Leadership in self-managing virtual teams

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Abstract

In this paper, we present a theory of leadership in self-managing virtual teams. We are particularly interested in self-managing virtual teams because self-management seems to be a common phenomenon in teams that interact primarily through information technology (so-called virtual teams). Building on leadership theory and structuration theory, the theory describes leadership as a process that results in the reinforcement, creation and evolution of ongoing structures and distinguishes between two types of leadership. We identify first-order leadership as leadership that works within and reinforces existing structures to elicit and guide group contributions. We define second-order leadership as behavior that effects changes in the structure that guides group action. We argue that second-order leadership is enabled by first-order leadership, is therefore action embedded, and is grounded in processes that define the social identity of the team. We propose that effective self-managing virtual teams will exhibit a paradoxical combination of shared, distributed first-order leadership complemented by strong, concentrated, and centralized second-order leadership. We conclude by presenting a set of research questions and suggestions for future research.

Keywords: self-managing teams, virtual teams, structuration theory, distributed leadership, behavioral leadership

Leadership in self-managing virtual teams

As organizations become increasingly knowledge-based and dependent on effective co-ordination of specialized knowledge for competitive advantage, teams are becoming a common means of organizing workers to accomplish tasks (Pearce & Manz, 2005). Teams and team–like structures now appear in many different settings, including fairly traditional, hierarchical contexts, as well as in new and evolving forms of organizing. Such teams exhibit a diverse range of purposes and working structures and increasingly exhibit high levels of both self-management and virtuality. By self-managing virtual teams, we mean work groups that have "responsibility and authority beyond that traditionally experienced by line workers" (Stewart & Manz, 1995) to execute, monitor and manage work processes, (Wageman, 2001) and that rely on mediating technology to support distributed interactions (Townsend, DeMarie, & Hendrickson, 1998). A brief list of teams that are high on both virtuality and self-management dimensions is surprisingly diverse: it includes open source software development teams, inter-organizational teams (e.g. vendor–customer teams), virtual scientific collaborations supported by cyber-infrastructure, virtual organizational communities of practice, distributed ad hoc task groups, and student teams that collaborate in distance learning contexts, to mention only a few (Saunders & Ahuya, 2007). The combination of virtuality and self-management creates a novel context for organizing that appears to have broad and growing utility.

In this paper, we focus on the nature of leadership in self-managing virtual teams. By leadership, we mean the "behavior of the individual when he [sic] is directing the activities of a group toward a shared goal" (Hemphill & Coons, 1957). The paper is motivated by a paradox that we have often noted in work with open-source software development teams and with virtual student teams. Effective self-managing virtual teams seem to exhibit a highly fluid, dynamic, emergent, and shared form of functional leadership when dealing with the essential work of the group. In other words, functional leadership appears widely decentralized. At the same time, successful teams seem to exhibit strong centralized leadership when it comes to establishing vi-

sion, mission, purpose, and strategic direction. They often include one or two strong leaders who implant distinctive approaches or structures for the team. This paper is an attempt to develop a theory of leadership in self-managing virtual teams that reconciles this paradox. Virtual teams are valuable to organizations because of their ability to bridge discontinuities of time and geography to enable access to and transfer of knowledge across geographic and organizational boundaries, thus leveraging human and intellectual capital (Duarte & Snyder, 2001). As organizations seek to maximize flexibility and responsiveness, the ability to quickly assemble teams with the expertise to solve immediate problems becomes paramount, so rather than moving people around physically, organizations increasingly deploy information and communication technologies (ICT) to assemble teams in a virtual space (Chudoba, Wynn, Lu, & Watson-Manheim, 2005; Lu, Watson-Manheim, Chudoba, & Wynn, 2006).

A recent review of leadership theory (Avolio, Walumbwa, & Weber, 2009) suggested research on virtual leadership as a future "growth area" for leadership research, as the nature of leadership in virtual teams seems likely to differ from conventional teams. In particular, some forms of virtual teams seem likely to rely more on self-management. Unlike conventional teams whose members work in relatively close proximity and thus interact regularly face-to-face, members of virtual teams are geographically and often organizationally or culturally separated (Watson-Manheim, Chudoba, & Crowston, 2002). Membership in such teams may be fluid, as individuals move in and out of the team depending on need, and individuals may be expected to contribute to multiple teams simultaneously (Chudoba *et al.*, 2005).

In some cases, virtual teams may lack appointed leaders altogether, being as a result formally self-managing and free to organize themselves as they see fit (e.g., when members are drawn from different units within a single organization, or even from different organizations, as in project teams that include vendors, consultants or subcontractors. In other cases, organizations may employ team self-management as a deliberate strategy to improve performance). Even when a team has appointed leaders, responsibility and decision-making can be delegated downward such that team members have a high level of autonomy in determining how to accomplish their

objectives. For example, managers may set general strategic directions, but leave day-to-day decisions about tasks and tactics to the team members. Stewart and Manz (1995) noted that giving team members autonomy to make decisions can increasing motivation and thus overall organizational performance, while Manz (1992) suggested that self-management can increase flexibility, a motivation for using virtual teams.

Alternately, self-management may be necessary because team members are not susceptible to hierarchical direction. For example, Howell et al. (1986) noted that teams of highly trained individuals would resist and in fact might not need hierarchical direction. A virtual team setting in particular seems likely to exacerbate difficulties for leadership. In the absence of face-to-face contact, appointed leaders may lack influence over team members due to organizational or physical separation. Kerr & Jermier (1978) described distance as a leadership neutralizer, while Howell et al. (1986) said that it makes leadership practices "nearly impossible to perform". These authors wrote before the extensive use of ICT for team interactions, but it is apparent that use of ICT does not completely ameliorate the problems of distance and separation. Hoegl et al. (2007) noted that leadership is less effective in dispersed groups. Team leaders often cannot directly observe member behavior or performance, which makes it difficult for them to manage task and social dynamics. Social interaction is reduced, making it difficult to moderate team process. Traditional forms of social control such as direct supervision, physical proximity and shared experiences are largely absent in virtual team environments (Pinsonneault & Caya, 2005). Opportunities to receive feedback are reduced, as are opportunities to assess perceived commitment to project or team goals (Konradt & Hoch, 2007). These effects of distance make traditional methods of leadership less effective, thus leading to self-managing teams as an alternative.

In summary, self-management seems to be growing more common, either as a deliberate design choice or as an adaptation to the growing variety of team settings, and to virtual team interaction in particular. However, the factors that give rise to different leadership structures in this novel context are not well understood. Where teams exhibit high levels of both virtuality and self-management, leadership dynamics are not explained by traditional theories that were largely

designed to explain interactions between subordinates and a single individual who occupies a formal, appointed managerial or supervisory position in a hierarchical organizational setting (House & Aditya, 1997).

