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A multilevel approach to building and leading learning organizations

Sean T Hannah
Wake Forest University, hannahst@wfu.edu

Paul B. Lester
U.S. Army's Comprehensive Soldier Fitness Directorate, paul.lester@us.army.mil

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A multilevel approach to building and leading learning organizations ☆

Sean T. Hannah *, Paul B. Lester [1]

Department of Behavioral Sciences and Leadership, United States Military Academy, West Point, NY, USA

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ABSTRACT

A multilevel model is offered proposing that organizational learning is an interdependent system where effective leaders enact intervention strategies at the individual (micro), network (meso), and systems (macro) levels. We suggest that leaders approach organizational learning by setting the conditions and structure for learning to occur, while limiting direct interference in the actual creative processes. First, leaders may increase the level of developmental readiness of individual followers, thereby increasing their motivation and ability to approach learning experiences and adapt their mental models. These individuals then serve as catalysts of learning within and between social networks. Second, leaders may promote the diffusion of knowledge between these knowledge catalysts within and across social networks through influencing both the structure and functioning of knowledge networks. Finally, leaders may target actions at the systems level to improve the diffusion to, and institutionalization of, knowledge to the larger organization.

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To maintain viability and flourish in the new knowledge economy, organizations must have highly effective learning processes. Organizations are open systems and their survival and prosperity depends on their ability to learn and adapt to threats and opportunities presented by dynamic external environments (Burke, 2002; Katz & Kahn, 1978). History is replete with examples of organizations that fail to learn and adapt internal processes to maintain congruence or "fit" (Nadler & Tushman, 1989) with evolving external environments. Foster & Kaplan (2001) point out that only 39 companies in the *Forbes* top 100 list existed 70 years after the first publication of the list. Perhaps more alarming is that of the 39 surviving companies, only 18 remained in the top 100. Without question, economic conditions, bad strategic decisions, changing technology, and other factors play a role in organizational demise. Yet, as Argyris & Schon (1978) as well as Mintzberg, Ahlstrand, & Lampel (1998) suggest, this demise is often a result of an organization's failure to learn and subsequently adapt.

With this in mind, we offer a multilevel theory for building and leading learning organizations. Our position is that doing so is best affected when leaders intervene: 1) at the micro level by fostering followers' readiness to learn and promoting their learning through engagement in developmental experiences, 2) at the meso level by promoting and facilitating effective knowledge-centric social networks, and 3) at the macro/systems level by scanning, sanctioning, and institutionalizing critical emergent knowledge using specific leadership and management practices.

1. Organizational learning in a complexity context

Organizational learning and adaptation is inherently complex in that it involves the conjunction of networks of varied and often conflicting individuals, groups, functions, policies, and processes. Through these competing demands, ideas emerge and increase in

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* Corresponding author. Tel.: +1 845 938 5945.
E-mail addresses: Sean.Hannah@usma.edu (S.T. Hannah), Paul.Lester@usma.edu (P.B. Lester).
[1] Tel.: +1 845 938 5034.

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complexity (Uhl-Bien, Marion, & McKelvey, 2007). The literature suggests that leaders can approach a complex context either with a reductionist strategy aimed at attempting to retain positive control over what is being learned, or by absorption via focusing on adaptability (Marion & Uhl-Bien, 2001). The leadership literature has largely viewed organizational learning and adaptation through reduction, suggesting that top-down and particularly linear learning processes can be initiated and controlled by senior leaders (Beckhard & Harris, 1977; Van de Ven & Poole, 1995). Conversely, based on recent theories of complexity leadership, we suggest that social systems in complex organizational contexts are inherently unstable and unpredictable, and the causal effects of leadership on organizational outcomes are rarely directly observable or entirely deterministic (Hannah, Eggers, & Jennings, 2008; Marion & Uhl-Bien, 2001). In sum, a complex context characterized by dynamic and discontinuous forces prevents the management of organizational learning entirely through top-down processes (Bridges, 1986; Weick & Quinn, 1999). The challenge for leaders, then, becomes how to pursue an absorption strategy that builds organizational capacity for learning and adaptability across organizational levels.

