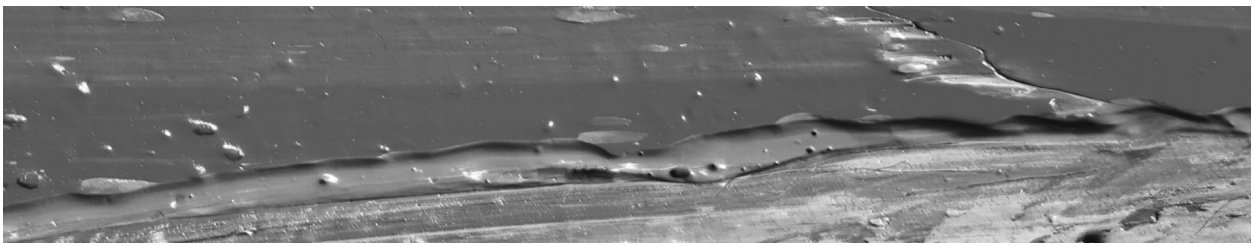
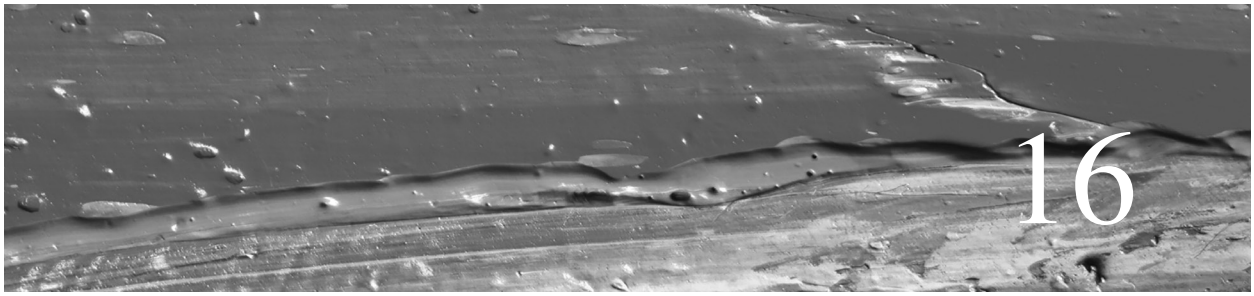
PART IX

# Groups: Team Performance





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# From Teams in Organizations to Organizing in Teams

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## INTRODUCTION

> The computer and the Internet are among the most important inventions of our era, but few people know who created them … It's … a narrative of how they collaborated and why their ability to work as teams made them even *more* creative. (Isaacson, 2014, p. 1)

In his latest book, *The Innovators: How a Group of Hackers, Geniuses and Geeks Created the Digital Revolution* (2014), Walter Isaacson reflects on the many biographies he has written on great minds – Albert Einstein, Benjamin Franklin, Steve Jobs. *The Innovators* relays Isaacson's realization that these individuals' success stories can be re-interpreted as *team* success stories. Isaacson recalled Steve Jobs' answer to his question of which product he was most proud of: 'you know, making a product is hard, but making a team that can continually make products is even harder. The product I'm most proud of is Apple and the team I built at Apple' (Big Think Editors, n.d.).

The study of small groups and teams has a long history in Psychology. What is now known as teams research grew out of a research tradition on small groups. Some of this earlier work focused on questions of how groups form and their developmental phases (Tuckman, 1965), or their social interaction processes and sources of process loss (Steiner, 1972). Early scholars were intrigued by groups as a context that exerted forces on the individual (Allport, 1962; Festinger, 1950; Lewin, 1947). A literature flourished exploring the various ways small groups affect individuals' thoughts, feelings, and actions (e.g., Asch, 1956; Janis, 1971).

A significant transition occurred as *groups* became *teams*, and research evolved from posing questions of group development and the effects of groups on individuals, to a focus on understanding how patterns of interactions, dubbed *team processes*, drive team performance. This was a focus brought on by the more applied and performance emphasis of Industrial/ Organizational (I/O) Psychology. This shift was eloquently announced by Levine and Moreland (1990): 'small group research is alive and well, but living elsewhere' (p. 620). Since that time, I/O and Organizational Behavior (OB) scholars have amassed a large body of theory and research that describes team interactions and explains the factors, or enabling conditions (Hackman, 2012), underpinning their success.

Yet, there are clear signs that we are at the cusp of another important shift in the area of teams research. Teams have now caught the attention

of scholars across a wide variety of disciplines. Computer scientists, information scientists, sociologists, and communication scholars are considering how to best design group technologies to enable new ways of working together (Ackerman, 2000; Galegher, Kraut, & Egido, 2014). Engineering scholars are posing new and interesting questions about the design and optimization of teams, and are exploring the social and organizational processes that enable systems engineering and design (Hinds, 2002; Horii, Jin, & Levitt, 2005). Scholars interested in translational research, evaluation science, management, health, other areas of psychology, and communications recently formed a new community – the science of team science (Stokols, Hall, Taylor, & Moser, 2008) – to understand and enable collaborative, team-based scientific research. In short, the team is a powerful vehicle for harnessing and integrating individual activity to produce collaborative outcomes.

Despite the maturity of teams research as a field of study, the dominant paradigm rooted in I/O and OB is aimed at understanding *teams in organizations*. This frame implies that teams perform tasks in organizations. There is an implied formality and deliberateness in this characterization of teams. However, today's collaborations are occurring *within* as well as *across* and *without* formal organizational boundaries. Many of the collaborations highlighted in Isaacson's *The Innovators*, were not formally appointed, nor were they contained within a single formal organization. Many teams form within online communities and exist for the sake of the team without serving an organizational purpose. These fluid collaborations reflect a type of team that is, somewhat ironically, increasingly prevalent in the digital age that Isaacson's innovators, those who invented the internet, brought on. We use the phrase *organizing in teams* to describe the expanding array of collaborative arrangements that are comprising this third era of teams research.

In Table 16.1, we summarize some prominent definitions of teams. Scanning these definitions, five themes are apparent in how teams have been conceptualized in prior work: **size**, **goals**, **interdependence**, **formation**, and **specialization** (or differentiation). In terms of size, Bales' (1950) classic definition set the range at 2 to 20 individuals.

**Table 16.1 Prominent definitions of teams**

| *Authors (Year)* | *Definition of a team* |
|---|---|
| Bales (1950) | '… ranging in number from two to something around twenty, then may be classified together as "small groups"… direct face to face interaction takes place in all of these groups.' (p. i) |
| McGrath (1984) | 'The central feature, the "essence," of a group lies in the interaction of its members – the behaving together, in some recognized relation to one another, of two or more people who also have some past and/or future relation to each other. So group interaction process is the centerpiece of the model.' (p. 13) |
| Sundstrom, De Meuse, & Futrell (1990) | 'Work teams are defined as interdependent collections of individuals who share responsibility for specific outcomes for their organizations.' (p. 120) |
| Salas, Dickinson, Converse, & Tannenbaum (1992) | 'A team is a set of two or more people who interact dynamically, interdependently, and adaptively toward a common and valued goal, each having specific roles or functions to perform and a limited life span or membership.' (pp. 126–127) |
| Katzenbach & Smith (1993) | 'A team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they are mutually accountable.' (p. 112) |
| McGrath, Arrow, & Berdahl (2000) | 'We view groups as bounded, structured entities that emerge from the purposive, interdependent actions of individuals. Groups bring together individuals who carry their pasts with them, and groups create their own history, guided by members' sense of the future, as they operate in time.' (p. 95) |
| Marks, Mathieu, & Zaccaro (2001) | 'Teams are multitasking units that perform multiple processes simultaneously and sequentially to orchestrate goal-directed taskwork.' (p. 356) |
| Kozlowski & Bell (2003) | 'Work teams and groups: (a) are composed of two or more individuals, (b) who exist to perform organizationally relevant tasks, (c) share one or more common goals, (d) interact socially, (e) exhibit task interdependencies (i.e., workflow, goals, outcomes), (f) maintain and manage boundaries, and (g) are embedded in an organizational context that sets boundaries, constrains the team, and influences exchanges with other units in the broader entity.' (p. 6) |
| Ilgen, Hollenbeck, Johnson, & Jundt (2005) | 'Teams are complex, dynamic systems existing in larger systemic contexts of people, tasks, technologies, and settings.' (p. 519) |

