension	Description
Change in goal hierarchy	Captures modifications in the relative importance of system goals, ranging from a stable goal hierarchy at lower levels to drastic and frequent changes in the goal hierarchy at higher levels.
Uncertainty of task requirements	Captures the uncertainty regarding component team activities required to fulfill system goals, ranging from requirements being well known at lower levels to being unknown at higher levels.
Fluidity of system structural configuration	Captures the changes in the linkages among component teams, ranging from stable linkages at lower levels to frequent shifts that substantially alter workflow at higher levels.
Fluidity of system composition	Captures the changes in system membership, ranging from system and team membership being stable at lower levels to frequent and substantial reconstitution of system and team membership at higher levels.

Diversion of attention	Captures the extent to which component team members' attention is focused on matters other than MTS-related tasks, ranging from members only being involved in one MTS at lower levels to members being concurrently involved in multiple non-overlapping systems at higher levels.

Source: Adapted from Luciano, DeChurch, & Mathieu (2015)

Overall, Luciano and colleagues present a unified theoretical framework of entity structure by articulating both the shapes of the structure (i.e., differentiation) and how they change over time (i.e., dynamism; Ranson, Hinings, & Greenwood, 1980). Luciano et al. (2015) then go on to advance a meso-theory of MTS functioning. They posit the MTS structural features of differentiation and dynamism generate boundary-enhancing forces and disruptive forces in MTSs, respectively. *Boundary-enhancing forces* reinforce the differences between component teams and increase the salience of team membership, whereas *disruptive forces* increase uncertainty and destabilize the system. In turn, these structural forces influence individuals' belonging needs, affective motives, and cognitive motives, and thereby emergent collective states at the component team- and system-levels. Notably, these forces can direct MTS members' needs and motives more toward their component teams than the MTS, which undermines collaborative interactions across teams.

Integration – Mending Rifts and Building Bridges

In the premiere MTS chapter, Mathieu and colleagues (2001) recommended four critical levers for enhancing MTS coordination and effectiveness: 1) shared mental models; 2) leadership; 3) information technology (IT) systems; and 4) reward systems. The emphasis on coordination follows from the fact that between-team coordination is often the weak point of otherwise well-functioning systems. Unfortunately, empirical research in several of those areas has been limited. Accordingly, in this section, we lay the groundwork for future investigations to delve more deeply into the macro-dynamics of MTSs. Specifically, we discuss several features of coordination and leadership as well as offer insights regarding their alignment with system configurations (i.e., differentiation and dynamism) to enhance MTS effectiveness.

Coordination and leadership mechanisms are both critically important to manage the MTS and promote effectiveness. These mechanisms can serve to offset structural elements of the system or compensate for the boundary-enhancing or disruptive forces creating rifts in the system (Luciano et al., 2015). Stated differently, mechanisms are needed to mend the rifts or to build bridges over them. Individuals working in MTSs will react to differentiation and dynamism by focusing their attention inward toward the component teams. Interventions, then, will be effective to the extent that they direct emphasis toward the system (rather than the component team) or aid in aligning the efforts of component teams.

Coordination

Early work on coordination in MTSs drew from the literature on (within) team processes (e.g., Marks, Mathieu, & Zaccaro, 2001). Examination of team processes focused on members' interdependent actions, rather than the mechanisms used to facilitate them. By way of extension, MTSs have to facilitate and enact processes at both the team- and system-levels. Empirical research on MTS coordination has examined the influence of coordination on MTS performance, detailing the role of different coordination *functions*, directed at different *foci*, exhibiting multiple *forms*, and being enacted during different *phases*. These aspects of MTS coordination can be defined as follows:

- *Coordination functions* – coordination behaviors (e.g., action, understanding, interests) that enable component teams to attain proximal team goals and superordinate system goals;
- *Coordination foci* – the collective (e.g., focal team, other team, system) whose needs are met by engaging in coordination functions;
- *Coordination forms* – the structure (e.g., boundary-spanners, members, centralized, decentralized) of who in the MTS enacts the coordination functions;
- *Coordination phases* – the timing of when coordination functions are enacted.

The earliest empirical examination of MTS coordination explored coordination *phases*. In a study of eight MTSs working on subprojects associated with a three-year new product development project at a European automotive organization, Hoegl, Weinkauf, and Gemuenden (2004) illustrated the positive relationships between interteam coordination, project commitment, and teamwork quality. They found those three process variables were stronger positive predictors of component team performance (Time 3) when measured at the end of the initial concept phase (Time 1), than at the end of the later design phase (Time 2; Hoegl et al., 2004). These findings highlight the predictive power of collaborative processes and the importance of tending to these processes early in the project timeline.

Later empirical examinations of coordination each featured more than one component of coordination (e.g., function and foci), however each offers insights regarding a particular coordination *function*. Definitions of coordination and its component functions abound (see Okhuysen & Bechky, 2009 for a review). Whereas many definitions focus on the action function of coordination (e.g., Marks et al., 2001), McGrath, Arrow, and Berdahl (1999) offered a more comprehensive definition identifying three dimensions of coordination – coordination of interests, understanding, and actions.Coordination of interests refers to the functional interconnections between member interests and goals and group interests and goals … Coordination of understanding refers to the development of shared perceptions and meanings among members, including an appreciation of the ways in which members reliably see and interpret events differently … Coordination of action is a synchronization and sequencing of member actions in time and place. (pp. 1–2)Herein, we address the coordination functions of interests, understanding, and actions.

In their study of undergraduates performing a flight simulation in a laboratory, Marks et al. (2005) examined *action* processes (*function*) both at the within-team and MTS (cross-team) levels (*foci*). They found that cross-team action processes positively predicted MTS performance beyond that accounted for by within-team action processes. Further, they manipulated the level of goal hierarchy interdependence (i.e., the level of cross-team interdependence the situation calls for), which is conceptually akin to coordination of *interests*. They found cross-team action processes were more important for MTS effectiveness in situations with more interdependent goal hierarchies (Marks et al., 2005). Stated differently, the level of coordination of interests required by the situation can influence the relative importance of the coordination of action at different levels of foci.

Hollenbeck, Ilgen, and their colleagues conducted a series of studies using US Air Force captains completing a remotely piloted aircraft simulation as a part of a leadership course. Each MTS was comprised of three specialized six-person teams, including a leadership team, a point team, and a support team. Notably, the leaders (i.e., the director and assistant director) of both the point and support component teams served in boundary-spanning roles and were also considered members of the leadership team (i.e., the leadership team contained two unique team members and four overlapping team members). This study design enabled important insights regarding coordination *foci* and *form*. Davison, Hollenbeck, Barnes, Sleesman, and Ilgen (2012) found cross-team coordinated action can be beneficial or detrimental to system performance, in part, depending on which team (*form*) is enacting the coordination behaviors and the relative importance of the targeted teams (*foci*). Specifically, coordinated action across teams only positively influenced system performance when directed at the component team most critical to addressing the demands of the task environment at that point in time (Davison et al., 2012). Additionally, Lanaj and colleagues (2013) demonstrated that the coordination *form* including the structure of linkages (i.e., being enacted in a centralized or decentralized manner), influences MTS performance. They found that decentralized planning can have both positive and negative effects; the positive effects were attributed to enhanced proactivity and aspiration levels, the (even stronger) negative effects were attributed to excessive risk seeking and coordination failures (Lanaj et al., 2013).

The third article using the US Air Force captain simulation population was conducted by Firth, Hollenbeck, Miles, Ilgen, & Barnes (2015). This study offers important insights for the coordination *function* of understanding by examining the influence of frame-of-reference training. They posited that frame-of-reference training would reduce representational gaps and found that it enhanced between-team coordination and thereby MTS performance. Furthermore, they found that within-team coordination improved the relationship between frame-of-reference training and between-team coordination, but the pattern varied based on team function (i.e., focal team, point team). This finding suggests that the quality of coordination of one *foci* can influence coordination of other *foci.*

Likewise considering the coordination *function* of understanding, Healey and colleagues (2009) adopted a transactive memory system approach. They examined three MTSs, each involving 11–19 different organizations, which engaged in a civil emergency response training exercise. Their study found that knowledge of others' expertise, at the component team and MTS levels (*foci*), is critical for team and system performance. They also offer insights concerning the differential effects of different forms of training exercises.