1.1. Leading a learning organization from a multilevel perspective

Given these discontinuous and dynamic social processes, we concur with Hamel's (2000) suggestion that learning and adaptation are best driven by coalitions of activists embedded in social networks at multiple levels of the organization that serve as catalysts to spur organizational learning through social interaction. The two central tenets of our proposed model first include the development of what we term *knowledge catalysts*, and second, the establishment of conditions that foster these catalysts interacting within and between social networks in such a way as to create and diffuse knowledge across the organization.

We argue for a multi-level approach to learning where top-down leadership serves to set the conditions to maximize the *emergence* of knowledge creation and diffusion, while limiting leader intrusion into the actual creative processes. Specifically, Kozlowski & Klein (2000) state that "a phenomenon is emergent when it originates in the cognition, affect, behaviors, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level, collective phenomenon" (p. 55). As such, by setting the conditions for knowledge emergence, yet allowing the creative process to self-organize, we propose that organizational learning will be improved.

1.2. Leading and leadership of organizational learning

Formal leaders are hardly obsolete in our model, but we propose that leaders focus less on *what* their organizations should learn, but rather on *how* to set the conditions for collectives to effectively learn and share knowledge. Indeed, formal leaders, due to their central positions in social networks, are in fact more likely than informal leaders to influence social interactions, such as those constituting collective learning (Ibarra, 1993; Sparrowe & Liden, 1997). Therefore, we distinguish *leading* from *leadership* and approach *leading* as an influence process where individual leaders behave in ways that set the proper conditions for individuals, groups, networks and systems to enact emergent behaviors that promote learning and adaptation. These individual leader actions then serve to either promote or deter effective *leadership* and its development, which based on Day (2000), we define as the collective capacity of organizational members to engage effectively in formal and informal leadership roles and processes that promote emergent learning and knowledge diffusion.

As proposed by Vera & Crossan (2004) and Berson, Nemanich, Waldman, Galvin, & Keller (2006), the leadership process encompasses both formal and informal leaders embedded throughout multiple levels of the organization that interact through varying degrees of shared leadership (Pearce, 2004) to influence organizational learning. "Leaders" and "followers" in this framework are therefore identified by their levels of influence in the network versus their formally appointed positions. In a dynamic learning network, one can thus oscillate between being a leader or a follower as his or her level of influence changes based on demonstrated expertise and other factors (Balkundi & Kilduff, 2005).

1.3. Advancing existing models of organizational learning

Informing our approach, researchers have linked leadership to improved organizational learning (e.g. Argyris & Schon, 1978; Mintzberg et al., 1998; Mumford, Scott, Gaddis, & Strange, 2002). Further, multilevel (Crossan, Lane, & White, 1999; Hannah et al., 2008) and social network approaches to leadership (Balkundi & Kilduff, 2005; Mayer & Piccolo, 2006) have also been offered. Most central to our focus here, Berson et al. (2006) and Vera & Crossan (2004) have made important advances in multilevel models that link leadership and organizational learning.

We differ from organizational learning models that focus on "extraordinary" leaders (i.e. visionary, inspirational, transformational) that are believed to influence learning processes in a more direct manner (e.g. Jansen, Vera, & Crossan, 2009; Vera & Crossan, 2004). We instead focus on the role of leaders as social architects and orchestrators of emergent processes relevant to learning. These architects operate in a less direct and visible manner, developing individual learners and effective social networks that then serve to promote organizational learning with minimal levels of further leader involvement. Our framework does recognizes the importance of a more active role of visionary leaders primarily *after* new knowledge emerges from a social network in order to promote and support the diffusion of that knowledge across networks to the larger organization. In sum, our intent is to advance existing multilevel perspectives by: 1) explicitly linking together the leadership, social network, and individual and organizational learning literatures, and 2) present specific leader interventions at multiple levels to set the conditions for knowledge emergence and diffusion at individual, network, and systems levels.