This minimum size of 2 has been echoed by subsequent definitions (e.g., Kozlowski & Bell, 2003; Salas, Dickenson, Converse, & Tannenbaum, 1992). The notion of a shared goal that unites individuals is a second common theme. Sundstrom, De Meuse and Futrell (1990) call it shared "responsibility for specific outcomes for their organizations" (p. 120). Salas and colleagues add the phrase 'a common and **valued** goal' (pp. 126–127; emphasis added), recognizing that members not only share, but also internalize the team's goal. The third theme is interdependence. McGrath (1984) eloquently expressed, 'the "essence" of a group lies in the interaction of its members – the behaving together' (p. 13). The fourth theme, formation, is one present in early but conspicuously absent in modern definitions of teams. Again quoting McGrath, groups 'have some past and/or future relation to each other' (p. 13). And a later definition of McGrath and his colleagues emphasizes that 'groups bring together individuals who carry their pasts with them, and groups create their own history, guided by members' sense of the future, as they operate in time' (p. 95). This notion of time-boundedness, and its accompanying attention to how and why the team comes together, is missing from many of the later definitions that came about when groups became teams. In contrast to McGrath's emphasis on individuals coming together to form groups, many subsequent definitions of teams de-emphasize formation and focus on the already bounded entity. For example, Marks and colleagues refer to teams as 'multitasking units' (p. 356; 2001), and Ilgen and colleagues describe them as 'complex, dynamic systems' (p. 519; 2005). Fifth, these definitions recognize that members posses different skills and develop differentiated role structures. Katzenbach and Smith capture this with the expression 'complementary skills' (p. 112; 1993); Salas and his colleagues note that individuals perform 'specific roles or functions' (pp. 126–127; 1992). Later we return to these themes and definitions as we consider the shift from conceptualizing teams in organizations to organizing in teams.

In this chapter, we mark the transition from explaining the functioning of *teams in organizations* toward an emphasis on understanding *organizing in teams*. Research on teams in organizations has much to contribute to this broader inquiry into organizing in teams, but requires that we revisit some of the simplifying assumptions routinely made about teams in organizational research, and adopt a more encompassing definition of what constitutes a team. First, we introduce the perspective of organizing in teams in order to encourage future research to better account for the wide array of collaborative organizational forms that involve teamwork. Then, we discuss recent theoretical and empirical work published in top outlets that has begun to tackle the challenge of studying organizing in teams. We end by considering new frontiers in data sources and analytic approaches poised to advance this era of organizing in teams.

## ARE THESE TEAMS?

Let us consider some examples of collaborative organizational forms that involve teamwork. When reading each example, consider the question, 'Are these teams?'.

**Big science 'teams':** The European Organization for Nuclear Research known as CERN, is a massive collaboration among experts who are striving to understand the fundamental structure of the universe (CERN, 2014). At present, CERN runs 26 large-scale projects, each of which has its own set of collaborators. For example, in ATLAS, a CERN project that began in 2009, researchers used the Large Hadron Collider, in which beams of particles collide together to form new particles (ATLAS Experiment, n.d.), to identify the presence of the Higgs Boson particle. As of February 2012, the ATLAS project involved over 3,000 scientists and collaborators from 174 institutions in 38 countries. These individuals work together in person at the facility in Switzerland and/or from across the world using virtually-mediated communication tools. Plans for additional ATLAS experiments span the next 20 years.

**Open source software:** GitHub (GitHub, 2014) is an online code-sharing community in which programmers collaborate to write and publish code. The programmers provide the expertise; GitHub provides the interface and collaboration resources. Group boundaries might be defined before groups begin coding, meaning that a group of individuals decides to work on a coding project together and use the GitHub interface to manage the project. However, group boundaries might also be defined or re-defined within the GitHub interface. GitHub has over 7 million users, each of which has the opportunity to contribute to any project on the site. Programmers wanting to help with an existing project can download the source code, make edits locally, then email the project owner with suggested changes. The project

owner determines whether to merge the changes with the existing code or reject the contribution (Finley, 2012). Because anyone has the potential to contribute, project membership can be quite fluid. At any given moment, each of the over 18 million projects on GitHub may have a minimum of 1 contributor and a maximum of over 7 million (the entire GitHub community).

**Peer production:** Wikipedia (Wikipedia, n.d.) is a free and open web-based collaborative encyclopedia. Any individual user can begin a new article on Wikipedia and anyone in the world can edit and update existing articles. Wikipedia pages are always open for editing, so new contributors might make edits to a page at any time. Wikipedia provides a 'talk' feature for contributors to exchange messages. These 'talk pages' are archived so new users can review previous discussions. Like GitHub collaborations, the number of contributors on a given Wikipedia page can range from one to millions of people who work together to construct an encyclopedia page simultaneously or over time. The contributors to a Wikipedia page jointly determine who collaborates, the amount of interaction involved in page creation and editing, the duration of the collaboration, and the degree to which individuals work together on different sections of the page.

Are these examples of teams? Certainly, each example involves teamwork, and there is a thriving literature that investigates teamwork in these contexts (Dabbish, Stuart, Tsay & Herbsleb, 2012; Kalliamvakou, Damian, Singer, & German, 2014; Holloway, Bozicevic, & Börner, 2007; Krige, 1993; Spek, Postma, & Herik, 2006). To some degree, each example aligns with commonly accepted definitions of *teams in organizations* such as:

> two or more individuals who (b) socially interact (face-to-face or, increasingly, virtually); (c) possess one or more common goals; (d) are brought together to perform organizationally relevant tasks; (e) exhibit interdependencies with respect to workflow, goals, and outcomes; (f) have different roles and responsibilities; and (g) are together embedded in an encompassing organizational system, with boundaries and linkages to the broader system context and task environment. (Kozlowski & Ilgen, 2006, p. 79)

However, the teams nucleating within these and other novel IT-enabled forms of organizing such as GitHub, Wikipedia, and CERN are pushing the bounds of traditional teams research in several important ways.

First, whereas the *minimum* size of a team has long been debated in organizational research, with some suggesting two people can constitute a team and others arguing that teams must include at least three people, teams research has not effectively dealt with the question of what is *the upper bound on team size*. Newly emerging collaborative forms are challenging teams researchers to consider this question. For example, as noted above, a collaborative project on GitHub might involve anywhere from two to over 7 million collaborators.

Second, today's collaborative forms challenge our assumptions of *what constitutes a common goal*. Shared goals have long been used to define the boundaries of groups and teams. Certainly, scientists at CERN, and within the GitHub and Wikipedia communities work toward common goals. However, some of these goals are quite distal such as CERN's 'understand the fundamental structure of the universe', suggesting that contributors must balance their efforts within a hierarchical goal structure by working both toward proximal goals (e.g., conduct experiments) as well as toward broader superordinate objectives. Furthermore, shared goals in novel forms of organizing are often collectively determined rather than assigned by a manager or formal organization. For example, contributors begin new projects and pages in GitHub and Wikipedia as their interests and experiences shift. Many of these teams fall at the extreme end of the self-managing continuum.

Third, novel forms of organizing encourage a reconsideration of the *definition of interdependence*. In organizational research, interdependence is typically depicted as a property of the task, reflecting the extent to which interaction is required to accomplish it (Hackman & Oldham, 1976). Certainly, task-based interdependence is present in the examples above. In GitHub, individuals recognize this interdependence and interact in ways that permit transparency in order to enable more streamlined collaboration (Dabbish et al., 2012). However, in many of today's collaborative forms, interdependence is a more fluid concept, where any given collection of individuals determines its own interdependence through their patterns of interactions. For instance, on Wikipedia, contributors jointly negotiate the degree to which tasks will involve interdependent interaction through the 'talk' function and their combined edits. Two nearly identical tasks could be performed by two teams, one interdependently and one independently. The same task can witness a shift in interdependence as the work evolves or as membership shifts over time.

Fourth, teams in organizations research assumes that teams are appointed. As the definition quoted earlier states, teams 'are brought together to perform organizationally relevant tasks' (Kozlowski & Ilgen, 2006, p. 79). However, there is a growing awareness that individuals exhibit significant personal agency in deciding who to work with and what to work on (Harrison & Humphrey, 2010; Humphrey & Aime, 2014).

Fifth, definitions and empirical investigations of teams often make the assumption that members are 'assigned specific roles' (Salas et al., 1992, p. 4), for example, by managers or formal team leaders. However, these often *hierarchical assumptions of task assignment* are becoming less the norm in today's collaborations. Although there are project 'leads' in GitHub, leadership in these contexts is more about demonstrating expertise and harnessing social capital and less about asserting formal authority over others or assigning followers to specific roles or tasks.

In summary, although the examples provided above do meet the minimal criteria of a team, they also challenge dominant notions in mainstream I/O and OB research about what constitutes a team. These novel IT-enabled forms of organizing force us to consider the upward size, the fluidity of interdependence, and the emergent nature of hierarchy, roles, and shared goals. We introduce the phrase *organizing in teams* to better account for these features of collaboration.

## ORGANIZING IN TEAMS

*Organizing in teams describes purposive collaborative interaction among a set of individuals.* Table 16.2 presents a summary of how research on organizing in teams differs from the traditional 'teams in organizations' perspective.