In sum, several empirical MTS studies provide important insights into the aspects of coordination that influence MTS performance. However, these studies often report differential effects of coordination on performance; some studies varied in strength of the effects (e.g., Marks et al., 2005), whereas others demonstrated both positive and negative effects of coordination (e.g., Davison et al., 2012; Lanaj et al., 2013). Accordingly, we anticipate complex contingency relationships between MTS structural configurations, their coordination mechanisms, and environmental factors, as related to MTS effectiveness. Discerning the precise nature of these contingencies remains a topic for the next generation of MTS research. However, below we offer some general guidance for such investigations.

When considering the functions, foci, forms, and phases of MTS coordination, it is important to take into account both: 1) the *mechanisms* used to facilitate coordination; and 2) the enacted *process* of coordination. Coordination mechanisms can serve to *offset* the structural features of the system, *compensate* for the boundary-enhancing or disruptive forces creating rifts in the system, or *both* (Luciano et al., 2015). Additionally, unpacking the coordination process offers rich insight regarding how to best enact the process to facilitate system effectiveness. Stated differently, we submit that developing a better understanding of how MTS coordination occurs, and how it may be changed to better align system configurations, will offer insights regarding how to enhance MTS effectiveness. Herein, we provide suggestions for aligning coordination functions, foci, forms, and phases with increasing levels of differentiation and dynamism, respectively.

Coordination and differentiation

Differentiation, the degree of differences between component teams, fortifies the boundaries of MTS component teams and increases the salience of team membership. Conceptually, those distinctions build walls around the component teams, which create particularly intense challenges for between-team coordination processes that must permeate those walls. Differentiation can stem from multiple sources. The particular source, or subdimension, offers insight regarding the mechanisms that may be most effective.

Notably, the differentiation subdimensions present more acute challenges for different coordination functions as they generate greater coordination needs. Higher levels of *goal discordancy*, dissimilar goal priorities and incompatible goals, directly challenges coordination of interests as within the system the goals are neither aligned nor interconnected. Additionally, higher levels of *competency separation* and *information opacity* are likely to increase challenges for coordination of understanding. High competency separation thwarts the development of shared perceptions and meaning because knowledge is siloed within component teams, which have vastly different capabilities. Coordination of understanding is likewise thwarted by high levels of information opacity as information regarding other component teams is unavailable or uninterpretable, which inhibits awareness and anticipation. Finally, higher levels *norm diversity* and *work process dissonance*, are likely to most directly influence coordination of actions. The synchronization of action will be hindered by incompatible expectations about 'the way things work' and the extent to which work processes are incongruent with and conducted separately from other teams, as they increase the potential for the component teams to be out of sync with other teams and the larger system. Stated differently, differences and incompatibilities in what component teams think they should be doing and how they go about doing it will cause particular issues for coordination of actions. Although higher levels of each differentiation subdimension will generate a greater need for one coordination function in particular, the subdimensions do not necessarily influence only one coordination function (e.g., high levels of information opacity is also likely to undermine coordination of action by impeding dynamic adjustment).

We chose to highlight the coordination functions potentially offering the greatest impact on MTS functioning. In their original MTS chapter, Mathieu and colleagues recommended four critical levels for MTS effectiveness: 1) shared mental models; 2) leadership; 3) IT system; and 4) reward systems. We suggest that overlaying these levers on the coordination functions could provide rich insight for intervention design (e.g., perhaps reward systems should be designed to coordinate interests between teams) and a fruitful area for future research (e.g., how do IT systems enhance coordination of understanding and/or action, do shared mental models indirectly influence coordination of action via enhancing coordination of understanding?).

In addition to considering the coordination needs created by differentiation, it is also important to contemplate who, how, and when coordination should be enacted. The MTS literature highlights several contingencies to consider. Therefore, in order to more comprehensively discuss coordination and differentiation in MTSs, we discuss the elements of *foci*, *forms*, and *phases*. In other words, it is not just *who* is doing *what* to enhance coordination, it is also important to understand *when* it is being done. For instance, although coordination is important for system effectiveness across project *phases*, it may be particularly critical during initial phases. Hoegl and colleagues (2004) found support for the notion that interteam coordination at earlier stages of a project determines the team's performance trajectory.

Adopting a more nuanced approach to the implication of phases for coordination, we suggest integration of Marks and colleagues (2001) recurring phase model of team processes (i.e., transition and action processes; see Marks et al., 2005). Transition processes include activities such as goal specification and strategy formulation, which are followed by action processes which include activities such as monitoring progress toward goals and team monitoring (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008; Marks et al., 2001). We suggest that within broader project phases (e.g., concept, design, development), transition and action processes will occur at both the team- and system-levels and not necessarily in parallel. For systems with higher levels of differentiation, we submit that during transition phases coordination should be more centralized (*form*) and focused on between-team coordination processes (*foci*), whereas during action phases coordination can be more decentralized and focused on focal teams.

Providing some support for the importance of aligning coordination foci and phase in an MTS with higher levels of differentiation, Bruns (2013) conducted an ethnographic field study of biology cancer research involving teams of scientists from different domains (i.e., experiments, computational modeling). She advanced a process model which included phases of within-team expert practice (action) alternated with phases of between-team coordination practices used to communicate progress and establish the next objective (transition). In essence, she demonstrated the utility of working asynchronously, while routinely communicating across teams and aligning efforts in order to make diverse contributions compatible. Bruns' (2013) study offers rich insight regarding how coordination occurs across multiple expert domains, however, she does not comment on which individuals or roles are enacting the coordination.

As MTSs increase in level of differentiation (as well as dynamism and size), it becomes increasingly inefficient and impractical for everyone to be coordinating with everyone else. Some degree of centralized system-level planning is useful to keep all component teams working in the same direction and avoid coordination failure (Lanaj et al., 2013), however boundary-spanners have a particularly critical role. Traditionally, the team boundary-spanning literature has focused on three type of activities; external representation, information search, and coordination of task activities with other groups (Ancona & Caldwell, 1992; Joshi, Pandey, & Han, 2009). In MTSs boundary-spanners are often members of both their own task-based component team and a leadership team (see Davison et al., 2012; Firth et al., 2015; Lanaj et al., 2013), which creates two sets of responsibilities – the boundary-spanners must represent, gain information for, and coordinate on behalf of both teams. For example, the boundary-spanner is tasked with: 1) getting the information for their task team to complete their task and maintain alignment with the system as well as; 2) providing information to the leadership team about the task team to enable making adjustments and overall system management. Davison and colleagues (2012) found that coordinated action across teams only positively influenced system performance when enacted by system leaders or boundary-spanners and directed at the component team most critical to addressing the demands of the task environment at that point in time (Davison et al., 2012).

In sum, we have several overarching recommendations for systems with higher levels of differentiation. First, consider the sources of differentiation and their influence on coordination *functions*. Interventions are best targeted toward facilitating between-team interactions, either by offsetting the differentiation or compensating for the boundary-enhancing forces (see Luciano et al., 2015). Second, regarding coordination *foci*, *forms*, and *phases*; during transition phases, coordination at the system-level that is centralized and primarily enacted by boundary-spanners or system leaders will best align coordination processes to promote system effectiveness. Conversely, during action phases, more decentralized team-level coordination will best promote system effectiveness.

Coordination and dynamism

Dynamism, the variability and instability of the system over time, creates uncertainty and fractures the linkages in the system (Luciano et al., 2015). Conceptually, dynamism captures the changes occurring in an MTS which destabilize the system and require adaptation. Interestingly, the ability to be adaptive and responsive to complex and challenging environments has been highlighted as one of the main benefits of MTSs (Mathieu et al., 2001). For example, Uitdewilligen and Waller (2012) argued, ‘Particularly in emergency situations, characterized by high levels of ambiguity, uncertainty, and rapidly changing environmental dynamics, these flexible structures are crucial for rapid organization adaptation in an unknown and developing environment’ (p. 365). Whereas the basic configuration of MTSs may be well-suited to adapt, each instance of change destabilizes the system and creates coordination needs.