We contend that at its most basic level, learning is about the creation and appropriation of knowledge by individuals. Consistent with the work of Nonaka (1994), we conceptualize organizational learning in Fig. 1 as a multilevel process where this appropriation can be influenced through leadership at each of the individual (micro), network (meso), and systems (macro) levels.

2. Leadership interventions targeting the micro-level: individual learning

We start our discussion of the model at the individual level. We propose that the organizational learning literature has not focused sufficient attention on the critical role of knowledge catalysts who can be embedded in the collective learning processes and subsequently act as fulcrums for organizational learning. Individuals are both the beginning and end of the learning process as individuals – not organizations – create new knowledge, disseminate that knowledge, appropriate knowledge from others, and ultimately codify that knowledge in organizational processes and systems (Nonaka, 1994). We will further argue that these knowledge catalysts can capitalize on opportunities facilitated by the network and serve as an important source of vicarious learning and modeling for others (Bandura, 1997).

If individual-level learning is about the appropriation of knowledge, then it is a cognitive process that ultimately results in lasting changes to mental models (i.e., categories, schemas, and scripts) held in long-term memory through creating new or altering existing connections or associations between knowledge structures (see Delosh, Busemeyer, & McDaniel, 1997; Holyoak, 1984; Shanks, Darby & Charles, 1998; Young & Wasserman, 2005 for reviews). Associative learning is foremost a response outcome where individuals increase the strength of the associations between concepts held in memory while weakening others. These associations become one's hypotheses about objects, concepts, people, and other facets and are strengthened as the causal or associated relationships between concepts are reinforced over time through one's experiences (Rescorla & Wagner, 1972; Young & Wasserman, 2005). Over time, these associations become mental representations of knowledge that are categorized and stored in an individual's long term memory architecture (Lord & Brown, 2004; Moskowitz, 2005). An example would be one's learned mental model of how a marketing campaign is best conducted. The discrete associations (linkages) between various mental models then allow him or her to adapt and draw from other associated mental models when primed. Here, knowledge structures activate other related knowledge structures within an individual's larger memory structure (Anderson & Bower, 1973; Moskowitz, 2005). Building on the previous example, if the marketing campaign was conducted in Asia by a Western European, connected mental models of cross-cultural influence may be activated along with the marketing campaign mental model, allowing the individual to adapt these models to the current situation.