The purpose of this paper is to develop a theory of leadership in the context of self-managing virtual teams. To do so, we integrate relevant leadership perspectives and structuration theory in order to develop a set of theoretical propositions about leadership in self-managing virtual teams. We draw on structuration theory because it provides a framework for conceptualizing influences on team members beyond formal authority structures. Secondarily, we attempt to identify those patterns of leadership that appear to be most effective in self-managing virtual teams. Thus, our paper provides a direction for future research by suggesting concepts and relationships that warrant further investigation. We conclude by describing directions for future research to test, refine, and extend our theory. The paper is primarily theoretical, but we illustrate our theory with several examples drawn from our work with open-source software development teams. Unless otherwise cited, these examples are drawn from field observations of open source software teams made by the first author and members of his research team over a seven-year period. The data from which these observations are drawn include interviews of open source team members, content analysis of electronically mediated interactions between developers, and analysis of technology support tool logs.

Literature Review

Structuration theory is used as a meta-theory to integrate three steams of literature into a theoretical framework that focuses explicitly on leadership dynamics in virtual teams. In this section, we review the three steams of literature on which we base our theory (1) the existing literature on virtual team leadership, (2) the literature on leadership in self-managing teams, (3) and shared leadership. The literature on leadership is voluminous, and as such, we necessarily focus our review on that subset of the literature most relevant to our theorizing; a recent article

by Avolio and colleagues (2009) provides more complete picture of the literature on team leadership. .

Leadership in Virtual Teams

The growing literature on virtual teams suggests that collaborating in virtual environments introduces discontinuities into the interactions of team members such that leadership in virtual settings differs from that in co-located organizational settings (Avolio et al., 2009; Bell & Kozlowski, 2002; Cascio & Shurygailo, 2003; Yoo & Alavi, 2004; Zigurs, 2003). Typically, leadership research, as well as investigations of leadership in virtual teams, has focused on the interaction between a single, appointed leader and other team members (Bass, 1990; Yukl, 2002). In contrast to this traditional leadership model, virtual teams may lack appointed leaders and take the form of self-organizing teams. However, even in instances in which leaders are appointed, traditional forms of social control such as direct monitoring, physical proximity, shared experiences, and imposition of rules and regulations are absent in virtual collaborative environments (Pinsonneault & Caya, 2007).

Theoretically, research on leadership in virtual teams has adopted theoretical frameworks developed to investigate leadership dynamics in co-located teams. Functional behavioral leadership theory has either implicitly or explicitly informed the majority of studies (Cogburn et al., 2002; Kayworth & Leidner, 2002; Misiolek & Heckman, 2005; Sarker et al., 2002; Sudweeks & Simoff, 2005; Tyran et al., 2003; Weisband, 2002; Yoo & Alavi, 2004). An examination of theoretical perspectives that either implicitly or explicitly were used to examine leadership in virtual teams indicates that the majority are behaviorally-based theories. In particular, the two-factor theory that underlies the functional theory of team leadership has been the predominant theoretical framework. Derived from Bales' (1950) work on small group dynamics, this theoretical perspective suggests that leaders engage in both task-oriented and relationship-oriented behaviors. Subsequent research on leadership in co-located teams guided by this perspective has focused on identifying those task- and relationship-oriented behaviors that distinguish leaders from non-

leaders in teams (Bass, 1990; Yukl, 2002). This analytic approach has also been adopted in studies of virtual team leadership based on this theoretical perspective.

Empirical research investigating leadership dynamics in virtual teams suggests that these teams evolve leadership structures that differ from conventional, single-leader, hierarchical structures, and that leadership dynamics differ in virtual teams (Balthazard, Waldman, Howell, & Atwater, 2004; Carte, Chidambaram, & Becker, 2006; Cogburn, Zhang, & Khothule, 2003; Connaughton & Daly, 2004; Guiri, Rullani, & Torrisi, 2008; Hoyt & Blaskovich, 2003; Kayworth & Leidner, 2002; Misiolek & Heckman, 2005; Nicholson, Sarker, & Sarker 2002; Pauleen, 2003, 2004; Pearce, Yoo, & Alavi, 2003; Piccoli & Ives, 2000; Piccoli, Powell, & Ives, 2004; Sarker et al., 2002; Sarker & Schneider, 2009; Sudweeks & Simoff, 2005; Tyran, Tyran, & Shepherd, 2003; Weisband, 2002; Wickham & Walther, 2007; Yoo & Alavi, 2004). Typically in these investigations, individuals are assigned to teams and required to complete a task that may range in duration from a week to several months. In some of these studies, a team member was appointed as the team leader at the outset. In others, no team member was appointed as the team leader. Once teams had completed their tasks, team members were asked to identify who the team's leader(s) had been. While some teams evolved a leadership structure in which a single team member emerged who was recognized by others as the team's leader, other teams evolved less centralized leadership, interaction, influence, and participation patterns. In the latter case, no single individual or core group of individuals was identified as the team leader(s). Even in studies in which a team member was appointed as the team's leader at the outset, individuals within the team other than the appointed leader were identified by other team members as having performed leadership roles (Kayworth & Leidner, 2002; Weisband, 2002).

In general, the literature on leadership in virtual teams suggests that leadership dynamics differ in fundamental ways in virtual teams:

- Leadership in virtual teams is *emergent*. Evidence from empirical studies of virtual team leadership suggests that, whether or not a leader is appointed, virtual teams *evolve* leadership structures based on the interactions of team members (Jarvenpaa & Leidner, 1999;

Kayworth & Leidner, 2002; Misiolek & Heckman, 2005; Weisband, 2002; Wickham & Walther, 2007; Yoo & Alavi, 2004). Berdahl and Craig (1996) note that team leaders emerge when "one of more members of a group composed initially of equal status peers (i.e., no appointed leaders) exhibits notably high levels of leadership behavior and thereby attains higher status in the eyes of fellow group members" (p. 22). In the absence of a formal or appointed leader, the literature suggests that different leadership structures evolve within virtual teams (Cogburn *et al.*, 2002; Misiolek & Heckman, 2005; Piccoli, Powell, & Ives, 2004). Some teams evolve a leadership structure in which one or two emergent leaders take the initiative to structure and guide the teams' work. Others evolve a more distributed structure in which the leadership of the team is shared by its members (e.g., Misiolek & Heckman, 2005; Yoo & Alavi, 2004). As was noted above, leaders emerge in the presence and in the absence of appointed virtual team leaders.

- Leadership attributions are *perceptual.* While status, power, or hierarchical position with an organization often are associated with leadership attributions in co-located teams, these cues are absent in virtual teams. The team leader (or leaders) are those individuals who are *perceived* by team members as having performed a leadership function within the team (Misiolek & Heckman, 2005; Sarker, Grewal, & Sarker, 2002; Weisband, 2002; Yoo &Alavi, 2004). While it is possible in co-located team environments to rely on external cues based on personal characteristics or interaction style on which to base leadership attributions, those cues are absent in virtual team environments. Instead, the literature suggests that leadership attributions are made on the basis of observed behaviors. Three of these behaviors have been consistently associated with being identified as a virtual team leader: quantity of communication, initiation of communication, and communication content (Jarvenpaa, Knoll, & Leidner, 1998; Jarvenpaa & Leidner, 1999; Misiolek & Heckman, 2005; Piccoli et al., 2004; Sudweeks & Simoff, 2005; Tyran et al., 2003; Yoo & Alavi, 2004).