Different subdimensions of dynamism present different coordination challenges. For example, higher levels of *change in goal hierarchy*, drastic and rapid changes to the relative importance of system goals, directly challenge the coordination of interests across component teams as the goal interconnections are broken and the goals may become misaligned. In contrast, *fluidity of system composition* and *diversion of attention* are likely to increase challenges for coordination of understanding. Fluidity of system composition impedes relationship formation and establishment of norms, thereby hindering anticipation of others’ behaviors, as well as generates the need for frequent on-boarding of new members. Diversion of attention reflects the level of members’ attention on non-MTS-related tasks. At higher levels, members frequently experience cognitive shifts when re-orienting to the task of the focal MTS, impeding development of shared understanding. Finally, higher levels of *uncertainty of task requirements* and *fluidity of system structural configuration* are likely to increase challenges for coordination of action. High uncertainty of task requirements inhibits the formation of routines and plans, which challenges appropriate sequencing of members’ actions. Fluidity of system structural configuration breaks the linkages between teams and alters workflow impeding the synchronization of actions. Similar to the influence of the differentiation subdimension, higher levels of each dynamism subdimension will generate a greater need for a specific coordination function, but not necessarily only one coordination function (e.g., higher levels of diversion of attention are also likely to thwart coordination of action by making it harder to call the system members to action). In sum, by undermining coordination it heightens the need for compensatory mechanisms to maintain or enhance MTS effectiveness.

Okhuysen and Waller (2002) discussed coordination processes and mechanisms in terms of *temporal semistructures* which have rhythmic shifts in focus to either MTS component teams or the system as a whole. Brown and Eisenhardt (1997) argued that semistructures need to be ‘sufficiently rigid so that change can be organized to happen, but not so rigid that it cannot occur’ (p. 29). The optimum balance of flexibility and rigidity, will vary in MTSs at different levels of dynamism. Higher levels of dynamism put a premium on flexibility, whereas systems with lower levels of dynamism can be effective with a more permanent stable structure. However, it is important to appreciate that regardless of the levels of dynamism some amount of system-level coordination is required to effectively disperse information and cohere the system, whereas too much system-level coordination can impede communication between teams and create rigidity.

Bigley and Roberts (2001) found that by combining traditional bureaucratic role-based structures with flexibility-enhancing processes, adaptive and improvisational capability could be attained. Continuing to build from those implications regarding *form* and *foci* of coordination, in systems with higher levels of dynamism the ability to shift system attention to different teams becomes increasingly critical. One coordination mechanism that may prove valuable in MTSs with higher dynamism is a transactive memory system (TMS). A TMS exists between individuals (or in the case of MTSs, between component teams) as a means to cooperatively store, retrieve, and leverage information (Lewis, 2003; Wegner, 1987). Behavioral manifestations of a TMS include members' development of specialized knowledge (specialization), trust and reliance on others' expertise (credibility), and efficient coordination of knowledge integration (coordination; Lewis, 2003). This collective awareness of *who knows what*, should be supplemented with a collective understanding of *who does what* (i.e., role clarity) as well as a collective understanding of *when* certain actions should be taken (e.g., when contingency plans should be enacted). Notably, Faraj and Xiao (2006) present a coordination-focused model of trauma patient treatment, which included both habitual and problematic trajectories and two major grouping of coordination practices: 1) expertise coordination practices (e.g., reliance on protocol, plug-and-play teaming); and 2) dialogic coordination practices (e.g., joint sensemaking, protocol breaking). As they discussed, the mastery of treatment protocols, such as the specification of care procedures often integrated with a flow chart for decision-making, can be critically important for high-quality performance. These protocols reduce task ambiguity, role ambiguity, and enhance decision-making in a dynamic environment; however, they do not apply to all situations (Faraj & Xiao, 2006) creating a need for other coordination practices and role-based structures.

In addition to situation-related triggers that determine the most appropriate coordination practices, the *phase* may also serve as a trigger. Phases may be determined in terms of the development or maturity of an MTS, or in terms of periods of different type of activities. Earlier we discussed the recurring phase model of team processes advanced by Marks and her colleagues (2001). Here we suggest that MTSs with higher levels of dynamism will have shorter, partially overlapping transition and action phases. While these phases may partially co-occur in real-time, the shift to transition phases should trigger system-level coordination processes (*form*) in order to realign and stabilize the system before taking additional actions (potentially in varying or incorrect directions).

In MTSs with high levels of dynamism it is nearly impossible and certainly impractical to anticipate all possible scenarios and eliminate uncertainty. Utilization of protocols and other expertise coordination practices combined with consensus on triggers that signal shifts to dialogic coordination practices will enhance coordination in MTSs, but will be particularly effective in MTSs with higher levels of dynamism. Notably, these coordination practices are examples of the flexibility-enhancing processes needed to supplement traditional role-based structures to promote system adaptive capability. These practices help manage uncertainty and stabilize the system.

Finally, we would be remiss to conclude our discussion of coordination and dynamism in MTSs without commenting on the source of dynamism. The MTS literature assumes that the dynamism in MTSs is in response to environmental dynamism. Stated differently, the MTS needs to be dynamic in order to align with the task environment. Whereas this holds true in much of the existing MTS work, it is not necessarily the case. For example, the dynamism subdimensions fluidity of system composition reflects frequency and magnitude of membership change in the system. This change can certainly be the result of the team no longer being needed to pursue the system goal, however turnover can occur for dozens of other reasons (e.g., members may be voluntarily leaving the MTS system due to dissatisfaction with the system leadership). Regardless of the dynamism trigger, it still creates disruptive forces, however understanding why the system is experiencing dynamism should yield insights for the most appropriate coordination mechanisms.

Leadership

Since the original observation concerning the premium on ‘between-team issues’ for MTS effectiveness (Mathieu et al., 2001), researchers have concentrated on understanding the leadership implications of operating in such environments. Early work on MTS leadership built upon the functional approach which has been influential in understanding team leadership (Fleishman, Mumford, Zaccaro, Levin, Korotkin, & Hein, 1991; Zaccaro, Rittman, & Marks, 2002). The core idea being that the job of a team leader is to do what is not being adequately handled to meet the needs of the group (McGrath, 1964). An important concept here is that leadership is a process, a set of functions that need to be executed for a collective to be successful, whether that collective is a small team or a larger entity such as an MTS. As a process, leadership may fall to a single individual or to some collection or group of individuals (Contractor, DeChurch, Carson, Carter, & Keegan, 2012). By way of extension, the essential function of MTS leadership is to serve as a bridge, providing an overall vision for the MTS, communicating constraints and ideas from one team to another, and to provide coaching that enables the component teams to adjust their actions to be more in line with those of others (DeChurch & Marks, 2006).

Empirical research on MTS leadership, to date, has examined the role of different leadership *functions*, directed at different *foci*, exhibiting multiple *forms*, and being enacted during different project *phases*. These aspects of MTS leadership can be defined as follows:

- *Leadership functions* – leadership behaviors (e.g., strategy, coordinating) that enable component teams to attain proximal team goals and distal system goals;
- *Leadership foci* – the collective (e.g., team, system, external boundary) whose needs are met by leadership;
- *Leadership forms* – the structure (e.g., the number of leaders, reciprocity, density, centralization) of who in the MTS enacts needed leadership functions;
- *Leadership phases* – the timing of when during MTS development leadership functions are enacted.

The earliest examinations of MTS leadership examined leadership *functions*. DeChurch and colleagues examined the leadership functions of strategizing and coordinating in both a laboratory and an archival study. In the laboratory study, they found that the strategy and coordinating leadership functions needed to be directed toward the interface between teams. The laboratory task included a leadership team who was directing two component teams, each with different functions, performing a combat flight simulation (DeChurch & Marks, 2006). In later work, Murase, Carter, DeChurch, and Marks (2014) used the data from the DeChurch and Marks (2006) study to explore the psychological mechanisms by which leadership training facilitates between-team coordination processes. They suggested that the accuracy of the leader's multiteam-interaction mental models (i.e., cognitive structures containing knowledge of appropriate between-team activities) is transferred to the team via strategic communication, which enhances the members’ mental model accuracy and in turn, between-team coordination (Murase et al., 2014).

These same strategy and coordinating *functions* were supported in a historiometric study using archival accounts of MTSs operating in extreme conditions (i.e., provincial reconstruction teams and cross-regional hurricane emergency response teams; DeChurch, Burke, Shuffler, Lyons, Doty, & Salas, 2011). In addition to finding strategy and coordinating functions, their qualitative analysis found three *foci* of leadership in MTSs. Leadership behaviors that are aimed at directing individual component teams (*within teams*), aligning component teams (*between teams*), and bridging the system to its external environment (*across the system*; DeChurch et al., 2011).