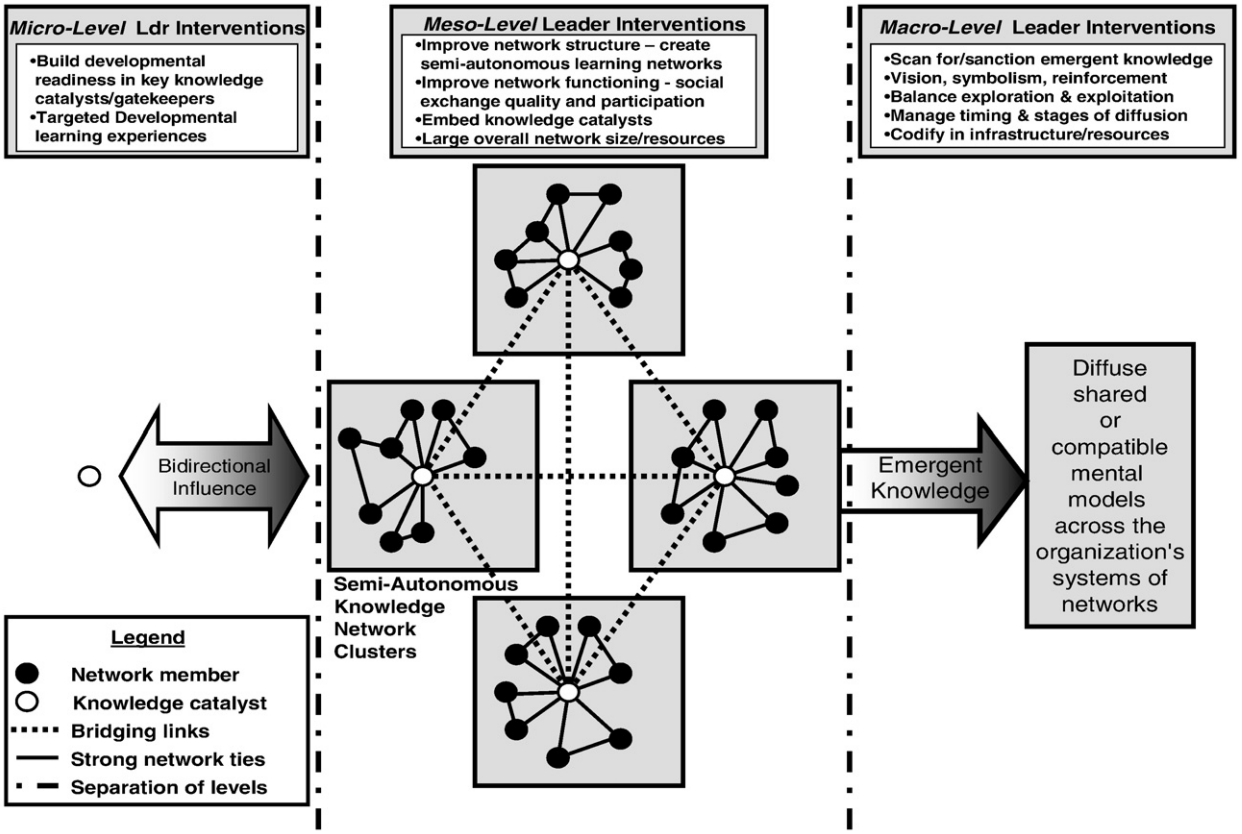

Fig. 1. Model of individual, network and systems level leader interventions.

2.1. Enhancing developmental readiness

Before followers' mental models can change, however, individuals require ability, orientation, and openness to learn, which we refer to as *developmental readiness* and define as both the ability and motivation to attend to, make meaning of, and appropriate new knowledge into one's long-term memory structures (Avolio & Hannah, in press). In a longitudinal experiment involving emerging leaders, Hannah (2006) determined that learning goal orientation, efficacy, and metacognitive ability interact to enhance developmental readiness. We propose that these three constructs will increase followers' readiness to create and diffuse knowledge. Below, we expand on each of these constructs and apply them to learning.

2.2. Assessing goal orientation

Goal orientation is considered to be a fairly stable individual difference construct, suggesting that followers will have different goal orientations with respect to learning. It consists of the two dimensions of learning goal orientation and performance goal orientation (Button, Matieu, & Zajac, 1996) and is thought to covary with an individual's implicit theory of self (Dweck, 1989). In a leader-follower context, learning goal-oriented followers tend to view themselves as incremental learners and interpret performance feedback as being developmental. Conversely, performance goal oriented followers are prone to look at themselves as an entity with their ability being more fixed, thereby creating a self-imposed "ceiling effect" to their learning and development (Button et al., 1996). Those with performance goal orientation tend to view feedback as self- versus task-diagnostic and often experience a negative reaction to it. They thus attempt to avoid learning situations that may result in failure or negative judgments of their competence (Dweck, 1989; Dweck & Leggett, 1988). Because positive and negative affect translate directly into approach and avoidance motivations (Davidson, 2003), negative affect will further deter these followers from engaging in learning experiences.