- *Quantity of communication.* Findings from studies of distributed team dynamics suggest that emergent leaders communicate with team members more frequently than non-leaders (Jarvenpaa, Knoll, & Leidner, 1998; Jarvenpaa & Leidner, 1999; Misiolek & Heckman, 2005; Piccoli *et al.*, 2004; Sudweeks & Simoff, 2005; Yoo & Alavi, 2004). Two studies that examined message length found that emergent leaders send longer messages than non-leaders in terms of number of words per message (Sudweeks & Simoff, 2005; Yoo & Alavi, 2004).
- *Initiating behaviors.* While only two studies examined the relationship between emergent leadership and initiation of communication, both suggest that taking initiative is positively associated with being identified as an emergent leader (Tyran *et al.*, 2003; Yoo & A*lavi, 2*004). This finding applies to the initiation of communication at the outset of a team's task, as well as to initiating communication that keeps members focused on the task throughout the team's life (Piccoli *et al.*, 2004; Tyran *et al.,* 2003; Yoo & A*lavi, 2*004).
- *Communication content.* The literature suggests that although emergent leaders may engage in both more task- and relationship-oriented communication than non-leaders, only task-oriented communication is associated with being identified as an emergent leader (Misiolek & Heckman, 2005; Yoo & Alavi, 2004).

- *Task-based contributions* to the work of the team appear are the basis for leadership attributions on the part of team members in virtual teams. The reduction in social cues and in social interaction within virtual teams appears to shift the basis for leadership attributions to task-based competencies and contributions (Misiolek & Heckman, 2005; Yoo &Alavi, 2004). A study that explicitly focused on patterns of emergent leadership in virtual teams tentatively suggests that virtual teams may evolve either centralized or shared leadership structure depending on the contributions of team members to the process of completing a task as well as their contributions to the substance of the task (Misiolek & Heckman, 2005). This differs from what is proposed by traditional leadership theory, which suggests that team leaders manage both social- and task-based

gests that team leaders manage both social- and task-based interactions within teams (Yukl, 2002). Pescosolido (2002) and Hart and McLeod (2003) suggest that emergent leaders increase their task-oriented communication in order to reduce ambiguity, provide direction, and move the work of the team forward. This suggestion is in line with Jarvenpaa and colleagues' (1998; 1999) observations concerning the relationship between communication content and the team lifecycle which suggest that social exchanges establish "thick" relationships among virtual team members as long as social exchange does not detract from the team's task focus.

While the studies from which these conclusions are drawn are informative, they also share three significant limitations: (1) the teams studied remained stable throughout the short duration of the studies, (2) in most studies, the tasks were relatively short-term in nature, ranging from 2 to 15 weeks, and (3) the broad distinctions between task- and relationship-oriented communication may not capture more subtle leadership dynamics suggested by the literature.

With respect to the third of these limitations, in virtual teams where members make diverse knowledge contributions, Misiolek & Heckman (2005) found it useful to distinguish between two types of task roles, *task coordination* and *substantive task contribution*. Task coordination behaviors are those involved in organizing and directing the team's work (*e.g.,* scheduling, dividing labor, creating processes) while substantive task contributions are those that actually accomplish the team's work (*e.g.,* idea generation, evaluation, synthesis) Thus, leaders may exercise their influence by means of their substantive expertise as well as through their coordinating and directing activities. Finally, in addition to the task and leadership functions which leadership must satisfy, Ancona and Caldwell (1988) argued that there are also leadership functions involved with maintaining relations with individuals and groups outside the team, which they called *boundary spanning*.

Despite the limitations noted, this body of literature provides evidence that the basic assumptions about the nature of leaders underlying much of "traditional" leadership theory (e.g., trait and new leadership theory, contingency and situational leadership theories, social exchange

and strategic contingency theories, and leader-member exchange theories) are not applicable to virtual team leadership. Leadership emergence within teams has been the subject of inquiry within primarily four steams of "traditional" leadership theory: trait and new leadership theory, contingency and situational leadership theories, the literature on leadership in self-managing teams, the literature on shared leadership, and behavioral leadership theory. Only the latter three steams of literature implicitly or explicitly acknowledge that emergent leadership can take different forms such as centralized forms in which a single member emerges who is recognized by others as the team's leader, or less-centralized forms in which leadership is shared among team members, as suggested by the evidence on virtual team leadership. This is consistent with the literature on self-managing teams, as well as that subset of the leadership literature focusing on shared leadership. Further, the evidence suggests that the basis for leadership attributions lies in the observed behaviors of team members rather than in formal status within hierarchical organizational structures, reinforcing the notion that leadership in an inherently behaviorally-based phenomenon, as suggested by behavioral leadership theory as well. This suggests linkages to those three steams of literature, which we briefly review below as background to our own theorizing.

Leadership in Self-Managing Teams.

While emergent leadership has not itself been the focus of much of the empirical research or theorizing in the literature on self-managing teams, this literature has contributed directly to the conceptual development of the shared leadership perspective and raises issues that are central to our theorizing on leadership in self-managing teams (Pearce & Sims, 2000). Stewart and Manz (1995) define self-managing teams as "work groups that are formally organized into teams and then, as a whole, given responsibility and authority beyond that traditionally experienced by line worker" (p. 749). Self-managing teams are characterized "by a high degree of decision-making and autonomy and behavioral control at the work group level…. (such that) a much greater emphasis is placed on control from within rather than outside the group (Manz & Sims, 1987, p.

107). Although these definitions may appear to suggest that self-managing teams are "leaderless" in that formal leadership is absent, this is not necessarily the case. Self-managing teams range from teams embedded within formal organizational hierarchies in which a formal leader is appointed by upper-level management to serve as the team's "leader" who is not a regular member of the team to loosely configured groups of individuals who come together to discuss or solve some issue or problem of interest to the group as is frequently seen in community-based organizing or in open source software development initiatives. Therefore, self-management represents a continuum rather than a state.

Much of the empirical research in this area has focused on the conditions under which self-managing teams with designated team leaders (or managers) embedded within organizational hierarchies become fully self-managing (Druskat & Wheeler, 2003; Stewart & Manz, 1995; Stoker, 2007; Wageman, 2001). However, Pearce and Sims (2000) note that the literature on self-managing teams does recognize that team members can and do perform leadership roles that had previously been the performed by managers. Wageman (2001) notes that self-management is a behavioral process, in which self-managing teams are given the authority to execute work and to monitor and manage work processes, for both of which they are held accountable. Specification of team goals and objectives and team structure are assumed to be outside the domain of self-managing teams. Within this context, team effectiveness is considered to have three dimensions similar to those that have been investigated in the traditional leadership literature: (a) task performance, (b) group process, and (c) individual satisfaction (Wageman, 2001, p. 560).

However, the degree to which specification of team goals and objectives and determination of team structure are outside the domain of team members may be a function of the type of organizational context in which the teams are embedded. As technology facilitates the development of new means of interacting and organizing, the degree to which these domains are integrated within the scope of teams' domains may change. As represented on a continuum of self-management, self-managing virtual teams that interact exclusively in technology-mediated envi-

ronments may take responsibility for determining goals and objectives as well as structure. An example would be open source software development teams. External leadership may be non-existent, or in the presence of the discontinuities present in the virtual environment, may be ineffective in providing this type of direction.