We use the term *purposive* instead of goal-directed. A goal implies a desired outcome or end state. Many teams come together with a similar reason for doing something, but not necessarily a clearly defined goal. Consider collaborations on WikiProjects, an online collaboration space where individuals come together to coordinate editing tasks and form meaningful social groups (Kittur & Kraut, 2008; Morgan, Gilbert, McDonald, & Zachry, 2014). Here individuals produce content (e.g., encyclopedia entries) and also serve task coordination roles. Although it may be too strict to argue WikiProject members have a shared goal, or end state, they clearly have a similar purpose around which their entitativity (Campbell, 1958) is based.

We use the word *collaborative* instead of interdependence. Beginning with Lewin (1935), groups and teams research has considered interdependence as a key feature of teams that arises in conjunction with common objectives and members who are motivated to achieve them (Johnson & Johnson, 2005). Certainly teams exhibit interdependence. But problematically, the term interdependence is often used to refer to a property of the task itself, rather than, as is often the case in many teams, a property of the team determined by the individuals who interact in the team. This task-based view stems, in part, from the task design literature, where interdependence refers to a potentially motivating feature of organizational tasks (Hackman & Oldham, 1976; Van de Ven, Delbecq, & Koenig Jr., 1976; Grant & Parker, 2009). In essence, the prevailing notion of interdependence implies that the task comes *before* the team; assuming there is a task that needs to be performed, and then a team of individuals is assigned to complete it. In fact, in many teams, the team may come before the task. Such is the case when a group of scientists comes together to pursue a new idea and then seeks out the funding to support it.

Finally, we use the word *interaction* as the centerpiece of the definition because it is the interactions occurring within the context of a shared purpose and collaborative intentions that

**Table 16.2 Comparing team definitions from two perspectives**

| | *Two views of teams* | |
|---|---|---|
| *Feature* | *Teams in organizations* | *Organizing in teams* |
| *Size* | Focus on *minimum* size | Focus on *maximum* size |
| Common goal vs. Common purpose | Members share a common *goal* | Members share a similar *purpose* |
| Task interdependence vs. Collaborative interactions | Interdependence is a property of the *task* | Interdependence is a property of the *task* and individuals' collaborative *interactions* |
| Formation | Teams are *appointed* | Teams can be *appointed* or can *self-organize* |
| Role specialization | *Differentiated* roles | *Emergent, dynamic* role structures |

ultimately characterize teamwork. Purposive interaction is what all teams share, whether they collaborate in a traditional organization or an online community (Kittur, Chi, Pendleton, Suh, & Mytkowicz, 2007; Kittur, Suh, Pendleton, & Chi, 2007; Zijlstra, Waller, & Phillips, 2012). The central role of interactions in defining teams makes dyadic, relational data and social network analytic approaches particularly appropriate for teams research. We touch on this topic in the section on new methodologies.

The organizing in teams perspective is clearly visible in Amy Edmondson's notion of teaming (2012). Teaming includes the set of interpersonal actions and behaviors needed for individuals to collaborate quickly and adaptively. Whereas the notion of teaming characterizes what individuals need to be able to do to work together flexibly and adaptively, the organizing in teams perspective also includes a range of multilevel processes, encompassing the individual, dyadic, team, and contextual perspectives in which the team phenomenon is rooted.

Importantly, the organizing in teams perspective is reflected in international work on teams. These reflect a focus on emergent and dynamic roles, as opposed to the traditionally differentiated roles (Cleveland, Finez, Blascovich, & Ginther, 2012; Li & Roe, 2012; Schraub, Michel, Shemla, & Sonntag, 2014). For example, Li and Roe (2012) introduced an intrateam, longitudinal approach to investigate how roles and emergent patterns change within teams over time. This work also investigates formation. Work on self-assembled teams during times of emergency (Zijlstra, Waller, & Phillips, 2012), as well as self-assembled family grown businesses (Sharma, De Massis, & Gagne, 2014) run contrary to the traditional conception of appointed team membership. Finally, virtual teams and multiteam systems (see Mathieu, Luciano, & DeChurch, in press [this volume]) have intrigued a global community of researchers (Bienefeld, & Grote, 2014; DeVries, Walter, Van der Vegt, & Essens, 2014; Rico, Bachrach, Sánchez-Manzanares, & Collins, 2011).

The view of organizing in teams has many potential levels of explanation, each of which is essential to understanding *purposive collaborative interaction among a set of individuals*. From an individual perspective, research has looked to people's personal characteristics (e.g., Bell, 2007), their thoughts, feelings, and actions, to understand their entree into and interaction within teams. From a dyadic or relational perspective, research has looked to the affective, motivational, and cognitive relationships, and the behavioral interactions that connect members of teams to one another (e.g., Crawford & LePine, 2013; Schraub et al., 2014). From a team perspective, researchers have looked for explanations in the emergent patterns of behavioral processes that characterize how a team works together (e.g., Marks et al., 2001) or toward emergent psychological states such as cohesion which characterize members' attraction to the group (e.g., Festinger, Schachter, & Bach, 1950; Mullen & Copper, 1994; Picazo, Gamero, Zornoza, & Peiró, 2015). At the contextual level, we can look for explanations in the design of collaborative technologies (e.g., Fussell, Kiesler, Setlock, & Scupelli, 2004; Majchrzak, Rice, Malhotra, King, & Ba, 2000), or embeddedness in multiteam systems (see Mathieu et al., this volume).

Having introduced the broader perspective of *organizing in teams*, we now consider how this vantage point opens up new theoretical directions and methodological opportunities for a more interdisciplinary science of understanding teams. In terms of theory, this vantage point allows us to see new team phenomena that may not be visible to the researcher looking only at teams in organizations. In terms of data and methods, this vantage point also makes new sources of data and some methodologies that have been traditionally underutilized in teams research, more attractive. In the next section we present a high level overview of recent research on teams with an eye toward two questions: (1) How does the voluminous literature on teams in organizations inform the broader view of organizing in teams? and (2) How does the organizing in teams perspective shift the nature of the research questions we ask and answer about teams?

## EXTENSIONS TO TEAM THEORY

Studies of teams in the I/O and OB literatures are framed using the well-established input–process–output (I-P-O) model of team effectiveness (Hackman, 1987; McGrath, 1984; Kozlowski & Ilgen, 2006) or the more recent and expansive input mediator output input framework (IMOI; Ilgen et al., 2005). Broadly, these models view teams as purposive collaborations that transform inputs, such as team composition, team design, and team leadership, into valued outcomes through various mediators (e.g., team processes, emergent psychological states). Recent reconceptualizations of these models advance a temporal view of teams whereby teams cycle through phases of action and transition, and outputs in one phase become inputs or mediators in another (Ilgen et al., 2005; Marks et al., 2001).

Relying on this fundamental architecture, the field of *teams in organizations*, has generated a great breadth of theory and empirical research on team effectiveness. Over the past decade, scholars have synthesized this work in many excellent reviews. These include general reviews of team effectiveness (e.g., Ilgen et al., 2005; Kozlowski & Ilgen, 2006; Mathieu, Maynard, Rapp, & Gilson, 2008) as well as reviews focused on specific team topics such as composition (Bell, 2007; Mathieu, Tannenbaum, Donsbach, & Alliger, 2014), leadership (Morgeson, DeRue, & Karam, 2010), cognition (DeChurch & Mesmer-Magnus, 2010a; 2010b; Mohammed, Ferzandi, & Hamilton, 2010), virtuality (de Guinea, Webster, & Staples, 2012), and adaptability (Baard, Rench, & Kozlowski, 2014). We refer the interested reader to those sources for a fuller treatment of these topics. In our review, we use the I-P-O model as an organizing framework to consider how recent work on teams is already ushering in the transition from a focus on teams in organizations to one of organizing in teams.

## Team Inputs

Team inputs are the antecedent factors that impact team functioning (Gladstein, 1984), and can stem from the individual-level (e.g., members' personalities or competencies), dyad-level (e.g., interpersonal ties; Balkundi & Harrison, 2006), team-level (e.g., team task structure, external leadership), or originate in the team's external context (e.g., organizational boundaries; Mathieu et al., 2008). For example, research on team composition has explored the compositional inputs of teams that have implications for team process and performance (e.g., cognitive ability, personality, sex, race, etc.).