Once avoidance behaviors are recognized, leaders can employ greater levels of individually considerate, supportive behaviors that promote psychological safety, defined by Kahn (1990, p. 708) as "feeling able to show and employ one's self without fear of negative consequences to self-image, status, or career" (also see May, Gilson, & Harter, 2004 for a review). In his study of research and development workers, Andrews (1967) found that creative potential was only related to innovation when workers attributed their environment to be safe and encouraging. Additionally, Nemanich and Vera (2009) found that cultures that promote learning and offer psychological safety and openness to diverse opinions promote both exploration of new knowledge and refinement of existing knowledge.

Beyond support, the goal setting literature suggests that leaders may be effective in promoting learning, particularly for followers with a performance goal orientation, when they use incremental goal-setting to steadily increase the difficulty or challenge of learning events within follower capabilities, while also illuminating and celebrating each achieved milestone (Locke & Latham, 1990). Leaders may also remove obstacles that prevent followers from appropriating new knowledge (House, 1971, 1996), such as giving followers intervals of time for learning away from the job, funding training programs, job reassignment, or by removing bureaucratic barriers that deter knowledge creation. Despite countering findings of Brett and Atwater (2001), the research generally shows that followers with high levels of learning orientation devote greater effort toward learning and seeking performance feedback (e.g. Butler, 1993; VandeWalle, Cron, & Slocum, 2001). They also more fully process performance feedback (Hannah, 2006; Wolters, 1998); suggesting leaders should actively increase feedback to maintain learning momentum.

Proposition 1a. *Leaders can promote learning in followers with a learning goal orientation via increasing task challenges and providing performance feedback.*

Proposition 1b. *Leaders can promote learning in followers with performance goal orientation via incremental goal-setting and by displaying individually considerate / supportive behaviors that establish psychological safety.*

2.3. Increasing learning efficacy

To increase developmental readiness, leaders can also target the development of followers' learning efficacy, defined as one's confidence in his or her ability to learn during a specific learning task or in a specific knowledge domain (Bandura, 1997). Efficacy beliefs are critical because when activated, they elicit encoding categories, affect, goals, expectancies, and self-regulatory plans that drive engagement and performance in tasks (Hannah & Luthans, 2008; Hannah, Woolfolk & Lord, in press). Specifically, learning efficacy has been shown to predict the ability to acquire complex skills (Kanfer & Ackerman, 1989), memory functioning and recall (e.g. Hertzog, Hultsch, & Dixon, 1989; Hultsch, Hertzog, Dixon, & Davidson, 1988), and academic performance (e.g. Schunk, 1981; Schunk & Gunn, 1986). Learning efficacy reflects not only individuals' assessment of their learning abilities, but also a motivational component, which Kanfer (1987, p. 260) terms "intentions for effort allocation". This increased motivation has been shown to contribute to goal setting independently from one's abilities (Kane, Zaccaro, Tremble, & Masuda, 2002; Locke & Latham, 1990), thereby sponsoring engagement in learning tasks.

Leaders can intervene to develop followers' learning efficacy through four well- established experiential formats: enacted mastery experiences, vicarious learning/role modeling, social persuasion and feedback, and physiological and psychological arousal (Bandura, 1997; Hannah, Avolio, Luthans, & Harms, 2008). First, hands-on mastery experiences are developmental experiences that challenge the adequacy of a person's current thinking and mental models (Avolio, 2005), or what Nonaka (1994, p. 22) terms "high quality learning experiences". Cognitive disequilibrium is produced when these mastery experiences challenge followers' assumed

knowledge insofar as their current knowledge cannot fully explain a given event or situation. These events "trigger" reflection to resolve the disequilibrium and to alter one's mental models by incorporating new knowledge or to create new compatible ones. Second, role modeling or vicarious learning can be an effective way for leaders to build followers' efficacy. Here, efficacy is built through viewing successful performance by similar others conducting mastery experiences, thereby convincing followers that they too can complete the learning task and that their capabilities for learning performance exceeds what they believed their current capabilities to be (Bandura, 1997). In both mastery and role modeling, resulting cognitive disequilibrium forces followers to update their efficacy beliefs, in this case upwards.