Millikin, Hom, and Manz (2010) considered the *form* of leadership and highlighted the importance of self-management strategies. They studied 21 MTSs in a US semiconductor plant and found that MTSs comprised of teams whose members widely practiced self-management strategies performed better (i.e., attain higher productivity gains). Furthermore, MTSs comprised of self-managing teams who were highly cohesive were the most productive. MTS studies examining the *form* of leadership have found both shared and redundant leadership can be differentially effective. For example, Johannessen, McArthur, and Jonassen (2012) advanced the importance of the availability of additional leadership resources (i.e., leadership redundancy), for system effectiveness in high-risk work in potentially extreme environments. In their case study of an MTS operating a petro-maritime vessel, they suggested that authority should be centralized into one role. However, Johannessen et al. (2012) argued that when under stress and time constraints, the one leader may not be able to perform all leadership functions and other leaders are needed to fill the void. Along similar lines, Bienefeld and Grote (2014), in their study on airplane crews during a simulated in-flight emergency, found that shared leadership among the cabin crews predicted component team goal attainment, while shared leadership by the boundary-spanner (purser) predicted cross-team goal attainment. Conversely, in the associated cockpit crews, leadership was not shared and the captain's vertical leadership predicted team goal attainment. Importantly, this study illustrates that the different regions of an MTS (i.e., foci) may benefit from different forms of leadership.

Finally, prior MTS work also suggests that leadership from multiple sources can have differential benefits depending on project *phases*. For instance, in their study of new product development MTSs at a European automotive organization, Hoegl & Weinkauf (2005) differentiated between managerial functions (structuring and support) performed at the team and project (i.e., MTS) levels. They found that team-level managerial functions were particularly important for facilitating performance during the initial concept phase of the project. Conversely, project-level managerial functions hindered performance during the concept phase, but were the most important for facilitating performance during the later development phase.

In sum, a steady stream of studies have begun to provide insight into the aspects of leadership that enable MTS effectiveness. However, these studies have largely focused on leadership as a direct antecedent of MTS effectiveness. Given the wide variation of MTS structural configurations and dynamism, we suggest that optimal leadership configurations are likely to be context-specific. Moreover, there may well need to be different types of leadership within different areas of an MTS and/or at different times. The complexity of MTSs precludes the one-size fits all approach to leadership.

Leadership and differentiation

Luciano et al. discuss the structural shape variation in MTSs in terms of goal discordancy, competency separation, norm diversity, work process dissonance, and information opacity (see Table 15.1). Regardless of the source of differentiation in an MTS, the implications for leadership are clear– leadership needs to bring coherence and cooperation to the distinct teams in the system. This is a situation of intergroup leadership (Hogg, van Knippenberg, & Rast, 2012), where the leadership imperative is to create an intergroup relational identity. An intergroup relational identity allows members of distinct teams to define themselves both as members of the component team as well as the larger system of teams. The natural tendency in intergroup situations is for groups to draw strong comparisons, and use out-group comparisons to fuel a positive in-group identity (Tajfel, 1982). It has been said that in-groups require out-groups, and in MTSs, out-groups can often be other component teams. The five sources of differentiation in MTSs identified by Luciano et al. (2015) all create boundary-enhancing forces that require leadership integration. This integration can stem from each of the four aspects of leadership that have been examined in previous research: the functions, foci, forms, and phases.

Leadership *functions* characterize the types of leadership behaviors that enable component teams to attain proximal team goals and distal system goals. Morgeson, DeRue, and Karam (2010) detailed specific team leader functions that align with important team processes outlined by Marks et al. (2001). Leadership functions that facilitate *transition or planning processes* include composing the team, defining the mission, establishing expectations and goals, structuring and planning tasks, training and developing the team, sense-making, and providing feedback (Morgeson et al., 2010). Leadership functions that facilitate *action processes* include monitoring the team, managing team boundaries, challenging the team, performing team tasks, solving problems, providing resources, encouraging self-management, and supporting the social climate. Each of these functions provides MTS leaders with the opportunity to build an intergroup relational identity. For example, in highly differentiated MTSs, defining the mission in terms of how each team's efforts contribute to the efforts of other teams and to the attainment of the MTS goal is a clear way to build such an identity.

The second aspect of MTS leadership with implications for mitigating boundary-enhancing forces is the leadership *foci*. Leadership foci were first introduced by DeChurch and Marks (2006), who found shifting the collective toward which leader actions were focused (i.e., from individual team members to collective teams) was associated with improved MTS interteam coordination. In later work, DeChurch et al. (2011) identified three levels or foci at which leader actions can be aimed: *leading within component teams*, *leading between component teams*, and *leading across the MTS* and its operating environment. MTSs require leadership at all three levels.

Leading within component teams is team leadership. Team leadership sets the direction and aligns the efforts of individuals working within component teams. Team-focused leadership involves gathering information about the team's performance environment and framing the team's task, setting team goals, planning how team members will work together to accomplish their goals, managing the flow of information within, and coordinating the actions among team members.

Leading between component teams involves setting the vision for the MTS, and building an intergroup relational identity so that teams can clearly see how their teams' actions affect other teams, and how their team actions are instrumental in attaining MTS goals. Between-team-focused leadership gathers information about MTS functioning, sets MTS goals, and plans how component teams will integrate their separate plans and actions so that they are compatible with one another.

Leading across the MTS and its environment is aimed at aligning the system with its operating environment. Behaviors in this foci involve gathering information about the MTS's performance environment, framing the MTSs task to external constituents, and integrating MTS plans with those of outside constituents (DeChurch et al., 2011). Behaviors in the ‘leading across’ foci can also be thought of from Ancona and Caldwell's perspective (1992), consisting of mapping behaviors to determine who the key stakeholders are, molding behaviors which attempt to influence stakeholders beliefs about the MTS, coordinating behaviors to ensure the MTS is aligned with external parties as needed, and filtering behaviors that sift through external information relaying a smaller amount back to MTS teams as needed. Though MTS leadership is needed to attend to all three levels, differentiation within MTSs will increase the importance of the higher foci; the between-team and external boundary leadership.

The third aspect of MTS leadership is its *form*. The form describes the pattern of influence within the MTS (Carter & DeChurch, 2013; Contractor et al., 2012; Zaccaro & DeChurch, 2012). This aspect of leadership answers three basic questions: 1) how many leaders are there?; 2) how are these leaders related to the component teams within the MTS?; and 3) how are these leaders related to each other within the MTS? Some important aspects of leadership forms include the number and representativeness of leaders, the extent to which multiple leaders influence one another (Carter, DeChurch, & Zaccaro, 2014), and the degree of hierarchy among leaders. The form of leadership can offset the boundary-enhancing effects of differentiation. For instance, sharing leadership across multiple people requires constant negotiation of ideas to be adopted and implemented. In differentiated MTSs, leadership forms that involve multiple leaders representing the different teams may be preferable to those wherein the highly influential individuals are disproportionately drawn from any particular team.

The fourth aspect of leadership that can offset the boundary-enhancing effects of differentiation is leadership *phase* – the timing of when during MTS development leadership functions are enacted. In line with Hoegl and Weinkauf (2005), leadership should shift over time from an early focus on the teams to a later focus on the system. However, with higher levels of differentiation, shifting the focus to the system may need to occur earlier to foster the needed intergroup relational identity. An additional caveat to this suggestion, there are circumstances (e.g., high levels of uncertainty of task requirements) under which leadership functions should first focus on the system-level in order to define the overall mission and determine the requisite structure of the MTS. Furthermore, these circumstances may generate the need for reciprocal processes across foci and phases. To further explore these circumstances, we turn to the second structural feature of MTSs: dynamism.

Leadership and dynamism

Luciano et al. discussed a second element of structural variation in MTSs in terms of dynamism. As shown in the lower portion of Table 15.1, dynamism can stem from changes in the goal hierarchy, from uncertainty in the task requirements, from fluidity of the structural configuration and composition of the MTS, and the diversion of members’ attention. In contrast to differentiation which creates boundary-enhancing forces, dynamism creates unpredictability and disruptive forces. The clear leadership imperative created by dynamism is to help teams to cope with the uncertainty in the system. Certain variations of leadership functions, foci, forms, and phases are better suited to deal with higher levels of dynamism.