A clear sign of the shift to a focus on organizing teams is the growing interest in *team self-organization*. Research on team self-organization signals a shift in understanding team composition as determined, to one of team composition as self-determined (Harrison & Humphrey, 2010). This view is reflected in large-scale investigations of teams who come together in the creative industries (e.g., Broadway musical teams) and those who come together to tackle scientific problems (Guimera, Uzzi, Spiro, & Amaral, 2005; Jones, Wuchty, & Uzzi, 2008). Studies of team self-organization view team composition as self-determined, and explore the natural processes that unfold within team ecosystems to determine the size and diversity of the team. Findings reveal that, over time within ecosystems such as Broadway performers or scientific disciplines, teams naturally evolve toward and settle on an optimal size that is large enough to provide ample expertise and specialization, but not so large as to become unmanageable. Teams also self-determine their diversity, and how they do this affects their ultimate success or failure – teams that include newcomers tend to outperform teams of people that habitually regroup with one another (Guimera et al., 2005; Jones et al., 2008; Nijstad, Berger-Selman, & De Dreu, 2014).

This work reflecting the organizing in teams perspective has clear implications for investigations of team inputs such as composition and diversity. There is no doubt that many organizational teams exhibit significant agency in shaping who's on the team. Guimera et al. and Jones et al.'s work, and other recent conceptual work (Harrison & Humphrey, 2010), point to the importance of understanding self-determined team inputs. One future direction for this genre is to uncover the mechanisms that explain these effects, i.e., how do newcomers change the dynamics within teams (Chen, 2005; Choi & Levine, 2004)?

A recent study of organizing in teams starts to do this, finding scientific teams are more likely than solo authors to insert novel combinations of citations into their papers, and that this combination of conventionality combined with atypical combinations of citations ultimately increases the chances the team's paper will be highly cited (Uzzi, Mukherjee, Stringer, & Jones, 2013). More investigations like Uzzi and his colleagues' that uncover the underlying mechanisms of team performance are essential to advance a science of organizing in teams. This is where research conducted within the teams in organizations tradition proves useful. As we review in the following section, research on teams in organizations includes a well developed conceptual framework for understanding the processes and properties that characterize the mechanisms of teams.

A new theoretical advancement gets right to the issue of understanding this team self-determinacy and its mechanisms for team effectiveness. This area, dubbed *team assembly* explores the agency individuals have in deciding who to work with on what (Contractor, 2013; Zhu, Huang, & Contractor, 2013). Self-assembled teams come together of their own accord. They not only choose who to work with but also determine the size of the team as well as the team's goals, interdependencies, and lifespan. Self-assembled teams experience greater initial cohesiveness (Strong & Anderson, 1990), greater satisfaction (Bacon, Stewart, & Silver, 1999; Chapman, Meuter, Toy, & Wright, 2006), and fewer logistical concerns (Bacon, Stewart, & Anderson, 2001) than individuals with less agency in making teammate selections. However, these

experiential benefits may come at a significant cost: self-assembled teams tend to be less heterogeneous (Bacon et al., 1999; Butterfield & Bailey, 1996), report more conflict (Chapman et al., 2006), be more prone to groupthink (Bacon et al., 1999), and perform more poorly (Butterfield & Bailey, 1996; Chapman et al., 2006) than typical deliberately designed teams.

Team self-assembly is the dominant mode of team formation in environments like GitHub and Wikipedia. Even in an environment like CERN, team assembly plays out as scientists chose one another either directly or because they gravitate toward common interests. The context of self-assembling teams stands in stark contrast to the manager-assembled teams studied in the teams in organizations perspective. Furthermore, the idea underlying team assembly challenges IPO and IMOI models by positing dynamics that occurring well *before* traditionally studied team inputs are of great importance to subsequent processes and outcomes. Questions about team assembly seek to understand the natural organizing processes that explain teammate attraction: who comes together and why? and what effects do the mechanisms of team assembly have on team functioning?

As these examples illustrate, there are clear signs, visible in the types of research questions being asked, that show research on team inputs is shifting toward an organizing in teams vantage point. Table 16.3 presents a summary of some exemplar questions that signal this shift, along with a tagging of the definitional features of teams exemplified in the article. Harrison and Humphrey's (2010) conceptual paper explores the chicken–egg argument surrounding tasks and work groups; should tasks or work teams be specified first, and in what ways should the input that takes precedence be allowed to impact the input that does not? The authors address team formation from a number of different angles, discussing seldom-mentioned topics such as rolling team membership. Similarly, Mariotti and Delbridge's (2012) research veers from the traditional team formation literature. The authors find a host of complex relational structures – such as redundant, latent, and 'potential' relationships – impact work group composition. Haas (2010) directly investigates emergent, dynamic role structures in a sample of self-managing teams from a multinational organization. Finally, Guimera et al. (2005) studied team size from a multifaceted perspective, emphasizing maximum rather than minimum team size, and viewing size as self-determined by the team.

## *Team Mediators: Team Processes and Emergent States*

In models of team effectiveness, mediators refer to the linkages between team inputs and outputs. Often, mediators constitute *emergent team phenomena* – constructs that originate at lower levels of analysis (e.g., within psychological characteristics of or interactions among team members), but over time, come to characterize the team as a whole (Kozlowski & Klein, 2000; Morgeson & Hofmann, 1999; Kozlowski, Chao, Grand, Braun, & Kuljanin, 2013). Commonly studied emergent mechanisms include team behavioral processes, affective and motivational team states, and team cognition.

The shift from teams in organizations to organizing in teams is less evident in the study of mediators than it is in the study of inputs like team composition and especially team assembly. We review this 'team process' literature with an eye toward how these mechanisms of teamwork could feature more prominently in investigations of teams conducted *outside* of I/O and OB research. In fact, much of the research on teams outside of those disciplines tends to focus only on inputs and outcomes with little, if any, attention paid to the rigorous theory and measurement of team dynamics apparent in Psychology and OB. This is an area where prior teams in organizations research has

**Table 16.3 Questions about team inputs that reflect an organizing in teams perspective**

| *Authors (Year)* | *Research question* | *Definitional features* |
|---|---|---|
| Harrison & Humphrey (2010) | Which input should take precedence: work group composition or task design? | Formation |
| Mariotti & Delbridge (2012) | How do redundant, latent, and potential relationships impact work group composition? | Formation |
| Haas (2010) | Do self-managing teams with high autonomy perform effectively? | Role specialization |
| Guimera, Uzzi, Spiro, & Amaral (2005) | How do changes in the size of a team over time impact performance? | Size, formation |

much to offer within the new organizing in teams perspective.

### *Team processes*

Team behavioral processes reflect 'what teams do' (Kozlowski & Ilgen, 2006, p. 95) and are the basic mechanisms that explain how members combine their skills and expertise towards the accomplishment of team objectives (Cohen & Bailey, 1997). Understanding processes is the chief avenue through which researchers can elucidate why and how teams accomplish certain outcomes (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008; Marks et al., 2001; Hülsheger, Anderson, & Salgado, 2009; Kozlowski & Ilgen, 2006; Mathieu et al., 2008). Research in the area of team process is advancing on a number of fronts: multilevel, time, structure, and materiality. We briefly review these advancements, not because they necessarily reflect an organizing in teams perspective, but because they reflect the rigor and sophistication of conceptualizing team process that could prove valuable in future work on organizing in teams.

The first advancement in work on team process is the reincorporation of the individual and the context into *multilevel* models of team processes. Teams reflect a meso level of inquiry (Mathieu, Maynard, Taylor, Gilson, & Ruddy, 2007), and explaining them requires at least some recognition that individual thoughts, feelings, and actions are the building blocks from which many team level processes regularize and emerge (Kozlowski et al., 2013). This view was central in the era of small group research (Emery & Trist, 1960; Katz & Kahn, 1966), though subsequent work on teams in I/O has tended to focus on both theory and measurement exclusively at the team level. Recent work is again using increasing multilevel frameworks as a way to bracket team phenomenon (Kozlowski & Klein, 2000; Hackman, 2003; Schraub et al., 2014) to look at teams and their drivers one level up (i.e., rooted in contextual-level phenomena) and one level down (i.e., rooted in individual-level phenomena). Bracketing across the individual- and team-levels is common in I/O and OB. For example, Chen, Kanfer, DeShon, Mathieu, and Kozlowski (2009) tested a multilevel model of motivation and performance in teams, showing the quality of team interactions affects individual motivation to work for the team; and team action processes affect how hard and how effectively individuals work to achieve their goals. Bracketing of the team and contextual levels is less common (Hackman, 2003), but the literatures on multiteam systems (see Mathieu, Luciano, & DeChurch, this volume) and team boundary spanning (Joshi, Pandey, & Han, 2009) represent two notable departures where teams are being studied in context.