Third, efficacy can be developed via social persuasion and feedback (Berson, Shamir, Avolio, & Popper, 2001). Specifically, leaders can increase follower creativity by providing support for the exploration of ideas (March, 1991), the resources and work support required to facilitate knowledge creation (Mumford et al., 2002), and the necessary social support that builds follower self-esteem and builds high expectations for performance, promoting followers to explore new skill domains (Eden, 1988). Fourth, learning efficacy can be increased through raising levels of psychological arousal (Bandura, 1997) by tapping into followers' individual interests (Hidi & Harackiewicz, 2000), which is conceptualized as an intrinsic motivational orientation that develops in relation to a particular topic. Individual interest is linked to increasing one's positive feelings about a particular topic area. We propose that the downstream impact of individual interest will be greater intrinsic motivation for followers, (Deci & Ryan, 2002), resulting in a greater allocation of effort to learn.

Proposition 2. *Leaders can impact learning efficacy by providing mastery experiences, vicarious learning, social persuasion, and psychological arousal.*

2.4. Increasing metacognitive ability

The final leader intervention we propose at the micro level to increase developmental readiness focuses on metacognitive ability (Brown, 1987; Flavell, 1987). Flavell defines metacognition as thinking about thinking — the awareness of one's cognitive processes, cognitive strengths and weaknesses, and cognitive self-regulation (see Metcalf & Shimamura, 1994; Nelson, 1996 for a review). Thinking is exemplified by merely processing a given learning problem, whereas thinking *about* thinking entails introspection over the actual thinking process. For example, individuals might assess the adequacy of their methodology, the influence of their emotions over their cognition, the adequacy of the information they are drawing from in their thinking, and what further information is needed to improve their judgments in the learning process.

Metacognition has the two main functions of monitoring and controlling human cognition (Nelson & Narens, 1990) and thus serves as an executive-control function that is critical in processing new knowledge and adapting mental models. Researchers have linked metacognition to the effective use of learning strategies (Schraw & Dennison, 1994), motivation for self-regulated learning (Sperling, Howard, Staley, & DuBois, 2004), and overall learning performance (Garner & Alexander, 1989; Schraw & Dennison, 1994). Likewise, both Schmidt & Ford (2003) and Hannah (2006) found that metacognitive processing was strongly related to heightened self-efficacy, goal orientation, mastery orientation, and superior training performance. Those individuals with higher levels of learning goal or mastery orientation have in turn been shown to allocate greater effort to scrutinize their learning and to seek more performance feedback (Butler, 1993; Hannah, 2006; VandeWalle et al., 2001).

We propose that leaders can develop follower metacognitive ability by exposing followers to various forms of efficacy-building experiences, as outlined earlier. These experiences in turn challenge what followers believe they know and then leaders may teach them, through guided reflection, various metacognitive processing strategies. These strategies consist of semantic (meaning-based) processing of information during reflection (Metcalf & Shimamura, 1994). Such reflection evokes deliberate (versus automatic) cognitive processing in order to more fully make meaning of environmental stimuli and to process any disconnects or voids discovered in current mental models in the presence of new information (Chaiken, 1980; Petty & Cacioppo, 1986). Specifically, leaders can train followers to assess the connections between concepts based on contingency judgments and causal relationships discovered between concepts (for a review, see Allan, 1993; Rescorla & Wagner, 1972; Shanks, 1987; Shanks & Dickinson, 1987; Young & Wasserman, 2005). Leaders who actively coach followers through metacognitive processes (i.e., guided reflection) can develop follower abilities to identify what *should* or *should not* be salient as valid predictors during learning processes. As an example of this process, many branches of the U.S. armed forces require organizations to participate in what are referred to as After Action Reviews following significant events with the sole intent to challenge the basic assumptions under which key decisions were made and to assess the adequacy of "thinking about thinking" during critical events.