Depending on the context in which teams members interact, the literature on self-managing teams suggests that the development of shared mental models may be a critical component affecting team process and outcomes. Druskat and Pescosolido (2002) argue that it is critical that self-managing work teams develop shared mental models, which they define as "cognitive theories about how the system operates that underlie behavioral team process" (p. 285). . These authors propose that some shared mental models are more appropriate than others in self-managing teams based on their review of published field studies in the literature. Specifically, they identify shared mental models of psychological ownership of team outcomes and processes that support continuous learning, and that promote heedful interaction as underlying success in terms of team process and outcomes. However, the authors also note that shared mental models of task and equipment may also influence teamwork, though these have not been examined in the literature.

Cohen and colleagues (1997) suggest that degree of team member involvement is the strongest predictor of team effectiveness, and that managerial, or supervisory, behaviors performed by formal, appointed team leaders are ineffective in self-managing teams. The implication of their findings is that a focus exclusively on external leadership may not adequately capture the team's internal and emergent leadership dynamics. Mathusamy and colleagues (2005) conceptual model of innovation dynamics in self-managing work teams suggests that the presence of self-leadership at the team level enhances innovative behavior, and consequently, team performance. Yang and Shao (1996) identify shared leadership as an outcome of effective self-management in teams. In research focusing on emergent leadership in self-managing virtual teams, Carte and colleagues (2006) suggest that the members of successful self-managing virtual teams exhibit a combination of shared individual and collective emergent leadership behaviors.

Specifically, higher performing teams engaged in significantly more concentrated behaviors oriented toward performance and more shared behaviors focused on process (i.e., keeping track of the team's work) than lower performing teams.

On the whole, the literature on self-managing teams reinforces the notion that leadership is both shared and emergent in these types of teams (Pearce & Manz, 2005). When external team leaders are appointed, their responsibilities are largely to facilitate (or mentor) rather than to direct the work of teams. The empirical findings also suggest that observed behaviors related to the process and the substance of the task are important factors related to team performance, as with virtual teams.

Shared Leadership.

Shared leadership is defined as:

> A dynamic, interactive process among individuals in groups for which the objective is to lead one another to the achievement of group or organizational goals or both… (that) often involves peer, or lateral, influence and at other times involved upward or downward hierarchical influence (Pearce & Conger, 2003b).

This perspective, similar to the notion of distributed leadership (Gronn, 2002), conceptuaizes leadership in terms of relational processes, shared phenomena occurring at different levels, and interdependencies among social networks or networks of influence (Fletcher & Kaufer, 2003). It differs from conventional leadership theory by conceptualizing leadership as a group-level rather than an individual-level phenomenon. Fletcher and Kaufer (2003) noted that in doing so it creates an important theoretical link between leadership research and research on teams that has been largely absent in prior work.

Shared leadership research suggests that it is unlikely that a "single multirole leader" will emerge. Decades of research on small-team interactions supports the notion that different individuals perform different leadership roles as circumstances warrant. For example, Houghton and colleagues (2003) observed that when the task-oriented and social supportive-oriented leadership roles in small teams have been examined empirically, these leadership roles are often split be-

tween two or more individuals. They attribute this outcome to the tensions created when one individual attempts to fulfill both roles, noting that "the directive or task-oriented leader often creates tension within the group through the assignment of tasks…(and) may not be in the best position to fill the social supportive role of solving or soothing the problems created by the task-related tension" (Houghton *et al.*, 2003). Alternately, the split may be due to differing levels of expertise. For example, Klein et al. (2006) described how attending surgeons, fellows and residents dynamically shared leadership in a trauma care unit, as the surgeons routinely stepped back to allow fellows and residents to assume leadership roles.

Empirically, shared leadership is relatively unexplored area of inquiry (Pearce & Conger, 2003b; Pearce, Manz, & Sims, 2009). The few empirical investigations that have investigated shared leadership have examined it in organizational settings in which both vertical and shared leadership were present. For example, in Klein et al.'s (2006) study of leadership in extreme action teams in an emergency medical center, attending surgeons formally outranked fellows and residents. Nevertheless, empirical research investigating the relationship between vertical and shared leadership and team effectiveness suggest that shared leadership is a useful predictor of performance (Ensley, Hmieleski, & Pearce, 2006; Pearce & Sims, 2002). Pearce and Sims (2002) investigated the relationship between vertical and shared leadership and effectiveness in 71 change management teams. Hierarchical regression analysis of the relative influence of vertical and shared leadership behaviors indicated that although vertical leadership explained a significant amount of the variance in self-ratings of team effectiveness, shared leadership behaviors accounted for more. Ensley and colleagues (2006) investigated the influence of shared versus vertical leadership in two samples of new venture top management teams on startup performance. Again, while both vertical and shared leadership were significant predictors of performance, shared leadership variables were found to account for a significant proportion of the variance in performance beyond that accounted for by vertical leadership alone in both samples.

In summary, the shared leadership perspective suggests that leadership is a group-level rather than an individual-level phenomenon. The behaviors enacted by individuals during team

interaction provide the basis for leadership attributions. Shared leadership retains the distinction between task-oriented and socially-oriented leadership posited by functional behavioral leadership theory. It also suggests that hierarchical/vertical and shared leadership are complementary, although higher performing teams exhibit greater shared leadership.

Summary.

In summary, the self-managing teams and shared leadership perspectives, and the results of empirical investigations of emergent leadership in virtual teams, demonstrate that leadership in teams can be both shared and emergent and that shared leadership is an important contributor to team effectiveness. Behavioral leadership theory provides additional insights into the classes of leadership behavior that leaders in these types of teams manifest. However, while behavioral leadership theory provides a framework for identifying classes of leadership behaviors, it falls short in explaining changes in leadership behaviors over time in response to changes in team composition and the environment. Nor have these studies explained how leadership behaviors enacted by individuals guide team interaction in these contexts, and how structures for task performance and team interaction emerge in conjunction with ongoing interaction. Understanding these dynamics is the motivation for our theorizing.

Conceptualizing the Dynamics of Leadership

To conceptualize the dynamic process by which individuals' actions can provide leadership in self-managing teams, we adopt a structurational perspective (Giddens, 1984). Numerous authors have used a structurational perspective to frame empirical analyses of team activities (e.g., Barley, 1986; DeSanctis & Jackson, 1994; Newman & Robey, 1992; Orlikowski, 1992; Walsham, 1993) and in particular, the development of virtual teams (e.g., Suprateek Sarker, Lau, & Sahay, 2001). We chose this framework because it provides a way to conceptualize how the leadership behaviors of one team member might shape the actions of others, even in the absence of traditional modes of authority, a key issue in our theorizing about leadership in self-managing virtual teams.

Structuration theory posits a recursive relation between team structure (defined as the rules and resources that influence, guide or justify individual action) and the actions of those that live within, and help to create and sustain, this structure. It is perhaps best described as a meta-theory: that is, rather than specifically describing particular factors of leadership or their relations, it describes the form that such a theory might take. Specifically, structuration theory suggests that a theory of leadership in self-managing virtual teams should consider structure and action in these teams and how the two are interrelated in different approaches to leadership.