A second advancement in work on team process is greater attention to the role of *time in team functioning* (e.g., Humphrey & Aime, 2014). Time is a centerpiece in two dominant perspectives of teams: developmental and episodic (Mathieu, et al., 2008). The former perspective considers how teams mature over time as they approach impending deadlines (Gersick, 1988) or become more skilled in conducting taskwork and teamwork (Kozlowski, Gully, Nason, & Smith, 1999). The latter perspective examines the task-driven cycles teams experience as they work together (e.g. Marks et al., 2001). Recent work in this domain has sought to examine when and why teams shift between transition and action behaviors and identify key moderating variables of the recurring phase model (Arman & Adair, 2012; Kennedy & McComb, 2014). Results suggest process team interventions that encourage teams to delay action processes can improve performance.

A third advancement in work on team process is greater attention to the role of *structural patterning*. Whereas the Marks et al. (2001) model classified the *content* of interactions needed for effective team functioning, Crawford and LePine (2013) suggest that the *pattern* of these interactions adds something more to our understanding of team functioning. Crawford and LePine's (2013) configural theory of team process posits that different patterns of processes – closure, centralization, and subgrouping – differentially impact team functioning.

A fourth advancement in work on team process is greater attention to the role of the *materiality* of team process which reflects the physical characteristics and the capabilities of a technology within which interactions occur (Orlikowski & Scott, 2008; Leonardi & Barley, 2008). This work emphasizes the inextricable linkage between the social (human-centric forces) and material (technology-centric forces) aspects of teamwork. Hence the sociomaterial perspective is one wherein technology, or its materiality (e.g. Leonardi, 2011), is conceptually integrated into the very notion of team process (e.g. Orlikowski, 2009; Cramton, 2001; Hinds & Mortensen, 2005; Hakonen & Lipponen, 2008; Kirkman & Mathieu, 2005).

Whereas these advancements in team process research are relevant to future work on organizing in teams, there are also some recent investigations of team processes that mark the changing vantage point. Table 16.4 summarizes some research questions that suggest an organizing in teams perspective, and the ways in which they define the team phenomenon somewhat differently than is

**Table 16.4 Questions about team process that reflect an organizing in teams perspective**

| *Authors (Year)* | *Research question* | *Definitional features* |
|---|---|---|
| Summers, Humphrey, & Ferris (2012) | How does team member role change affect team coordination? | Role specialization |
| Kalliamvakou, Damian, Singer, & German (2014) | What are the mechanisms of efficient coordination in self-organized, virtual collectives? | Collaborative interactions |
| Keegan, Gergle, & Contractor (2013) | Does collaboration structure differ in self-assembled teams operating under threat and time pressures compared to those that are not? | Formation |
| Hoda, Noble, & Marshall (2010) | What role structures enable efficient coordination in self-organizing teams? | Role specialization |

customary in the literature on teams in organizations. For example, Summers, Humphrey and Ferris (2012) find dynamic role structures can lead to high levels of flux in team coordination. Their central assertion is that team membership is fluid, and as such, so are the patterns of collaboration in many modern teams. Further emphasis on the perspective of organizing in teams can be found in the work of Kalliamvakou et al. (2014). Findings from their qualitative analysis of GitHub teams revealed that members predominantly work independently, while relying on self-organization to coordinate work when necessary. A defining feature of these teams was the lack of a predetermined task structure; rather, they relied on a self-determined pattern of interdependence to accomplish teamwork. Additional work embodies the organizing in teams' perspective by examining the coordination dynamics of online communities that come together to serve an overarching purpose, but do not possess a clearly defined goal in the traditional sense. For instance, Keegan, Gergle and Contractor (2013) examined the coordination dynamics of self-assembled groups of Wikipedia collaborators, and found that breaking article groups exhibit similar coordination patterns over time to that of non-breaking article groups. Lastly, an additional marker of the organizing in teams perspective can be found in the work of Hoda, Noble and Marshall (2010). Their perspective on informal role structure emphasizes the emergent nature of collective interaction as a defining characteristic of self-organizing software teams.

The conceptual foundation for team process is well established empirically (LePine et al., 2008), and multiple promising avenues for future research have arisen aimed to account for the increasingly complex nature of modern teamwork. Whereas much of the research on mechanisms of teamwork focuses on these behavioral interactions, research also explores two broad classes of emergent states, affective and cognitive.

### *Affective/motivational emergent states*

Affective and motivational team states are emergent team properties originating in members' motives, emotions, or attachment to the team. These properties include team cohesion, collective efficacy, affect, mood, and emotion, and team conflict, and each has important implications for team functioning. As a set, affective and motivational properties of teams are some of the most robust predictors of team viability and performance (c.f., Beal, Cohen, Burke, & McLendon, 2003; DeChurch, Mesmer-Magnus, & Doty, 2013; Stajkovic, Lee, & Nyberg, 2009), and so greater integration of them within the *organizing in teams* perspective is clearly warranted.

Team cohesion captures members' 'bonding to the team and its task' (Kozlowski & Ilgen, 2006, p. 87), and is related to team performance, specifically in highly interdependent tasks (Beal et al., 2003; Evans & Dion, 1991; Gully, Devine, & Whitney, 1995; Mullen & Copper, 1994). Collective efficacy refers to the confidence a team has in its ability to be effective (Bandura, 2000), and is also a strong predictor of team performance (Stajkovic et al., 2009). Recent work on efficacy has also uncovered some of its antecedents, revealing that leaders, managers, and even the composition of the team each play unique roles in shaping collective efficacy (Priesemuth, Schminke, Ambrose, & Folger, 2014; Wu, Tsui, & Kinicki, 2010; Zyphur, Narayanan, Koh, & Koh, 2009). Team affect, mood, and emotion capture a team's 'affective processes and reactions' (Kozlowski & Ilgen, 2006, p. 87), and are related to common team performance antecedents such as communication, group perceptions, and information sharing (Baysinger, Scherer, & LeBreton, 2014; Lehmann-Willenbrock & Allen, 2014; van Knippenberg, Kooij-de Bode, & van Ginkel, 2010). Finally, team conflict captures a team's 'fractures, frictions, and disagreements'

**Table 16.5 Questions about team affect that reflect an organizing in teams perspective**

| *Authors (Year)* | *Research question* | *Definitional features* |
|---|---|---|
| Dabbish, Stuart, Tsay, & Herbsleb (2012) | What is the value of transparency in distributed collaborations? | Collaborative interactions |
| Hogg, van Kinppenberg, & Rast (2012) | How do leaders in intergroup collaborative contexts develop members' intergroup relational identities and encourage collective performance? | Common purpose |
| Bunderson & Boumgarden (2010) | How does team self-management influence team conflict? | Role specialization |
| Arazy, Nov, Patterson, & Yeo (2011) | How does the mix of content and administrative team members affect team performance? | Formation; Role specialization |

(Kozlowski & Ilgen, 2006, p. 87), and has important implications for both team performance and satisfaction (DeChurch et al., 2013; De Dreu & Weingart, 2003; de Wit, Greer, & Jehn, 2012).

Research on team affect shows some signs of moving toward the organizing in teams perspective; Table 16.5 shows some exemplar studies that reflect this new orientation. For example, Dabbish et al. (2012) found that acting in ways that promoted transparency helped online teams streamline their coordination. Their view of transparency emphasizes that teams shape their own interdependence. Recent research also highlights the agency of teams, particularly team leaders, in creating a sense of purpose. In their theory of intergroup leadership, Hogg, Van Knippenberg and Rast (2012) explain the process through which leaders communicate in ways that activate an intergroup relational identity between interdependent groups. Another marker of the organizing in teams approach shows up in a question posed by Bunderson and Boumgarden (2010), who considered how self-management affects the experience of conflict. Their work explicitly recognizes that role structures can be team-determined. Lastly, Arazy, Nov, Patterson and Yeo (2011) examined the effects of how a team organizes itself on team performance; finding teams need to maintain a balance of content and administrative team members.

### *Team cognition*

Team cognition is another robust predictor of team performance (DeChurch & Mesmer-Magnus, 2010b; Mohammed et al., 2010). Team cognition characterizes the patterns of team members' team- and task-related thoughts, beliefs and expectations (Klimoski & Mohammed, 1994). Two commonly investigated constructs in the team cognition literature are team mental models (TMMs) and team transactive memory systems (TMS). Whereas TMMs are 'organized mental representations of the key elements within a team's relevant environment that are shared across team members' (Mohammed et al., 2010, p. 877), TMS refers to the set of information possessed by each member of a group combined with a shared awareness of who knows what within the group (Wegner, Giuliano, & Hertel, 1985; Lewis, 2003). Greater attention to team cognitive processes are also a priority for future works on organizing in teams.

Research on team cognition shows some signs of moving toward the organizing in teams perspective. Table 16.6 displays exemplar studies that signal this new orientation. Research on team cognition has started to consider the agency teams have regarding with whom to work (i.e., formation) in their formulations of cognitive constructs. For example, Lewis, Belliveau, Herndon and Keller (2007) consider how team membership changes can degrade TMS and impede the transfer of information within the team. Mortenson (2014) also grapples with the issue of team formation and boundaries directly, introducing the concept of a membership model to characterize individuals' mental representations of who is and is not a team member.