We also suggest that leaders can teach followers to conduct metacognitive reflection in group settings. We know that meaning-making processes are best conducted via action learning, which according to Revans (1982) and Raelin (2006), consists of the generation of learning through human interaction as learners work through organizational problems together in a collaborative environment. Raelin states that "learning arises not just from representations of conceptual material but from questioning among fellow learners as they tackle unfamiliar problems" (2006, p. 152). This sentiment is echoed in the team (Entin, 1999; Entin & Serfaty 1999), creativity and leadership (Mumford et al., 2002), and human factors (Espinosa et al., 2001) literatures.

Proposition 3a. *Leaders can enhance follower metacognition via guided reflection exercises that assess the adequacy of follower thinking during key events and by training metacognitive processing strategies.*

Proposition 3b. *Followers benefit more from metacognitive reflection conducted in collective settings through action learning, than they do from unguided individual reflection.*

2.5. Towards developing knowledge catalysts

Summarizing the discussion of individual learning thus far, we believe that followers with increased developmental readiness will be better motivated and prepared to engage in a greater breadth of learning experiences, and in turn, this readiness enables them to better reflect upon and learn from those experiences. Over time, these knowledge catalysts will build greater cognitive complexity, defined as "the capacity to construe social behavior in a multidimensional way" (Bieri et al., 1966, p.185). Cognitively complex individuals have enhanced mental models that allow them to make sense of new information, while also enabling them to acquire and store new knowledge and spend more time interpreting new information (Bower & Hilgard, 1981; Dollinger, 1984; Hersey, Walsh, Read, & Chulef, 1990; Lurigio & Carroll, 1985). Ultimately, these followers will become organizational experts because they are able to make connections between multiple domains of knowledge (Ericsson & Charness, 1994). For example, using their more advanced knowledge structures, experts learn to reason in a forward direction to formulate inferences that better lead to envisioned solutions and outcomes, while novices tend to formulate and test "exploratory" hypotheses as they are less likely to comprehend and enact causal relationships (Patel, Kaufman & Magder, 1996). In sum, these developmentally ready knowledge catalysts are critical in the creation and diffusion of new innovations and knowledge. Specifically, although new knowledge may initially flow from the source through a mass media channel (e.g. company newsletter or report), it is often via interpersonal channels and "opinion leaders" that persuade individuals to adopt or reject the new knowledge (Rogers, 2003).

2.6. Selection of knowledge catalysts

The model we present in Fig. 1 does not suggest that leaders should indiscriminately select and develop knowledge catalysts. Rather, we propose that the identification and selection of the "right" knowledge catalysts is imperative to any learning initiative because leaders have limited time and resources, and some followers may have individual differences that could preclude them from selection. Further, leaders may wish to focus their resources on individuals with greater levels of social influence. As such, we propose not only looking to mid- and junior-level leadership within the organization, but also looking to key informal leaders, and organizational gatekeepers. As it will become clearer later, gatekeepers likely can become key knowledge catalysts that operate between all three organizational levels (micro, meso, and macro) discussed in this paper due to their access to and impact on organizational communication flow.

Chronicled in the management and communication literatures, gatekeepers have been defined in several ways, but the common thread throughout is the facilitation or suppression of communication. For example, Freeman (1980, p. 133) defines gatekeepers as individuals who are "located in a communication structure so as to control messages flowing through a communication channel." Similarly, Katz, Tushman, & Allen (1995) conceptualize gatekeepers as individuals "who are strongly networked to both internal and external sources of critical information" (p. 850). Additionally, the gatekeeper literature suggests that they can serve at every level of an organization and they often transcend the role of boundary spanner, although they can and often do perform both roles. Specifically, while boundary spanners establish communication links beyond an organization's borders, they are often isolated from many sectors of the organization that are not within their purview. Gatekeepers, however, are not isolated because by definition their role is to facilitate, or in some cases hinder, the communication between multiple parties (Tushman & Katz, 1980).