In our work, we consider structure as comprising three kinds of rules and resources identified in prior work (Barley & Tolbert, 1997; Stein & Vandenbosch, 1996): (1) interpretive schema that create structures of signification, (2) authoritative and allocative resources that create structures of domination, and (3) norms and rules that create structures of legitimation. (It should be noted that this division into three kinds of structure is an analytic convenience: in practice, they are overlapping and mutually reinforcing.) Individual actions may be guided by this structure or may seek to change it, as will be discussed further below. For example, an individual team member may follow a set process for a task (an individual action) because that process is the accepted norm within the team (*i.e.*, because of a structure of legitimation).

Structure matters because the development of shared structure improves team performance if it enables more effective contributions by team members. In this way, effective structure may serve as a substitute for conventional leadership in the way that it guides individuals' actions towards desired group outcomes. It is not a question of the presence or absence of structure, but rather its nature and the degree of agreement among team members. For example, without common interpretive schema (a kind of shared structure), individuals from different teams or backgrounds may interpret tasks differently based on their backgrounds, making collaboration and communication difficult (Dougherty, 1992). In the absence of developed team norms, team members will draw on norms they have acquired in other settings to guide their actions, but these diverse norms may conflict. The tendency for individuals to interpret tasks according to their

own perspectives is exacerbated when working in a virtual environment, with its more varied individual settings and less opportunity for informal discussion and mutual observation.

We turn now to the question of how structure is developed and the role of leaders and leadership in this development. The key notion here is the "duality of structure", meaning that the structural properties of a social system are seen as both the means and the ends of the practices that constitute the social system. As Sarason (1995) explains, in structuration theory:

> The central idea is that human actors or agents are both enabled and constrained by structures, yet these structures are the result of previous actions by agents. Structural properties of a social system consist of the rules and resources that human agents use in their everyday interaction. These rules and resources mediate human action, while at the same time they are reaffirmed through being used by human actors or agents. (p. 48).

Simply put, by doing things, we create the way to do things (or as Askehave & Swales (2001) put it more poetically, "the wheels of life go round, and as they go round, they form ruts which channel the wheels of life"). For example, the norm of using a particular process for a task is not a given, but rather is itself the outcome of prior actions by team members. By following the norm, members reinforce its legitimacy ("we always do it this way"); by taking different actions (*e.g.*, skipping a step because it is seen to be too time-consuming or using a different approach because the accepted approach seems unable to deal with important problems), they undermine its legitimacy, perhaps eventually changing the norm. Indeed, as we will discuss, such behaviors may be deliberately chosen for their effects on structure.

Figure 1, adapted from Barley and Tolbert (1997), graphically summarizes the relation between institution (which the authors use synonymously with structure) and action, and how both evolve over time. In this figure, the two bold horizontal lines represent "the temporal extensions of Giddens' two realms of social structure: institutions and action," while the "vertical arrows represent institutional constraints on action" and the diagonal arrows, "maintenance or modification of the institution through action" (p.100). For example, the influence of a team norm on a member to use a particular work process is represented by a downwards vertical arrow, while reinforcement or changes to the norm due to actions is represented by an upwards

diagonal arrow. We use this model of action and structure as the basis for our theorizing about the nature of leadership in self-managing virtual teams.

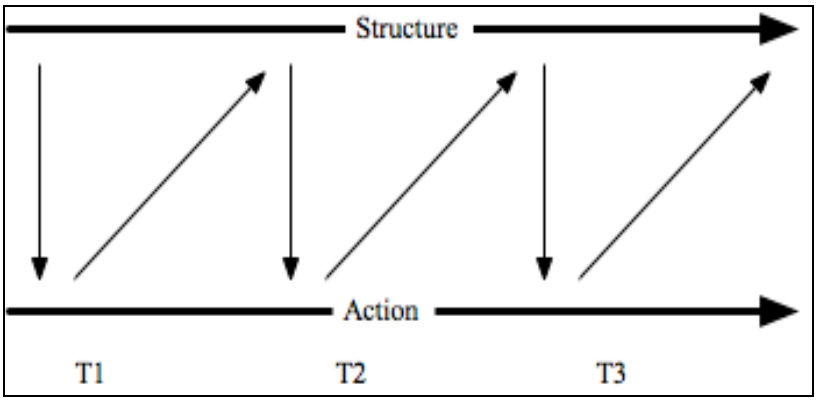

Figure 1. A sequential model of the relation between structure and action (from Barley & Tolbert, 1997).

A Structurational Perspective on Leadership in Self-managing Virtual Teams

In the following section, we develop an argument that leadership in self-managing virtual teams consists of behaviors that generate or reinforce structure (*i.e.*, the upwards diagonal arrows in Figure 1). To illustrate applications of our theory, we present brief examples of leadership in a particular self-managing virtual team context, namely free/libre open source software (FLOSS) development projects. FLOSS projects are prime examples of self-managing virtual teams. Developers contribute from around the world, meet face-to-face infrequently (sometimes not at all) and coordinate their activity primarily by means of computer-mediated communications (CMC) (Raymond, 1998; Wayner, 2000). FLOSS teams have several features that set them apart from virtual teams that have been studied in prior research. First, many (though by no means all) programmers contribute to projects as volunteers, without working for a common organization or being paid. Second, in addition to member contributions, non-member involvement plays an important role in the success of the teams. Users who are non-members or peripheral members contribute to the projects in multiple ways, and become a crucial resource of potential recruitment (Heckman, Li, & Xiao, 2006). Finally, the teams are largely self-managing, often without for-

mally appointed leaders or indications of rank or role. Though being a core developer can bestow some rights, including deciding what features should be integrated in the release of the software, when and how to empower other code maintainers, or to "pass the baton" to the next volunteer (Raymond, 1999), in comparison to traditional organizations, more people can share power and be involved in group activities. In many projects, anyone with enough interest and skills can access the code, contribute patches, make suggestions to the group and possibly influence important decision processes. Unless otherwise cited, these examples are drawn from field observations of open source software teams made by the first author and members of his research team over a seven-year period. The data from which these observations are drawn include interviews of open source team members, content analysis of electronically mediated interactions between developers, and analysis of technology support tool logs.

While it might first appear that a consideration of leadership would be relevant primarily to an understanding of structures of domination, we propose that leadership in self-managing virtual teams is expressed through all three systems of structure: signification, domination and legitimation. Indeed, leaders may lack formal control over authoritative and allocative resources that produce structures of domination. Instead, as suggested by the combination of functional behavioral leadership theory and structuration theory reviewed above, we argue that a key role of emergent leadership in self-managing virtual teams is the development of the full range of structures that guide the actions of team members and overcome the challenges created by discontinuities. Howell et al. (1997) similarly suggest that organizational members can receive task guidance from numerous factors other than leaders, such as professional norms and standards while Kerr and Jermier's (1978) substitutes for leadership theory suggested that an important task or organizational formalization might substitute for a leader. As an example of another modality of influence, in their study of shared leadership in a trauma center Klein et al. (2006) emphasized the importance of shared routines, traditions and values for governing interactions and the role of formal leaders in promulgating these values.