Research on team cognition is also dealing with the issue of emergent, dynamic *cognitive* role structures in teams. For example, Mell, van Knippenberg, and van Ginkel (2014) investigated differing structures of TMS (centralized vs decentralized) in decision-making teams, finding teams need to communicate their evolving roles to help others gain an understanding of the knowledge retrieval process. Similarly, Pearsall, Ellis and Bell (2010) found role identification behaviors contribute to the formation of TMMs and TMSs.

## *Team Outputs*

At the end of the day, researchers and practitioners alike are interested in predicting outcomes of collaboration. Despite this objective, more attention

**Table 16.6 Questions about team cognition that reflect an organizing in teams perspective**

| *Authors (Year)* | *Research question* | *Definitional features* |
|---|---|---|
| Lewis, Belliveau, Herndon, & Keller (2007) | How does team membership change affect transactive memory and information exchange? | Formation |
| Mortenson (2014) | How does membership model divergence affect team performance? | Formation |
| Mell, van Knippenberg, & van Ginkel (2014) | How does TMS structure impact team transactive retrieval processes and decision making? | Role specialization, Collaborative interactions |
| Pearsall, Ellis, & Bell (2010) | How do role identification behaviors foster team cognition? | Role specialization |

has been spent on questions of *who* and *how* and less attention on understanding the end results (Mathieu et al., 2008). The result is a large body of literature with vast differences in how team 'effectiveness' is operationalized. For example, team success is variously defined across industries (e.g., health care teams use objective measures such as patient health and mortality; West et al., 2002; scientific and product development teams use innovation; De Dreu & West, 2001; Hülsheger et al., 2009; customer service teams use ratings of customer satisfaction; Gilson, Mathieu, Shalley, & Ruddy, 2005; Kirkman, Rosen, Tesluk, & Gibson, 2004). As we transition to research on organizing in teams, performance metrics should be designed so they are conceptually related to the function and tasks of the teams being studied, sensitive enough to capture the important aspects of performance rather than global assessments, and rely on a formally articulated combination algorithm such as that employed in balanced scorecard techniques (Mathieu et al., 2008). Another caveat with team performance measurement is that team self-report should be avoided as a way to operationalize team performance. Numerous meta-analyses of team construct relations find team self-report operates differently than either supervisor ratings or objective metrics of team performance (e.g., Hulsheger et al., 2009; Mesmer-Magnus & DeChurch, 2009).

Furthermore, although IPO frameworks tend to broadly define team outcomes as performance or affective reactions (e.g., such as viability or satisfaction; Mathieu et al. 2008), other outcomes may be of relevance as we shift toward an organizing in teams perspective. In Table 16.7 we present some examples of how team performance has been operationalized in the literature. These typically involve either objective or subjective indicators of the degree of team goal accomplishment. But as we broaden our conception of the team, the relevant criterion space expands. For example, team adaptability may be the best marker of effectiveness for teams that frequently encounter novel and complex environments (Baard et al., 2014) and may be increasingly important as we transition to studying when, and how effectively individuals organize collectively. Having explored the ways in which the organizing in teams perspective is and can continue to shape theory on teams, we now consider data sources and analytics that are particularly valuable for exploring organizing in teams.

## *Leveraging New Data Sources and Analytics to Understand Organizing in Teams*

Rapid advancements in technology are changing the way people collaborate as well as the methodological approaches researchers use to understand these collaborations. In this final section, we consider new sources of data and increasingly prevalent analytic approaches that can be harnessed to understand the purposive collaborative interactions that constitute 'organizing in teams'.

### *New data sources*

To begin, research on organizing in teams can capitalize on *digital trace data* – records of activity gathered through virtual systems – to understand purposive collaborative interaction. Digital trace data offer many advantages for teams research. These data are often voluminous, automatically recorded, and readily available (Howison, Wiggins, & Crowston, 2011; Williams, Contractor, Poole, Srivastava, & Cai, 2011). Digital traces offer researchers a more precise window into real-world interactions. For example, users leave digital traces of their interactions as they engage with one another through social networking websites (e.g., Facebook, Twitter, LinkedIn), massively multiplayer online role-playing games (e.g., Sony's Everquest II), large-scale online collaborations (e.g., Wikipedia, GitHub), or other virtual communication tools (e.g., email, chat logs, 'smart' phones, video conferencing). By capturing the nature of interpersonal interactions

**Table 16.7 Objective and subjective operationalizations of team performance**

| *Authors (Year)* | *Operational definition* |
|---|---|
| Objective indicators | |
| Gilson, Mathieu, Shalley, & Ruddy (2005) | Team effectiveness: 'We used three archival measures gathered by the organization to track team effectiveness … Machine reliability was the average number of copies made by machines between service calls … Response time was the average length of time between a customer's call and the technician's (or technicians') arrival … Parts expense was the percentageof budget associated with replacing machine parts … three performance indexes collectively constituted an aggregate construct.' (p. 525) |
| Kirkman, Rosen, Tesluk, & Gibson (2004) | Team effectiveness: 'One independent component of the balanced scorecard was "process improvement," an assessment of reductions in cycle time for each team based on the number of days between an order for a travel reservation system and the effective operation of a system … process improvement was viewed as an objective assessment of team learning, or a team's ability to continually refine, processes and develop innovative solutions to shorten the cycle time needed to deliver and install reservation systems.' (p. 181) |
| West, Borrill, Dawson, Scully, Carter, Anelay, … & Waring, (2002) | Team performance: '…Six measures of health outcomes were obtained. These were deaths following emergency surgery, deaths following non-emergency surgery, deaths following admission for hip fractures, deaths following admission for heart attacks, re-admission rates and a mortality index.' (p. 12) |
| Subjective indicator | |
| De Dreu & West (2001) | Team innovation: 'Innovation was assessed through interviews with the team supervisors … Interviewers subsequently asked supervisors to indicate for each of the innovations they identified whether the innovation was primarily the result of (a) the entire team; (b) one individual team member; (c) outside sources, including other teams in the postal service; or (d) the supervisor himself or herself.' (p. 1194) |

at exceptionally high levels of resolution, researchers can observe indicators of emergent team phenomena (e.g., trust, cohesion) as these constructs manifest over time. As an example, Zhu, Kraut, and Kittur (2013) used a sample of approximately 182 million digital trace indicators of interaction to identify emergent leadership processes among collaborators on Wikipedia pages.

Teams researchers can also capitalize on *digital traces* obtained in more traditional laboratory-based or quasi-field study team settings. These settings continue to aid knowledge accumulation on teams by enabling causal inferences based on controlled experimentation. Furthermore, laboratories and quasi-field studies are particularly helpful in construct validating digital metrics against established scales and observer ratings. Laboratories also allow for the collection of technology-mediated automated observations that continuously measure individual behavior (e.g., physical location, active task work), information availability (e.g., sharing, utilization), and interpersonal processes (e.g., communication) without interruption to enable direct investigation of team dynamics. For example, Cooke and her colleagues (Cooke, Gorman, Myers, & Duran, 2013) used digital traces of communication in the lab to study team cognition as a 'dynamic flow of team interaction' (p. 266). A significant open question is the extent to which these digitally-derived metrics adequately capture the team behavioral, affective, and cognitive constructs described earlier. *At this point, rigorous construct validation studies based on triangulated data streams are critical to teams research.*

Another promising source of data stems from sensors. *Sociometric badges* (e.g., Kim, Chang, Holland, & Pentland, 2008) and *neural sensors* (e.g., Derks, Inzlicht, & Kang, 2008) collect large amounts of information about individual actions and interactions. Sociometric badges worn by study participants generate at least one-hundred data points per minute which can include information about participants' patterns of speech and body movement, tone of voice, spatial positioning, gestures, frequency of speech, or tendencies to listen or interrupt during conversation. Sociometric badges are useful for teams research in both lab and field settings. Using sociometric badges in field settings allows researchers a relatively unobtrusive window into team dynamics. Using sociometric badges in traditional laboratory studies provides researchers with rich high-resolution data in controlled settings. These badges represent a viable alternative to labor-intensive methods of studying teamwork such as hand-coding

of video or audio recordings. Prior laboratory-based studies of teams using sociometric badges demonstrate that teams whose members' engage in more evenly distributed communication patterns tend to be more effective (Pentland, 2012; Woolley, Chabris, Pentland, Hashmi, & Malone, 2010). *Neural sensors* record electrical potentials through the scalp and provide access to data on brain activity over time. Although not yet a widely used tool to understand teams, neural sensors can provide access to data on individual perspectives of social psychological phenomena through brain activity (Derks et al., 2008), and can shed light on constructs such as team identity, team affect, and other team attitudes.