Returning to the functions of leadership detailed by Morgeson et al. (2010), particular *functions* can be especially valuable in offsetting dynamism-created disruptive forces. For example, transition leadership functions that define the mission, establish expectations, and structure and plan work, will go a long way toward reducing the uncertainty facing each of the component teams.

Additionally, leadership directed at multiple *foci* can also offset disruptive forces. The three foci of MTS leadership; leading within component teams, leading between component teams, and leading across the MTSs and its operating environment, each play an important role in allowing the system to cope with dynamism and stabilize post changes. MTSs require leadership at all three levels, and dynamism likely increases the importance of leadership at each level.

Furthermore, leadership *forms*, especially those involving shared leadership arrangements where multiple people rotate or otherwise divide up the functions of leadership over time (Contractor et al., 2012), can provide some needed flexibility, redundancy, and resilience to the system. Dynamism creates a clear need for built-in redundancy in leadership whereby multiple individuals have the capacity to direct and coordinate within, between, and across the MTS. As changes occur, leadership structures that involve greater decentralization may best enable a functional rotation regarding who guides the system. Leadership forms involving multiple leaders and decentralization or evenness in the status hierarchies of MTSs may be useful for coping with lower levels of dynamism or more predictable changes (e.g., shifts in system structural configuration are enacted in response to specific events). However, in circumstances that overlay temporal urgency and unpredictable changes, with higher levels of dynamism, more centralized forms of leadership focusing on the between-team and across system foci with redundant leadership focused on the within-team foci may be better suited to facilitate system functioning.

Lastly, the timing (*phase*) of when leadership is enacted will play a role in setting up clear norms and expectations for how things are done within the MTSs. MTS leadership faces an inherent tradeoff between ideation and predictability. On one hand, to maximize ideation leadership activities are best introduced a bit later, after sufficient time has passed enabling multiple individuals and teams to have input. On the other hand, to maximize predictability leadership activities are best introduced as soon as possible, before confusion and inaction become normalized. Dynamism exacerbates this tradeoff, requiring leadership earlier on to provide needed predictability, but also gaining involvement early on to maximize ideation as well. In addition, after occurrences of change, in particular unpredicted changes of greater magnitude, MTS leadership may be required to realign the component teams and stabilize the system.

In sum, leadership in MTSs exhibits four factors that have been studied in relation to MTS effectiveness – function, form, foci, and phases. However, differently structured MTSs create different demands for leadership. Differentiation creates boundary-enhancing forces, which require leadership to build an intergroup relational identity that bridges the rifts between teams. Dynamism generates uncertainty creating disruptive forces, which require leadership arrangements that afford needed stability and predictability to component teams.

Overall, leadership and coordination mechanisms can serve to integrate the teams in MTSs. In this section we offered numerous insights regarding the alignment of variations in aspects of coordination and leadership (i.e., function, foci, form, and phase) with different system configurations (i.e., levels of system differentiation and dynamism). We also highlighted the predictability of change and temporal urgency as potentially influential factors. However, we should note there are likely other factors that influence the suitability of different integration mechanisms. In particular, the nature of the proximal and distal goals may generate differences in performance requirements, and in turn, differences in integration requirements. For example, several studies have considered the leadership structure and behaviors best suited to support innovative goals or tasks (Hoch, 2013; Hunter & Cushenbery, 2011; Rosing, Frese, & Baush, 2011).

THE ROAD FORWARD

Over the past 15 years, MTS researchers have journeyed down a long and winding road, to generate important advancements in understanding MTSs. While important progress has been made, there is still much farther to go. In this section we begin to map out the road forward for the MTS domain. This road includes both rigorous theoretical development, in particular native system-level theory, as well as substantial empirical research using multiple research methodologies.

Research Methodologies

MTSs can be studied using a variety of research methods ranging from passive observational methods, to various types of simulations, to quasi- and experimental methods, to longitudinal designs. All approaches offer some unique advantages and disadvantages. Notably, outside of the laboratory, random assignment and manipulations/interventions will be difficult to come by, and research is likely to lean more heavily on correlational and longitudinal methods and analyses. Below, we briefly review four major approaches: 1) cross-sectional field studies; 2) laboratory simulations; 3) longitudinal field investigations; and 4) case studies that may be used to study MTS phenomena.

Cross-sectional field studies

Cross-sectional field studies are naturally limited by the inability to unpack developmental phenomena or to specify causal order. Yet, cross-sectional studies do provide some comparative insights. For instance, Kirkman and Rosen (1999), de Jong, Ruyter, and Lemmink (2005), and Mathieu, Gilson, and Ruddy (2006) all found MTS processes related positively to important team-level processes and outcomes. Using a cross-level design, Mathieu, Maynard, Taylor, Gilson, and Ruddy (2007) found that MTS processes interacted with team processes to influence team performance. Specifically, team processes evidenced a stronger positive relationship with team performance when MTS-level processes were less, in comparison to more, cooperative. These findings are consistent with those of Marks et al. (2005) which were found in an experimental laboratory investigation. Accordingly, correlation field studies provide some insights as to how current MTS states relate to other variables of interest. However, they are unable to inform us about how those MTS states evolved, nor can they permit strong cause–effect inferences.

Laboratory simulations

Laboratory simulations have developed in their sophistication from relatively simple four-person two-team combat flight simulations run for 4–5 hours with undergraduates (e.g., Mathieu, Cobb, Marks, Zaccaro, & Marsh, 2004), to complex 14-person three-team training platforms run over the course of five weeks with active duty Air Force Captains (e.g., Davison et al., 2012). Modern-day simulations for studying MTSs come in a wide variety of configurations and can be played by a variety of sample populations. Notably, these simulations have common features such as clearly distinguishable teams, interdependencies between teams, and proximal team and superordinate system goals. Yet many of their surface features vary, such as the number of teams (cf., Mathieu et al., 2004; Lanaj et al., 2013), the nature of their interdependencies (see Marks et al., 2005), and their duration of activities (cf., Carter et al., 2014; Davison et al., 2012; DeChurch & Marks, 2006). Resick and colleagues (2012) cautioned against the allure of these platforms and advised '(a) do not be enamored by the platform's apparent capabilities, and (b) do not be constrained by the platform's apparent capabilities' p. 498). Their sage advice comes down to avoiding the creation of *a science of the simulation, rather than a science of MTS phenomena.* Resick et al. (2012) also provided an analysis of the relative benefits and disadvantages of laboratory-based simulations in terms of threats to validity.

In addition to Resick and colleagues' (2012) observations, we should note that these simulations permit researchers to fully script scenarios, yet have computer controlled entities responding intelligently to evolving circumstances. A scripting feature ensures that all teams will confront identical performance conditions at the onset of an experimental trial or episode. This affords a high degree of experimental control and consistency. Given that the number and actions of various units are fully controllable, one can create anywhere from a very simple slowly evolving scenario to an exceptionally complex and demanding one to test the influence of factors such as workload, environmental complexity, stress, and so forth, on individual, team, and MTS performance outcomes and behaviors. In other words, in an experimental sense, MTSs may be placed in identical 'initial states' in different scenarios, but the exact nature of the engagement that is experienced will differ as circumstances evolve and artificial intelligence (AI) guided entities respond to MTS actions. In this sense, the participating MTS members' actions actually create the nature of future environmental factors that they confront. The fact that computer controlled entities respond intelligently to evolving circumstances but in adherence to their programmed 'strategies or rules or engagement' yields a scenario that remains realistic even if different experimental teams execute actions that were not anticipated by research designers. This provides a far better balance of experimental control and fluid emergent phenomena than has been available in earlier laboratory tasks and environments. They also permit a blending of experimental and training platforms (e.g., Cromwell & Neigut, 2014; Davison et al., 2012), or what we refer to as hybrid settings (i.e., having features of both laboratory and field settings).