Example: Structures guide action. *Interviews with four developers affiliated with the highly successful Apache Lucene Java project suggest that shared structures can act as a substitute for conventional leadership in self-managing virtual teams. The interviews provide some evidence of these structures in action, helping members work in productive ways. One finding was the high degree of sharing of key definitions, such as project goals, users and challenges. For example, two senior members mentioned that the team does not have clearly stated goals, yet the community appears to work towards the same goals. As one of them put it, "It's really kind of a free flowing communal meeting of the minds". This sharing is also evident in the way all project committers identified the project goal in nearly identical terms, as developing a search library for developers who want to incorporate search into their applications. Only the more peripheral, non-committer member described the project as "information retrieval" project. All interviewees described the member selection process similarly, though at different levels of detail. The three members noted a strong norm most conversations use the public email list when "it comes to Lucene itself". This norm is consistent with the Apache rule that communication should involve the whole community in the group work. In summary then, the interviews provided evidence of shared structures that guided team member behavior in productive directions, even in the absence of direct vertical leadership.* This broader range of actions is the key element of our theorizing: while all leaders likely help create structure that guides the actions of team members, we suggest that leaders in self-managing virtual teams exert influence through all three modalities of structure. Thus we define leadership in this context as follows:

Definition. Leadership in self-managing virtual teams is a process that results in the reinforcement, creation and ongoing evolution of team structures that guide the actions of team members.

Based on this definition, we present three propositions that describe the specific aspects of the nature of leadership in self-managing virtual teams, followed by a discussion of directions for future study.

A two-order theory of leadership in self-managing virtual teams

If leadership in self-managing teams is a process that results in the reinforcement, creation and ongoing evolution of structures, how does this process operate? The structurational perspective suggests that some actions serve to reinforce existing structures, while others have the effect of modifying structures. We therefore discriminate between two orders of leadership: one that influences behavior while maintaining or reinforcing existing structures (first-order) and one that works by modifying team structures (second-order). First-order leadership is thus predominantly functional and operates within and reinforces existing structures. Second-order leadership is predominantly transformational, and operates to modify or transform structures. The distinction we draw between first-order and second-order leadership is intended to parallel the distinction between single-loop and double-loop learning as proposed by Argyris and Schön (1978), and the distinction between first-order and second-order change as described by Watzlawick, Weakland and Fisch (1974). Positing a distinction between first-order and second-order leadership raises the questions of what patterns of first-order and second-order leadership are likely to emerge in self-managing virtual teams, and of those, which are likely to be most successful? We address these questions next.

First-order leadership

We define first-order leadership as behaviors that influence other team members to make effective contributions to the team task, while working within and reinforcing existing structures of signification, domination and legitimation. (We discuss later how such structures might arise.) Functional theories of leadership have identified four classes of leadership behaviors that we view as associated with first-order leadership: (1) task coordination; (2) substantive task contribution; (3) group maintenance; and (4) boundary-spanning. Stewart and Manz (1995) provide a

similar list of leader behaviors for leaders to achieve the most significant long-term improvements from self-managing teams. These behaviors are especially important in self-managing teams in which, rather than working on tasks based on the direction of a manager, members often decide for themselves what they will do (and not do), based on discussion with other members and observation of what they are doing (and not doing). In the area of task coordination in open source software development teams, for example, self-assignment was the predominant mode by which division of labor was accomplished (Crowston, Wei, Li, Eseryel, & Howison, 2005). However, to be able to contribute effectively in such a setting, team members must share ideas about what is important to the team, what resources are available and to whom, and the kinds of actions that are appropriate or necessary, that is, they must draw on shared structures of signification, domination and legitimation. As leaders work in ways that also draw on these structures, they make them visible, reinforce them and by increasing their effect on the behavior of other members, improve the functioning of the team. We argue that these leadership behaviors provide first-order leadership when they work in the context of existing structures, drawing on them as resources to guide, legitimize, enable and give meaning to the behaviors.

How might first-order leadership be exhibited in a self-managing virtual team? Research has documented that different teams faced with similar contextual and task demands often evolve very different role and leadership structures, and work practices (Abdul Karim & Heckman, 2005; Brown & Eisenhardt, 1997; Misiolek & Heckman, 2005). For example, in one study, self-managing teams working on identical tasks within a controlled context developed very different leadership structures, some highly centralized with one or two strong leaders performing leadership behaviors, and others highly decentralized with leadership behaviors widely distributed, or shared, among team members (Misiolek & Heckman, 2005).

We propose that shared first-order leadership will lead to more effective self-managing virtual teams. Our rationale for doing so is three-fold. First, research on face-to-face teams (e.g., Bales, 1950; Yukl, 2002) suggests that the same individual is unlikely to perform all four functional leadership roles equally well. Second, teams that attempt to integrate diverse, specialized

knowledge workers may require many different kinds of first-order leadership in the form of substantive task contribution (Grant, 1996). Finally, we suggest that the presence of a leadership structure that incorporates both vertical and shared leadership implies the presence of distributed first-order leadership. Consistent with this view, in an empirical study, Taggar et al. (1999) found higher performance in groups where leaders and members both exhibit high levels of leadership. In short, the nature of work in self-managing virtual teams creates a pressure for shared first-order leadership. We thus offer the following proposition:

Proposition 1: First-order leadership can be either centralized or distributed, however, it is more likely to be fluid, distributed, emergent and widely shared in effective self-managing teams.

Example: Decision Making In Open Source Teams. *Decisions in open source teams can be divided into two categories: (1) decisions involving changes to the software product itself, and (2) decisions regarding higher order issues such as strategic direction, system platform, license structure, etc. When making decisions about changes to the software, first order leadership in effective teams is highly distributed and shared. Analysis of 360 decision episodes across six successful open source projects showed that such distributed decision making was efficient, fast, and occurred without lengthy discussion or recourse to hierarchical authority. Members independently chose which problems to work on (self-assignment), made changes to the code, and simply announced their decision to the team. This distributed method of allocating, controlling, and accomplishing work is in stark contrast to the hierarchical decision process seen in traditional software development organizations*

Second-order leadership

We define second-order leadership as behaviors that result in modifications to the structures of signification, domination and legitimation and thus the way that team members work. While first-order leadership influences team member behavior within the given constraints of

existing structures and thereby serves to reinforce them, second-order leadership effects change in the structures. Schriesheim et al. (1976) discussed in detail initiating structure as a key leadership dimension, including among other aspects such as defining and structuring work and encouraging a pleasant environment. Second-order leaders help other team members see make sense of the world in different ways and develop new norms of behavior and new patterns of authority to match changing needs. Foldy et al. (2008) discussed how a leader was able to help members of an organizational understand an important element of the organization's work and Taggar and Ellis (2007), how a leader was able to increase the norm of collaborative problem solving in a group, both examples of the development or modification of structures that guide group members' actions.