Scientists are also developing new IT-enabled platforms designed to enable data collection by providing a virtual space for participants to interact and engage. For example, *Volunteer Science* (Volunteer Science, n.d.) is an online data collection laboratory that allows researchers to bypass the cost and time involved in collecting social science data. Researchers conduct their experiments on the site and benefit from a large pool of study participants from around the world. For an experiment involving teams, participants select the research in which they wish to participate, and are placed in a waiting room while others join.

*The MyDreamTeam Builder* ('My Dream Team Assembler', n.d.) is another example of an IT-enabled platform being used to understand organizing in teams. This recommender system helps individuals self-assemble into teams. Users begin by completing some background measures (e.g., personality, expertise, values, social networks), before creating queries to identify their 'Dream Team'. The builder provides recommendations as well as an interface for users to send and receive invitations to join teams. To date, The MyDreamTeam Builder has been used to build teams in university classrooms and real-world organizations. Initial findings from a sample of 95 university students shows that teams who exercised their agency by using the builder to choose teammates communicated more, had more confidence in their team, and expressed more balanced expectations of their team members, as compared to teams that were randomly assigned, or had less agency in team formation (DeChurch et al., 2013). Not only does this tool enable team self-assembly, researchers can use this tool to study team organizing processes in real-time.

## Data analytic approaches

Teams research in general, particularly through the lens of organizing in teams, is benefiting from the increased uptake of methodological advances including social network analysis, topic modeling and sentiment analysis, and computational modeling. In fact, many of the studies that have capitalized on the new sources of data just described are leveraging recent advances in network analysis, topic modeling, and sentiment analysis. We now consider how each of these analytic methods is currently advancing, and can continue to advance research on organizing in teams.

### Social network analysis

Social network analysis is a useful tool for understanding the structural aspects of teams (Crawford & LePine, 2013; Katz, Lazer, Arrow, & Contractor, 2005). Furthermore, many if not most questions about teams, how they form and interact, what drives their performance, are essentially questions about structure. Social network analysis relies on dyadic (i.e., relational) data, evaluating the properties (e.g., type, magnitude, direction) of social ties that exist among a set of nodes (e.g., people, teams, organizations, concepts; Borgatti & Foster, 2003; Wasserman & Faust, 1994; Slaughter, Yu, & Koehly, 2009). Although network analysis has a long tradition in group research (e.g., Bavelas, 1950; Bavelas & Barrett, 1951); these methods have only recently gained wide recognition in the teams literature (Slaughter et al., 2009). Social network methods are particularly well suited for revealing and predicting the many types of relationships that characterize *organizing in teams*.

Social network *descriptive indices* describe relational patterning across multiple levels of analysis including the dyad (e.g., reciprocity), triad (e.g., transitivity), subgroup (e.g., clustering), and group level (e.g., centralization, density; Wasserman & Faust, 1994; Hanneman & Riddle, 2005). These indices can be used to depict compilational (i.e., patterned) emergent phenomena in teams (Kozlowski & Klein, 2000) such as team processes (Crawford & LePine, 2013), transactive memory systems (Mell, van Knippenberg, van Ginkel, & Heughens, 2014), or leadership (Carter, DeChurch, Braun, & Contractor, 2015; DeRue, 2011). Networks research on teams demonstrates that differences in teams' relational patterns have meaningful implications for team performance (e.g., Drach-Zahavy, 2011; Granovetter, 2005; Henttonen, Johanson, & Janhonen, 2013; Oh, Labianca, & Chung, 2006; Sparrowe, Liden, Wayne, & Kraimer, 2001; Tröster, Mehra, & van Knippenberg, 2014). But beyond just characterizing structure, network methods can also be used to understand how these compilational emergent phenomena come about.

Recent advances in network analysis, *inferential models of network development*, go beyond

description. These include exponential random graph models (ERGM) or p* models (Lusher, Koskinen, & Robins, 2012), stochastic actor oriented models (Snijders, 2011; Snijders, van de Bunt, & Steglich, 2010), and relational event network methodologies (Butts, 2008; Leenders, DeChurch, & Contractor, 2015). These models allow teams researchers to understand the antecedent factors that give rise to patterns of relationships. For example Zhu, Huang and Contractor (2013) used ERGM/p* models to investigate the team self-assembly mechanisms of ad hoc project teams. Their results showed that individuals tend to join ad hoc teams to complete short duration, difficult projects and tend to choose teammates with complementary skills as well as similar age, skill level, and/or organizational affiliation.

Research using network approaches to teams generally explores three sets of questions, each of which positions networks at different places in the IMOI model. A first set of questions probe the ways in which social networks, such as friendship and advice networks, affect aspects of team functioning and effectiveness. These studies use social networks as team inputs examining either I→M or I→O relationships. For example, a recent study found that the density of team instrumental ties (i.e., relationships developed for exchanging work-related resources such as knowledge, expertise, advice) shapes members' cognitive perceptions of the team's procedural justice climate (Roberson & Williamson, 2012).

A second set of questions explores how the social networks within teams come about. These studies use networks to represent team processes or emergent states, and examine I→M relationships. Liu, Hernandez and Wang (2013) used this approach in their investigation of the antecedents of structural patterns (centralization and density) of procedural justice (PJ) relationships in teams. This study showed that differentiation in leader–member-exchange (LMX; Graen & Uhl-Bien, 1995) relations affected intrateam trust which significantly influenced the centralization and density of within team procedural justice perceptions such that higher levels of LMX differentiation led to lower intrateam trust, more centralized and less dense PJ networks.

A third set of questions considers the network structures that promote team outcomes. These questions use network approaches to represent mediators such as team processes or emergent states, and examine M→O relationships. Bavelas and colleagues (1950, 1951) began this work in the 1950s by manipulating communication patterns, such as centralization, in five-person teams and identifying the network structure(s) that were most optimal for team performance. In a more recent study, Balkundi, Kilduff and Harrison (2011) showed that the centrality of a formal team leader in the team advice network drives followers' perceptions of the leader's charismatic leadership, which in turn, impacts team performance. Other recent studies show that a team's task (workflow) network structure and cultural diversity impact team potency and performance (Tröster et al., 2014), and certain structures (e.g., bonding ties within teams; bridging ties between teams) of social connections affect team identity and performance effectiveness (Henttonen et al., 2013).

Although social network methods have always been useful for understanding team phenomena, they are becoming increasingly relevant and useful to understanding teams as we orient toward organizing in teams. Not only has the team phenomenon evolved to require such methodologies, but network methods have made significant recent advancements allowing them to go well beyond describing teams or providing basic metrics to characterize aspects of teams.

### *Lexical analysis*

Groups and teams research, particularly within Communication and Social Psychology, has a long history of using lexical analysis to understand teams (e.g., Scholand, Tausczik, & Pennebaker, 2010). However, as described above in our examples of new sources of teams data, technology is increasing the extent to which collaborative interactions are more visible to teams researchers, making these methodologies increasingly valuable for teams research. Advancements in lexical-based techniques such as topic modeling and sentiment analysis can help researchers transition large tracts of digital trace communication data into analyzable representations of team phenomena.

Whereas *topic modeling* is a machine learning approach used to uncover the themes (i.e., content) in collections of text (Blei, 2012), *sentiment analysis* characterizes emotions present in language (Pang & Lee, 2008). Lexical-based approaches are often used in combination with social network analysis to determine both the content and structure of relationships among actors. For example, Li et al. (2011) used topic modeling in communication data from a large online community in order to detect the thematic structure of communication within and across different subgroups. Their approach detected the emergence, spread, and disappearance of topics over time.

Sentiment analysis, or opinion mining, is the computational treatment of subjective opinion and emotion in textual data (Pang & Lee, 2008).

Pennebaker and colleagues' linguistic inquiry and word count (LIWC) software (Pennebaker, Booth, & Francis, 2006; http://www.liwc.net/) is one example of a sentiment analysis program that can be harnessed to study organizing in teams. LIWC uses built-in dictionaries to classify words into dimensions, such as positive or negative emotion, and has been fruitfully applied in organizational research. For example, Huffaker (2010) used LIWC to analyze discussions in Google Groups in order to understand the language and social behaviors of leaders, finding that apart from their network centrality, leaders use affective, assertive, and diverse language to exert influence. In a second application of LIWC, Gilbert and Karahalios (2009) uncover intimacy words within Facebook exchanges in order to determine the tie strength between individuals. Although this work has intended implications in social media, gleaning the strength of relationships from textual information also has clear application to understanding relationships in teams.