Longitudinal Field Studies

Longitudinal field investigations are considered to be a powerful research design but are rarely conducted with MTSs. No doubt this stems from the difficulty of gaining access, the challenges of gathering data consistently over time, and the logistics of gathering data from comparable MTSs over time. However, many modern-day MTSs coordinate their actions primarily through digital means which may leave trace measures that can be used for research purposes (e.g., voice communications, texts, positional data). As with any archival trace measure, such data may not be suitable to examine certain research questions; however, they do reveal which component teams are interfacing with which others, in which patterns, and under which circumstances. Such interactions may also be amenable to content coding. That is to say, secondary data sources and archival records may yield unique insights into MTS operations that would not be feasible using more intensive approaches such as qualitative methods.

Notably, detailed digital trace measures may be particularly suitable for multi-dimensional (i.e., multi-plex) network analysis applications (cf., Borgatti & Foster, 2003; Contractor, 2009). Multiplex network analyses simultaneously model the impact of network properties along several dimensions (e.g., identity, cooperation, communication) and analyze their unique and combined influences (Xi & Tang, 2004). Modeled over time, multi-plex networks might reveal which MTS features, at what times, are most influential in yielding MTS effectiveness (Carley, 2003; Contractor, Wasserman & Faust, 2006).

Case Studies

Given the evolving state of knowledge, there remains a need for well-conducted case studies and other forms of qualitative investigations to understand better the nature and development of MTSs. Yin (1989) defined the case study method as an ‘empirical inquiry that investigates a contemporary phenomenon within its real-life context, addresses a situation in which the boundaries between phenomenon and context are not clearly evident, and uses multiple sources of evidence’ (p. 23). Case study methodologies come in many varieties, and Yin (1993) outlined a 3 × 2 matrix of types; case studies can be exploratory, descriptive, or explanatory, each of which can be based on single or multiple samples. Yin (1993) further argued that ‘the exploratory case study has perhaps given all case study research its most notorious reputation … [as] in this type of case study, fieldwork and data collection are undertaken prior to the final definition of study questions and hypotheses’ (pp. 4–5). In other words, exploratory case studies are fine for generating hypotheses, but not for testing them. Given the stage of our understanding of MTSs, we believe that there are many insights to be gained from exploratory case studies with rich descriptions of the phenomena.

Descriptive case studies are efforts to categorize the nature and dimensions of a given phenomenon within its natural context. In this sense, descriptive case studies would be useful for illustrating similarities and differences in different aspects or dimensions of MTS frameworks such as the ones that Zaccaro et al. (2012) and Luciano et al. (2015) have advanced. In contrast, explanatory case studies seek to present data bearing on cause–effect relationships. Thus, while exploratory case studies can be atheoretical and designed to generate hypotheses, descriptive and explanatory case studies can leverage a priori theories to categorize and then tie certain dimensions to outcomes, respectively. Yin (1993) further noted that case studies could be one-shot deals or sample multiple situations offering the opportunity to replicate, and thereby to validate, researchers’ inferences. We suggest that if MTSs were selectively sampled from across theoretically identified dimensions (cf., Luciano et al., 2015), then the resulting insights will be easier to interpret and more quickly advance the discipline.

Finally, opportunities may exist to conduct mixed-methods investigations. For example, Xie, Wu, Lu, and Hu (2010) performed a multifaceted investigation of a (primarily) sequential construction MTS. They both gathered survey data from MTS members, and indexed their mail and other correspondence to conduct network analyses of their communication patterns. They then followed up with descriptive methods to reveal the underlying causes of the occurrence of problems. This is a vivid example of how different research methodologies can provide important insights into the functioning of an MTS.

Looking Toward the Next Chapter

The past 15 or so years have witnessed an embracing of the MTS concept and a proliferation of work across a wide variety of domains. From individual and comparative case studies, to a range of relatively simple to exceedingly complex laboratory investigations, to longitudinal and multi-level investigations, work in the area of MTSs has been exciting. At the same time, however, it has been disjointed and difficult to synthesize. No doubt part of the problem stems from the grounded or contextualized nature of the work. In other words, efforts to simplify and control some of the myriad of effects operating in an MTS environment can lead to modeling of the simulation environment rather than generalizable relationships (Resick et al., 2012). Alternatively, qualitatively rich, deep-dive investigations of MTSs in a particular context – while revealing – are no more generalizable than laboratory investigations. The multitude of idiosyncrasies present in any given MTS field study, too, limit the generalizability of their findings. Unifying frameworks and theories to guide the sampling and study of MTSs, as well as the integration of results, have been solely needed

Zaccaro et al. (2012) and Luciano et al. (2015) have provided such frameworks, and we are encouraged that they will help to unify the field. These two works also make vivid the alternative approaches for studying MTSs. To date, we would characterize much of the MTS work as: 1) within- versus between-team processes; and 2) MTSs as context. The former style investigation typically considers the relative value of processes focused on component teams versus between-teams or system-wide phenomena (e.g., Marks et al., 2005). The latter style of work either specifically indexes MTS features and uses them as contextual predictors of team-level phenomena (e.g., Mathieu et al. 2007), or uses the MTS generic environment as a contextual backdrop within which certain phenomena, such as shared leadership, should flourish (e.g., Millikin et al., 2010).

We advocate two different directions for future research. First, there is a need for *MTS level comparison studies*. For example, considering the subdimensions of differentiation and dynamism (Luciano et al., 2015), why are certain MTSs more effective than others? What environmental forces influence that answer? Investigations of this sort require a sampling of MTSs ‘in kind’ – such as those in a laboratory environment (e.g., DeChurch & Marks, 2006) or hybrid situations (e.g., Davison et al., 2012). Alternatively, creative approaches such as historiometric after-action analyses of events of a similar kind (e.g., fire-fighting engagements, disaster relief, military operations) might be leveraged (cf., DeChurch et al., 2011). Notably, this style of investigation would ostensibly treat MTSs as a collective whole – as unified systems of different types or indexed along different dimensions. The variance of interest would be that which differentiate MTSs from one another.

A second approach for future investigations might be *intra-MTS network style work*. Here, we suggest that variations within MTSs, in terms of constituent parts, subsections, or over time, would be the variance of interest. Recall that Bienefeld and Grote (2014) found that different forms of leadership were more effective in- and between-different regions of MTSs working on emergency flight simulations. Davison et al. (2012) illustrated that there is a premium on the functioning of different teams at different times for optimal MTS effectiveness. What we are advocating here is along the lines of network indices of MTSs features and processes which can consider factors such as node (i.e., component teams) centrality, dyadic ties between pairs of teams, clusters, or sub-regions of MTSs (i.e., cliques), and other parameters. This recommendation parallels that of Crawford and LePine's (2013) advocacy of network applications for the study of teamwork. Their argument was that teams are not likely to have a uniform structure or set of relationships that hold for all member pairs. That different individuals might, for example, work more closely, have better relations, etc. with some members than with others; and that ignoring such differences obscures important insights as to their functioning. Extended to the MTS context, between-team interfaces are not likely to be uniform throughout an MTS. A given component team may have drastically different interdependencies and working relationships with different teams within an MTS. Moreover, the configuration and intensity of that pattern of relationships may change as a function of time or circumstances. What is needed, therefore, are techniques that index MTS structure and processes as a set of evolving network relationships (cf., Borgatti & Foster, 2003; Contractor, 2009). The input for such networks could come from qualitative methods, surveys, or better still digital traces. This approach, which is conceptually, logistically, and analytically very intensive, may well hold the key to unlocking our understanding of MTSs and their effectiveness.

For the MTS domain to advance theoretically, it will be critically important to develop native system-level theory that embraces MTSs as a unique form (cf., Luciano et al., 2015). Although other literatures offer important insights to draw upon, simply importing theories of team or organizational processes and performance, without considering the implications of system dynamics at the individual, team, and system-levels, will likely yield disappointing results. To be clear, we are not suggesting that existing theory will not apply to MTSs; rather we suggest existing theory is insufficient and additional system-level theorizing is required for a comprehensive understanding of MTSs. In the pursuit of MTS theory, we submit that focusing on factors that inherently influence functioning, rather than descriptive attributes that can vary in their influence, will more quickly build a deeper understanding of MTSs.