We next consider the pattern of second-order leadership. As with first-order leadership, we propose that self-managing virtual teams will evolve a variety of second-order leadership structures, but in the case of second-order leadership, we propose that a more centralized or concentrated form of leadership will be associated with effectiveness in the long run. That is, we propose that the most effective self-managing virtual teams will be characterized by a leadership structure that includes widely distributed and shared first-order leadership within the team, complemented by strong, centralized second-order leadership. We argue that centralized second-order leadership will be more effective because of the need for clarity and agreement among team members about the structure that governs and constrains their behavior. To be effective, teams must have a high degree of shared consensus about structures of signification, domination and legitimation. This is more likely to occur in teams that have strong leaders able to clearly articulate a vision of these structures that is broadly embraced by team members. Studies by Kayworth and Leidner (2002) and Piccoli et al. (2004) suggest that the most effective self-managing teams were those in which one or two team members took the initiative to clarify team members' responsibilities and work process structures. We thus offer the following proposition:

Proposition 2: Second-order leadership can be either centralized or distributed, however, it is more likely to be centralized in effective self-managing virtual teams.

Example: Central figure guides creation of structures. *The Apache Lucene Java interviews provide some evidence regarding the centralization of creation of structure in this highly effective project. Two senior interviewees mentioned that, "the project founder will always sort of be the head [leader] still". The project founder is not currently active in the project, yet two interviewees stated that, "his opinion carries a lot of weight in the community" in recognition of his past contributions. For example, interviewees mentioned a norm regarding community relationship: B stated the rule as, "we all try to be cordial with each other." He attributes this rule to the project founder since, "he brings a lot in this area". All four interviewees discussed the shared norm about the process of team decision-making. They point out "everybody has a say and right", so there is no person who always has the last word. However, two of the interviewees recognize the weight carried by the project founder. One interviewee stated, "he will let things play out by themselves a lot… since he doesn't want to influence things" and another described the founder's influence by stating "if he said 'no I don't think we should do that', then that would probably be the final world." In summary, the interviews suggest that the creation of the shared structures is centralized within the project.*

Relationship between first and second-order leadership

Whether second-order leadership is highly concentrated and centralized or widely distributed and shared, a fundamental question remains: How do those who are able to influence change in underlying team structures gain the power to do so (*i.e.*, why are some actions structure changing and others not)? We propose that the answer to this question lies in the nature of the interrelationship between first-order and second-order leadership. We suggest that second-order leadership is action embedded. By this we mean that second-order leadership derives its authority not from communication alone, but from substantive, action-oriented contribution that

provides evidence to other team members of the individual's abilities and thus ability to lead, and makes their attempts to alter structure credible and effective. Sarker et al. (2009) note the importance of substantive task contribution in particular to perceptions of leadership. We thus offer the following proposition:

Proposition 3: First-order leadership behavior, especially substantive task contribution, is a prerequisite for second-order leadership behavior. Members acquire "permission" to be second-order leaders by performing first-order leadership behaviors.

Example: Being seen as a leader depends on contribution. *The Apache Lucene Java interviews provide some evidence that being perceived as a leader in the project is related to the degree of contribution. First, selection as a core member of the group is clearly based on contributions. One interviewee mentioned a criteria of selecting members as "specialty in certain area, active for a while, submit good patches and responsible enough." He further identified the development skill as "knowledge in search, Java and know how open source works". Another interviewee mentioned the "litmus test" as "contributing high quality stuff, for a time period", as well as being "cordial to each other". He listed necessary skills as "Java, personality skill, specialty, know where to look in other parts of code, know how to ask, know what you know and don't know". Regarding the move from member to leader, the interviews again suggest a reliance on contribution. Consistent with our impression of the team as being self-managed with shared leadership, one interviewee (A) suggested that there are either no leaders at this time or multiple leaders. However, the interviewee also suggested that there might be leadership in certain parts of the project, as well as perhaps a leader from the overall organizational perspective, and acknowledged that he might be perceived as one of the leaders due to the work he did the previous year. In fact, another interviewee (B) also identified A as one of the two current leaders. According to these two interviewees, leadership is connected with sustained contribution. Interviewees mention the weight gain by actual contribution as well. Another developer commented that if somebody*

"does a significant amount of work" in certain areas, he will have more says in those parts, suggesting that perceptions of leadership are based on contributions to the group.

This proposition, about how individuals accumulate the authority to lead in self-managing virtual teams, conflicts with commonly accepted theories of power that equate power with the capacity to influence team members, and in which power derives from control of resources that are valued or desired by others. In this view, team members are dependent on resources controlled by the influencer for need satisfaction or goal achievement, and are therefore willing to grant power (Turner, 2005).

In contrast, our proposition is consistent with a social identity model of leadership and power (Reicher, Haslam, & Hopkins, 2005; Turner, 2005; van Knippenberg & Hogg, 2003), which reverses this causal sequence. The social identity model argues that it is psychological group formation that produces influence, and that power and control of resources derives from influence (Turner, 2005), which theoretically supports the action-embedded nature of second-order leadership we have observed. This model seems more appropriate for describing self-managing virtual teams, in which team members have more discretion over their contributions and control of resources and dependence may be problematic concepts. Indeed, in some cases, members may even be volunteers who are free to work as little or as much as they like on the team's projects, or to leave the team at any time.

Given our definition of second-order leadership and its relation to first-order leadership, we might ask if change in structures is incremental or discontinuous? Advocates of double-loop learning (Argyris & Schön, 1978) believe that change in underlying structures is only possible when teams have consciously reflected on conditions eliciting a need for change, have surfaced the team's deep assumptions and beliefs, and engaged team consensus for change. In effect, double loop learning theory requires that team members be consciously aware of team structures before they are able to change them, something we have suggested is an outcome of first-order leadership behaviors. Before changes in theory-in-use (*i.e.*, the tacit structures that govern behavior) are possible, members "…require external references. There must be public representations

of organizational theory-in-use to which individuals can refer…. These are the shared descriptions of the organization which individuals jointly construct and used to guide their own inquiry" (Argyris & Schön, 1978).

In contrast to this highly rational, discontinuous change model, we propose that the structural change influenced by second-order leadership may sometimes also result from a more incremental, subconscious process. For example, a team's role structure may gradually evolve as the overall task is divided into pieces suitable for different kinds of participants. The job of coordinating task assignment is an example of first-order leadership on a day-to-day basis, and much of this coordination will be distributed self-assignment (*i.e.,* individuals voluntarily taking on tasks for which they have particular skills or interest). But as the role structure evolves, second-order leadership will call attention to and clarify the newly emergent structure, and influence the team to embrace it. The process of consciously surfacing and describing underlying structures may not be necessary in virtual teams using information and communication technology to collaborate, because the transparent dialogues themselves, archived for subsequent viewing, become the external reference called for by Argyris and Schön (1978), the public representation of organizational theory in use to which individual members can refer.

Discussion

In this paper we have presented a theory of leadership in self-managing virtual teams, using an approach building on structuration theory and functional behavioral leadership theory. Because functional leadership theory does not fully explain the relationship between leadership and team change, we have expanded upon it to include the notion of second-order leadership, a form of leadership that influences changes in the structure that guides team behavior. We have proposed that effective self-managing virtual teams will exhibit a paradoxical combination of widely shared, distributed first-order leadership complemented by strong, concentrated, and centralized second-order leadership. Finally, we have proposed that second-order leadership is en-

abled by first-order leadership, is therefore action embedded, and is grounded in processes that define the social identity of the team.