### *Computational modeling*

Another set of advanced analytic techniques that are being increasingly applied to team phenomena are computer simulations. At present, there are two common uses of the phrase 'computer simulations' in teams research. First, the phrase is commonly used by teams researchers to describe interactive tasks that human teams complete with the aid of computers (Marks, 2000). Many laboratory studies of teams have been conducted with the aid of these simulated tasks, such as DDD (e.g., Hollenbeck et al., 2002), ACES (e.g., Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005), Longbow2 (e.g., Chen, Thomas, & Wallace, 2005), and SIMCity (e.g., Resick, Murase, Randall, & DeChurch, 2014). Here, the phrase 'computer simulations' is being used to describe a '*human-in-the-loop*' simulation – a task where humans interact with realistic models of tools and tasks (Manning, 2000). For this first meaning of computer simulation, the 'human-in-the-loop' term is preferable because it avoids confusion with the second type of computer simulations used in teams research. The second use of the phrase 'computer simulation' refers to a class of computational methods in which computer-simulated agents, or in the case of teams, computer simulated team members, behave according to programmed interaction rules (Hastie & Stasser, 2000; Ilgen & Hulin, 2000; Kozlowski et al., 2013; Vancouver, Putka, & Scherbaum, 2005).

In particular, agent-based modeling (ABM) is a computer simulation approach that affords insight into emergent behavior resulting from actions and interactions that occur within complex systems (Macy & Willer, 2002). In ABM, theories about human behavior and interaction are programmed into basic computational rules. ABM allows multiple, complex theories to be incorporated into a single model in order to understand the behavior that will result from multiple determinants. Moreover, this approach can be used to formally specify 'a set of rules or goals that guide the behavior of entities or "agents" of interest, *in dynamic interaction with other entities*' (Kozlowski et al., 2013, p. 14, italics in original). Thus, scholars have advanced ABM approaches as particularly useful for understanding social context in the area of networks (Harrison, Lin, Carroll, & Carley, 2007; Monge & Contractor, 2003; Palazzolo, Serb, She, Su, & Contractor, 2006) and teams (Ilgen & Hulin, 2000; Kozlowski et al., 2013).

ABM is particularly useful in the area of teams given the difficulty of obtaining rigorous, rich data on teams in context. Using models to first integrate theories, and then conduct '*virtual experiments*', allows teams research to economize subsequent 'human-in-the-loop' team experiments. Virtual experiments are computer simulations where a computational/agent based model is first used to generate observational data by 'playing out' some set of processes that are suggested by theory and translated into model equations. Then, initial conditions of focal variables in the model are varied, and resulting team variables measured.

The virtual experiment approach was applied by Sullivan, Lungeanu, DeChurch and Contractor (2015) to understand leadership emergence in multiteam systems. After building an agent based model based on existing leadership, team, and MTS research, Sullivan and her colleagues investigated how manipulating two aspects of MTS structure, the geographic dispersion and organizational membership of component teams, would affect the emergence of different leadership network configurations. An important qualifier is that the effects identified in computational models are always tentative and require evaluation in human teams. Sullivan and colleagues' virtual experiments resulted in a set of hypotheses about how the structure of component teams shapes the emergence of leadership; these hypotheses are ripe for evaluation in human-in-the-loop MTS studies.

Two additional applications of computational modeling to understand teams were artfully conducted by Kuljanin (2011) and Zhou (2014). In his dissertation, Kuljanin modeled the effects of team member task and social skills, and the structure of collaboration, to predict the degree to which teams efficiently utilize members' skills. A total of 216 experimental conditions were evaluated in 216,000 simulated teams. An interesting question

posed by Kuljanin: how does the structure of collaboration (e.g., fully connected, three-star, two-star, one-star) affect the likelihood that the team will work interdependently? Findings suggest that although members have the most connections to one another in the fully connected collaboration network, the probability of them working interdependently is actually the highest in the one-star network. The framing of this research question clearly reflects the collaborative interactions aspect of the organizing in teams perspective. In her dissertation, Zhou (2014) built a model of team leadership in order to integrate and evaluate multiple theories related to leader and team regulation. Zhou's model manipulates the team task structure, team composition, leader reactivity, and the magnitude and duration of environmental disturbances experienced by the team. She then ran the model to understand how different combinations of these factors would affect team leadership behavior. Her results showed that when teams experience either large or long disturbances, team leaders increase their task-contingent leader behavior, and these effects were stronger when the disturbance occurred closer to a team deadline.

Given the complexity of social interaction within teams, and the large number of existing theories that explain team functioning, using computer simulation approaches such as ABM can be extremely useful to integrate theory. These models are best used alongside observational and experimental studies of teams, so that model results can be validated on human teams.

## *Future Research Directions*

Our review highlights a number of questions for future research that will be important to better understanding the organizing in teams phenomenon. First, just as research in teams shifted from a focus on how groups affected members' thoughts, feelings, and actions to a focus on how patterns of interactions within teams affect performance, future research will need to shift further to consider how new contextual realities of the organizing in teams phenomenon affect team assembly, process, and performance. Given that teams are collaborating within and across organizational boundaries, what implications do such contextual dynamics have for team functioning (e.g., team identity)?

Another important direction for future research is to explore the implications of greater self-agency in team formation, process, and goal-orientation. The greater self-agency common to today's technology-enabled organizations affects how best to conceptualize and study team composition, size, dynamics, and member motivations. Related questions include: (1) Which team and task characteristics determine the maximum effective team size? and (2) What constitutes a common team goal? With regard to this second question, we argue teams today are more purposive than they are goal-directed as members often collectively determine the team's purpose and sub-goals rather than have these dictated by a manager.

Future research might also explore how what we know about leadership in teams may differ in an organizing in teams perspective. For example, a traditional assumption within teams research has been that leadership is typically a function on hierarchical designation or authority. However, we have begun to realize that within today's organizing in teams perspective, leadership is often a function of expertise and social capital rather than legitimate authority (Carter, DeChurch, Braun, & Contractor, 2015).

Our conceptualization of interdependence within teams will also need to shift. For example, traditionally interdependence has been a preset feature of the team's task. However, we now see interdependence as a more fluid concept wherein team members determine interdependence through their patterns of interactions, and this interdependence may shift as work evolves or as membership changes over time. On a related point, since patterns of interactions within teams are likely to shift over time as a function of changing membership, member expertise, or task demands, future research should examine the role of dynamic role structures on team coordination effectiveness.

New data sources and analytic strategies also give rise to new questions for research. For example, to what extent do these digitally-derived metrics adequately capture the team behavioral, affective, and cognitive constructs they are intended to capture? Rigorous construct validation studies based on triangulated data streams will be critical to teams research.

## *Practical Implications*

We also identify a number of practical implications associated with a shift to an organizing in teams perspective. First, the shift from other-determined to self-determined team composition has practical implications for both human resource compliance as well as team functioning. For example, self-determined teams set both the membership of the team as well as its diversity. Given individuals' natural preference for homophily, teams may be less diverse than would be desired

for EEO compliance. Similarly, as we mention above, self-determined teams tend to be more cohesive and satisfied and face fewer logistical concerns than teams with less agency when making team selections, but these teams are also more prone to groupthink, conflict, and unmet performance expectations, which raises implications for management of these teams.

Second, self-determined teams tend to have a shifting membership over time. Changing team membership will clearly have implications for the efficiency of team processes as well as the content of shared team cognition. This raises team management and training considerations as well as a need for future research to explore the extent to which changing membership can change and/or degrade team cognition and process.

Finally, an important practical implication for organizational leaders is that the organization's role within the organizing in teams phenomenon is significantly different from the role it played in the teams in organizations phenomenon. Leaders must appreciate the potential as well as the challenge of operating within and across, as well as without, organizational boundaries.

## CONCLUSION

We have covered a lot of ground in our chapter. We began by considering some novel organizational contexts within which individuals are teaming (Edmondson, 2012). These new contexts challenge the field to reconsider some of the defining aspects of teams such as the upper limit on size, the nature of collaboration objectives and interdependencies, and the agency with which teams form and collaborate. We then elaborated a view of organizing in teams, and contrasted it with the dominant paradigm of teams in organizations. Next, we considered examples of recent work conducted in each of the thematic areas: team inputs, behavioral processes, affective emergent states, cognitive emergent states, and outcomes, with an eye toward the unfolding shift in perspective we term, *organizing in teams*. Lastly, we considered some exemplars of new data sources and analytic approaches used to understand teams that have been both inspired and enabled by new forms of organizing.

*We hope this chapter invites a broader perspective on teams, effectively marking the transition from explaining the functioning of teams in organizations to understanding organizing in teams*. The knowledge base on teams has much to offer in the way of understanding the larger phenomenon of organizing in teams. Similarly, the phenomenon of organizing in teams poses many challenges to traditional approaches to team theory and empirical research. These challenges invite teams researchers to ask new questions using new sources of observations combined with advances in network and computational approaches.

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