Finally, we hope future MTS research, both theoretical and empirical, will continue to embrace and examine the tensions in MTSs (cf., Davison et al., 2012; Lanaj et al., 2013). MTSs seem to present a paradox; system effectiveness requires simultaneously structuring strong component teams that also function well as a part of a system. Resolving this paradox will require leveraging the polarities inherent in the system (Johnson, 1992, 2014). Leveraging polarities involves yielding the benefits of seemingly opposite interdependent pairs (e.g., decentralization and centralization; autonomous teams and a unified system; stability and change) while avoiding overemphasis on either pole. The shape and influence of these polarities is likely to be influenced by MTS configuration (e.g., perhaps a MTS with higher levels of dynamism will exhibit a different manifestation of the stability–change polarity than a system with lower levels) and presence of integration mechanisms (e.g., a system-level leadership team with members from each component team may help to leverage the decentralization-centralization polarity). In sum, MTSs are tasked with addressing seemingly opposing needs and the integration of polarities thinking may assist in this endeavor.

Assuming that we gain an increased understanding of the underlying drivers of MTSs, the best leverage points for influencing their effectiveness should become evident. As discussed here, interventions aimed at mitigating or compensating for differentiation and dynamism-generated sources of complexity are natural starting points. So, too, is the multifaceted approach to leadership throughout the system that we advocated. Yet other potential sources of coordination exist including the role of IT systems, rewards, and other mechanisms (cf., Mathieu et al., 2001). MTSs have proven to be difficult to investigate and to understand. Naturally, they are even more difficult to manage effectively. Hopefully, increased theoretical and empirical work will better enable the successful management of MTSs.

In conclusion, the past decade and a half has produced a wealth of information and enthusiasm about the MTS concept. Yet far more work remains to be done. Progress will hinge on the advancement and application of unifying frameworks and theoretical models, on meso-style approaches that traverse two or three levels of analysis, and on innovative research methodologies and investigations. We believe that the confluence of those developments will occur in the next decade or so, and we anticipate that our understanding of, and ability to influence the effectiveness of, MTSs will accelerate rapidly. The journey thus far has been interesting, but the road ahead should be even more exciting.

ACKNOWLEDGMENTS

We would like to thank Stephen Zaccaro and Michelle Marks for their continued support and encouragement, and in particular, for sharing their thoughts for this chapter.

REFERENCES

Ancona, D. G., & Caldwell, D. F. (1992). Bridging the boundary: External activity and performance in organizational teams. Administrative Science Quarterly, *37*(4), 634–665.
Bienefeld, N., & Grote, G. (2014). Shared leadership in multiteam systems: How cockpit and cabin crews lead each other to safety. Human Factors: The Journal of the Human Factors and Ergonomics Society, *56*(2), 270–286.
Bigley, G. A., & Roberts, K. H. (2001). The incident command system: High-reliability organizing for complex and volatile task environments. Academy of Management Journal, *44*(6), 1281–1299.
Borgatti, S. P., & Foster, P. C. (2003). The network paradigm in organizational research: A review and typology. Journal of Management, *29*(6), 991–1013.
Brown, S. L., & Eisenhardt, K. M. (1997). The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. Administrative Science Quarterly, *42*(1), 1–34.
Bruns, H. C. (2013). Working alone together: Coordination in collaboration across domains of expertise. Academy of Management Journal, *58*(1), 62–83.
Caldwell, B. (2005). Multi-team dynamics and distributed expertise in mission operations. Aviation, Space, and Environmental Medicine, *76* (Supplement 1), B145–B153.
Carley, K. M., (2003). Dynamic network analysis. In R. Breiger, K. Carley, &, P. Pattison (Eds.), Dynamic social network modeling and analysis: Workshop summary and papers. Committee on Human Factors, National Research Council, pp. 133–145.
Carter, D. R., & DeChurch, L. A. (2013). Leadership in multiteam systems: A network perspective. In D. V. Day (Ed.), Oxford handbook of leadership (pp. 482–501). New York: Oxford University Press.
Carter, D. R., DeChurch, L. A., & Zaccaro, S. J. (2014, January). Impact of leadership network structure on the creative output of multiteam systems. In Academy of Management Proceedings (Vol. 2014, No. 1, p. 16874). Academy of Management.
Contractor, N. (2009). The emergence of multidimensional networks. Journal of Computer-Mediated Communication, *14*(3), 743–747.
Contractor, N. S., DeChurch, L. A., Carson, J., Carter, D. R., & Keegan, B. (2012). The topology of collective leadership. The Leadership Quarterly, *23*(6), 994–1011.
Contractor, N. S., Wasserman, S., & Faust, K. (2006). Testing multitheoretical, multilevel hypotheses about organizational networks: An analytic framework and empirical example. Academy of Management Review, *31*(3), 681–703.
Crawford, E. R., & LePine, J. A. (2013). A configural theory of team processes: Accounting for the structure of taskwork and teamwork. Academy of Management Review, *38*(1): 32–48.
Cromwell, R. L., & Neigut, J. S. (2014). Human Exploration Research Analog (HERA) Experiment Information Package. NASA Flight Analogs Project Human Research Program.
Davison, R. B., Hollenbeck, J. R., Barnes, C. M., Sleesman, D. J., & Ilgen, D. R. (2012). Coordinated action in multiteam systems. Journal of Applied Psychology, *97*(4), 808–824.

de Jong, A. D., Ruyter, K. D., & Lemmink, J. (2005). Service climate in self-managing teams: Mapping the linkage of team member perceptions and service performance outcomes in a business-to-business setting. Journal of Management Studies, *42*(8), 1593–1620.
DeChurch, L. A., & Marks, M. A. (2006). Leadership in multiteam systems. Journal of Applied Psychology, *91*(2), 311–329.
DeChurch, L. A., & Zaccaro, S. J. (2010). Perspectives: Teams won't solve this problem. Human Factors: The Journal of the Human Factors and Ergonomics Society, *52*(2), 329–334.
DeChurch, L. A., Burke, C. S., Shuffler, M. L., Lyons, R., Doty, D., & Salas, E. (2011). A historiometric analysis of leadership in mission critical multiteam environments. The Leadership Quarterly, *22*(1), 152–169.
Faraj, S., & Xiao, Y. (2006) Coordination in fast-response organizations. Management Science, *52*(8), 1155–1169.
Firth, B., Hollenbeck, J., Miles, J., Ilgen, D., & Barnes, C. (2015). Same page, different books: Extending representational gaps theory to enhance performance in multiteam systems. Academy of Management Journal, *58*, 813–845.
Fleishman, E. A., Mumford, M. D., Zaccaro, S. J., Levin, K. Y., Korotkin, A. L., & Hein, M. B. (1991). Taxonomic efforts in the description of leader behavior: A synthesis and functional interpretation. Leadership Quarterly, *2*(4), 245–287.
Gibson, C. B., & Dibble, R. (2013). Excess may do harm: Investigating the effect of team external environment on external activities in teams. Organization Science, *24*(3), 697–715.
Healey, M. P., Hodgkinson, G. P., & Teo, S. (2009). Responding effectively to civil emergencies: The role of transactive memory in the performance of multi team systems. In Proceedings of NDM9 the 9th international conference on naturalistic decision making (pp. 53–59).
Hoch, J. E. (2013). Shared leadership and innovation: The role of vertical leadership and employee integrity. Journal of Business and Psychology, *28*, 159–174.
Hoegl, M., & Weinkauf, K. (2005). Managing task interdependencies in multi-team projects: A longitudinal study. Journal of Management Studies, *42*(6), 1287–1308.
Hoegl, M., Weinkauf, K., & Gemuenden, H. G. (2004). Interteam coordination, project commitment, and teamwork in multiteam R&D projects: A longitudinal study. Organization Science, *15*(1), 38–55.
Hogg, M. A., van Knippenberg, D., & Rast, D. E. (2012). Intergroup leadership in organizations: Leading across group and organizational boundaries. Academy of Management Review, *37*(2), 232–255.
Hunter, S. T., & Cushenbery, L. (2011). Leading for innovation: Direct and indirect influences. Advances in Developing Human Resources, *13*, 248–265.
Johannessen, I. A., McArthur, P. W., & Jonassen, J. R. (2012). Leadership redundancy in a multiteam system. In J. Frick & B. Laugen (Eds.), Advances in production management systems. Value networks: Innovation, technologies, and management (pp. 549–556). Berlin, Heidelberg: Springer.
Johnson, B. (1992). Polarity management: Identifying and managing unsolvable problems. Amherst, MA: HRD Press.
Johnson, B. (2014). Reflections: A perspective on paradox and its application to modern management. The Journal of Applied Behavioral Science, *50*(2), 206–212.
Joshi, A., Pandey, N., & Han, G. H. (2009). Bracketing team boundary spanning: An examination of task-based, team-level, and contextual antecedents. Journal of Organizational Behavior, *30*(6), 731–759.
Keyton, J., Ford, D. J., & Smith, F. L. (2012). Communication, collaboration, and identification as facilitators and constraints of multiteam systems. In S. J. Zaccaro, M. A. Marks, & L. A. DeChurch (Eds.), Multiteam systems: An organization form for dynamic and complex