In this paper, we have developed three propositions deductively from prior theory rather than inductively from systematic empirical observations. To support these propositions requires that they be systematically tested in future research. As well, the theory (like all theories) is only partial. Future research should extend the framework presented here by inductively exploring the antecedents, patterns and consequences of leadership in self-managing virtual teams.

We therefore conclude this paper by discussing several methodological issues and possible questions to guide future systematic inquiry. A variety of research approaches could be applied to study the processes of leadership in self-managing teams (Walsh, 1995). Use of interview data would enable exploration of the team members' perceptions of the leadership process and allow direct comparison between different members' perceptions of structures, thus explicitly examining how these are developed. On the other hand, content analysis of the interactions between members of self-managing virtual teams would enable detailed analysis of the influence process as it unfolds. Such analysis infers the deep structures and processes from informed examinations of the artifacts that these surface level dialogues provide. This approach has the advantage of avoiding reliance on the recollections of team members, which may degrade over time or be unreliable in other ways. Such research may be feasible in some cases. For example, many Internet-based collaborations maintain archives of their interactions that are publicly available and corporate virtual teams may have similar data that could be accessed. However, two guidelines for such research should be kept in mind. First, observations should be longitudinal and dynamic, carefully observing changes that occur over time. The phenomenon of leadership is inherently rooted in the passage of time and cannot be observed in a snapshot. Rather, it is a structurational process that can only be seen through a longitudinal lens. Second, the unit of coding and analysis in such research should be the episode. Leadership is fundamentally an interaction process between leaders and followers, and such interactions are best observed episodically.

To further develop and test this two-order theory of leadership in self-managing virtual teams, research is needed to address the following questions:

1. What are the dimensions of first-order leadership? Building on functional leadership theory, we have proposed that first-order, functional leadership consists of four classes of behavior: (1) coordination, (2) substantive task contribution, (3) group maintenance and (4) boundary-spanning. Future research should assess whether these four dimensions provide a relatively comprehensive description of first-order leadership, specifically investigating the behaviors and/or roles in which leaders engage in self-managing virtual teams.

2. What patterns of first-order leadership emerge in self-managing virtual teams? In previous research on leadership in virtual teams (Misiolek & Heckman, 2005), we observed that very different patterns of first-order leadership can exist in different teams. While we have discussed centralized versus decentralized leadership patterns, such a distinction may prove to be too simple to fully describe the leadership patterns that emerge in various types of self-managing teams. Future research should classify the first-order leadership patterns that emerge in order to develop valid and reliable operational definitions of centralized and decentralized patterns.

3. How do patterns of first-order leadership evolve over time? Leadership is not a static phenomenon. As teams grow and attract new members, lose existing members or face new environmental constraints, leadership patterns may change. For example, in a current study of FLOSS teams (Heckman, Crowston *et al.*, 2006), we observed growing levels of participation in decision-making in one project and declining levels of participation in another. A recent study of student project teams (Misiolek & Heckman, 2005) documented the fluid emergence and distribution of first order leadership behaviors as outside activities constrained the ability of individuals to participate at different times. A longitudinal research design will be necessary to systematically observe and understand such dynamic changes in leadership patterns.

4. What aspects of structure are most important to observe in order to understand second-order leadership, and what is the nature of this structure? We have described structures of signification, domination, and legitimation that exist in self-managing teams Again, the observa-

tion of various types of self-managing teams will allow us to inductively infer and classify these structures, better understand their nature, and their instantiation in actions.

5. How does second-order leadership influence change in team structures? Some scholars (e.g., Argyris & Schön, 1978) suggest that deep structures are best modified by a rational, discontinuous change process that includes discovery of hidden beliefs and assumptions (structures), followed by a consensus-based examination of and experimentation with potential new structures. Others suggest that the change process might be less rational and more emotional, less discontinuous and more incremental, and action-embedded rather than communication-driven. Schein (1987) noted that some of the most powerful mechanisms for embedding and reinforcing culture are based on leaders' actions—what they pay attention to, reward, sanction, and their reaction to critical incidents and crises.

6. How do second-order leaders gain influence? We have proposed that second-order leaders gain influence by virtue of their action-embedded first-order leadership contributions. We also suggested that this process is more consistent with the social identity model of power than with the traditional resource dependence models of power. These assertions require systematic testing that will best be accomplished through detailed longitudinal observations of numerous self-managing teams.

7. How do different patterns of leadership (both first-order and second-order) relate to team effectiveness? Once we have inductively classified the first- and second-order leadership patterns that emerge and have developed valid and reliable operational definitions of these patterns, we will be in position to test the proposition that the most effective self-managing virtual teams will exhibit decentralized first-order leadership and centralized second-order leadership. In order to do this we will need a measure of project effectiveness or success.

8. What are the boundaries to first- and second-order leadership? We have argued that first- and second-order leadership involve reliance on and changes to structure. However, structure maybe shared only imperfectly and so may present a boundary to the influence of this form of leadership. On the other hand, Kellogg et al. (2006) note that coordination does not require

equivalence or similarity of interpretations; rather, different teams can agree on "general procedures of exchange even while they may have different local interpretations of the objects being exchanged" (p. 39).

9. In which contexts will self-management via structure be effective? While we believe that the theory developed above applies to self-managing teams in general, we have drawn in particular on work on self-managing virtual teams. These teams are composed primarily, if not exclusively, of knowledge workers, meaning that our theory may not apply to other kinds of work. Future empirical work should investigate the limits of the applicability of this theory.

The theory and propositions we have developed represent an attempt to integrate and consolidate several previously developed theoretical perspectives on leadership and team dynamics in self-managing teams. We hope that this will provide a starting point for future research and thereby make a contribution to the study of self-managing teams.

Conclusion

The primary contribution of this paper has been to develop a set of theoretical propositions about the nature of leadership in self-managing virtual teams. However, even in its nascent state, our theory has some implications for the practice of leading virtual teams. The theory suggests specific actions that members of self-managing virtual teams can take to improve performance. These include ensuring that all first-order leadership functions are performed well and preferably by many team members, in a decentralized mode. It also suggests that there is value in centralizing second-order leadership functions. Self-managing virtual teams might more explicitly recruit or select members who are particularly skilled at these functions and pay more attention to the on-going process of developing shared interpretive schema, role structures and rules and norms. Since virtual work is increasingly common, educational programs for all kinds of workers might incorporate these ideas. For example, distance education classes that use technology support for instruction should provide instruction for students on the nature of leadership in

self-managing virtual teams and thus set expectations for how the work can best be accomplished, as well as requiring team projects to provide an opportunity to practice these skills.

Whether these propositions are confirmed or disconfirmed by future research, understanding how teams of independent knowledge workers can more effectively work in self-managed virtual teams and virtual environments will improve both the traditional and non-traditional organizations within which they exist. The results of the research we hope to stimulate will then serve as a road map to improve organizational performance and foster innovation.

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