environments (pp. 173–190). New York: Routledge.
Kirkman, B. L., & Rosen, B. (1999). Beyond self-management: Antecedents and consequences of team empowerment. Academy of Management Journal, *42*(1), 58–74.
Kratzer, J., Gemünden, H. G., & Lettl, C. (2008). Balancing creativity and time efficiency in multi-team R&D projects: The alignment of formal and informal networks. R&D Management, *38*(5), 538–549.
Lanaj, K., Hollenbeck, J., Ilgen, D., Barnes, C., & Harmon, S. (2013). The double-edged sword of decentralized planning in multiteam systems. Academy of Management Journal, *56*(3), 735–757.
LePine, J. A., Piccolo, R. F., Jackson, C. L., Mathieu, J. E., & Saul, J. R. (2008). A meta-analysis of teamwork process: Towards a better understanding of the dimensional structure and relationships with team effectiveness criteria. Personnel Psychology, *61*, 273–307.
Lewis, K. (2003). Measuring transactive memory systems in the field: Scale development and validation. Journal of Applied Psychology, *88*(4), 587–604.
Liu, Y., & Simaan, M. A. (2004). Noninferior Nash strategies for multi-team systems. Journal of Optimization Theory and Applications, *120*(1), 29–51.
Luciano, M. M., DeChurch L. A., & Mathieu, J. E. (2015). Multiteam systems: A structural framework and meso-theory of system functioning. Journal of Management, doi:0149206315601184.
Marks, M. A., DeChurch, L. A., Mathieu, J. E., Panzer, F. J., & Alonso, A. (2005). Teamwork in multiteam systems. Journal of Applied Psychology, *90*(5), 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*(3), 356–376.
Mathieu, J. E. (2012). Reflections on the evolution of the multiteam systems concept and look to the future. In S. J. Zaccaro, M. A. Marks, & L. A. DeChurch (Eds.), Multiteam systems: An organization form for dynamic and complex environments (pp. 511–544). New York: Routledge.
Mathieu, J. E., Cobb, M. A., Marks, M. A., Zaccaro, S. J., & Marsh, S. (2004). Multiteam ACES: A research platform for studying multiteam systems. Scaled Worlds: Development, Validation and Applications, 297–315.
Mathieu, J. E., Gilson, L. L., & Ruddy, T. M. (2006). Empowerment and team effectiveness: An empirical test of an integrated model. Journal of Applied Psychology, *91*(1), 97–108.
Mathieu, J. E., Marks, M. A., & Zaccaro, S. J. (2001). Multi-team systems. In N. Anderson, D. Ones, H. K. Sinangil, & C. Viswesvaran (Eds.), International handbook of work and organizational psychology (pp. 289–313). London: Sage.
Mathieu, J. E., Maynard, M. T., Taylor, S. R., Gilson, L. L., & Ruddy, T. M. (2007). An examination of the effects of organizational district and team contexts on team processes and performance: a meso-mediational model. Journal of Organizational Behavior, *28*(7), 891–910.
McGrath, J. E. (1964). Social psychology: A brief introduction. New York: Holt, Rinehart and Winston.
McGrath, J. E., Arrow, H., & Berdahl, J. L. (1999). Cooperation and conflict as manifestations of coordination in small groups. Polish Psychological Bulletin, *30*(1), 1–14.
Millikin, J. P., Hom, P. W., & Manz, C. C. (2010). Self-management competencies in self-managing teams: Their impact on multi-team system productivity. The Leadership Quarterly, *21*(5), 687–702.
Morgeson, F. P., DeRue, D. S., & Karam, E. P. (2010). Leadership in teams: A functional approach to understanding leadership structures and processes. Journal of Management, *36*, 5–39.
Murase, T., Carter, D. R., DeChurch, L. A., & Marks, M. A. (2014). Mind the gap: The role of leadership in multiteam system collective cognition. The Leadership Quarterly, *25*(5),

972–986.
Okhuysen, G. A., & Bechky, B. A. (2009). Coordi-nation in organizations: An integrative perspective. The Academy of Management Annals, 3(*1*), 463–502.
Okhuysen, G. A., & Waller, M. J. (2002). Focusing on midpoint transitions: An analysis of boundary conditions. Academy of Management Journal, *45*(5), 1056–1065.
O'Sullivan, A. (2003). Dispersed collaboration in a multi-firm, multi-team product-development project. Journal of Engineering and Technology Management, *20*(1), 93–116.
Ranson, S., Hinings, B., & Greenwood, R. (1980). The structuring of organizational structures. Administrative Science Quarterly, *25*(1), 1–17.
Resick, C. J., Burke, C. S., & Doty, D. (2012). Multiteam System (MTS) research in laboratory settings: A look at the technical and practical challenges. In S. J. Zaccaro, M. A. Marks, & L. A. DeChurch (Eds.), Multiteam systems: An organization form for dynamic and complex environments (pp. 487–510). New York: Routledge.
Rosing, K., Frese, M., & Baush, A. (2011). Explaining the heterogeneity of the leadership-innovation relationship: Ambidextrous leadership. The Leadership Quarterly, *22*, 956–974.
Salas, E., Shuffler, M. L., & Rico, R. (Eds.) (2014). Pushing the boundaries: Multiteam systems in research and practice (Vol. 16). Bingley, UK: Emerald Group Publishing.
Scheerer, A., Hildenbrand, T., & Kude, T. (2014, January). Coordination in large-scale agile software development: A multiteam systems perspective. In System Sciences (HICSS), 2014 47th Hawaii International Conference on (pp. 4780–4788). IEEE.
Tajfel, H. (1982). Social psychology of intergroup relations. Annual Review of Psychology, *33*(1), 1–39.
Taplin, S. H., Foster, M. K., & Shortell, S. M. (2013). Organizational leadership for building effective health care teams. The Annals of Family Medicine, *11*(3), 279–281.
Uitdewilligen, S., & Waller, M. J. (2012). *Adaptation in multiteam systems: The role of temporal semi-structures*. In S. J. Zaccaro, M. A. Mark, & L. A. DeChurch (Eds.), Multiteam systems: An organization form for dynamic and complex environments (pp. 365–394). New York: Routledge.
Wegner, D. M. (1987). Transactive memory: A contemporary analysis of the group mind. In Theories of group behavior (pp. 185–208). Springer: New York.
Xi, Y., & Tang, F. (2004). Multiplex multi-core pattern of network organizations: An exploratory study. Computational & Mathematical Organization Theory, *10*(2), 179–195.
Xie, C., Wu, D., Lu, J., & Hu, X. (2010). A case study of multi-team communications in construction design under supply chain partnering. Supply Chain Management: An International Journal, *15*(5), 363–370.
Yin, R. (1989). Case study research: Design and methods (
Rev. edn
). Beverly Hills, CA: Sage.
Yin, R. (1993). Applications of case study research. Beverly Hills, CA: Sage.
Zaccaro, S. J., & DeChurch, L. A. (2012). Leadership forms and functions in multiteam systems. In S. J. Zaccaro, M. A. Marks, & L. A. DeChurch (Eds.), Multiteam systems: An organization form for dynamic and complex environments (pp. 253–288). New York: Routledge.
Zaccaro, S. J., Marks, M. A., & DeChurch, L. A. (2012). Multiteam systems: An introduction. In S. J. Zaccaro, M. A. Marks, & L. A. DeChurch (Eds.), Multiteam systems: An organization form for dynamic and complex environments (pp. 3–32). New York: Routledge.
Zaccaro, S. J., Rittman, A. L., & Marks, M. A. (2002). Team leadership. The Leadership Quarterly, *12*(4), 451–483.

- coordination
- teams
- team process
- team leadership
- flight simulation
- simulations
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http://dx.doi.org/10.4135/9781473914957.n16