What is clear from the gatekeeper literature is just how important they can be to organizational performance and, by extension, perhaps the success of learning initiatives. Specifically, empirical evidence has linked gatekeepers to the quality of communication flow within technical and R&D organizations (Taylor, 1982); junior management promotion (Katz et al., 1995); team performance (Lievens & Moenaert, 2000); and the facilitation of external communication with clients (Katz et al., 1995). Indeed, gatekeepers would act as focal points in what Rogers (2003, p. 338) terms a "radial network." Radial networks exist where a group of individuals are linked to a focal individual but not with each other in a meaningful way, leaving to the role of the gatekeeper to connect parties and their diverse knowledge to create synergies. Importantly, network radiality has been associated with innovation (Valente & Foreman, 1998).

We propose that knowledge catalysts serving as gatekeepers help learning initiatives in multiple ways. First, as previously noted gatekeepers can help or hinder information flow (Freeman, 1980); if leaders fail to recruit gatekeepers, the learning initiative could be undermined at any point in the process. Second, gatekeepers are often informal organizational leaders (Katz et al., 1995), and their informal power often gives them access to sectors of social networks that formal leaders cannot reach. Third, gatekeepers likely have the ability to provide meaning to others simply because they may be more informed as to the intent behind the learning initiative due to the information filtering process that happens as information trickles down organizational levels.

Proposition 4a. *The more that leaders focus resources on raising the developmental readiness of key knowledge catalysts, the more likely they are to enhance organization knowledge creation and diffusion.*

Proposition 4b. *Leaders who develop knowledge catalysts in gatekeeper (versus other) positions will have the greatest influence on the diffusion of knowledge.*

3. Meso-level leadership interventions: social network level

3.1. Toward shared or compatible mental models

We move now to the meso level of the framework shown in Fig. 1 and detail the social network structuring and functioning that we propose facilitates the linkages between various knowledge catalysts and serves to diffuse knowledge across networks and

organizations. Before we begin to discuss these meso-level learning processes it is important to make explicit that we do not subscribe to notions of an abstract "group mind." Rather, our framework is based on the position best attributed to Floyd Allport (1924), who suggested that groups are only "sets of ideals, thoughts, and habits repeated in each individual mind and existing only in those minds" (p. 9). However, we do contend that network members can achieve sufficient similarity in shared mental models through interventions that expose them to similar experiences, social influences, and knowledge. These shared mental models can drive patterns of collective behaviors which may appear epistemologically as an isomorphic higher order construct, or group mind (Weick, 2001). Indeed, recent empirical work by Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers (2000) suggests that shared mental models do exist to varying degrees in team members (see also, Entin & Serfaty, 1999; Orasanu, 1990; Orasanu & Salas, 1993). Lord & Emrich (2001) use the term *organizing schema* to describe such shared mental models, defined as "a socially constructed understanding of the world derived from social exchanges and interactions among multiple individuals in a group or organization" (p. 552).

A contrary point of view is that mental models do not emerge isomorphically from individual to the collective level, but emerge discontinuously thereby forming *compatible* mental models. Compatible mental models are those that hold different knowledge structures across individuals, yet form a congruent whole when combined through social interaction (Kozlowski, Gully, Salas, & Cannon-Bowers, 1996; Kozlowski & Klein, 2000; Wegner, 1991). In such a system, individual knowledge is distributed across a complex social network, and through social interaction, knowledge is later synthesized into an emergent whole and accessed when needed. As suggested previously, we believe gatekeepers play a critical role in linking and synthesizing compatible knowledge held by individuals in separate networks in this way.

As a certain level of heterogeneity is desired to promote innovation (Benner & Tushman, 2003; Pelz & Andrews, 1966), the processes of isomorphic and discontinuous emergence suggests that leaders might perhaps choose to attempt a dual strategy of influencing the formation of shared mental models on aspects or domains requiring homogeneity (e.g. an organization's safety procedures or its core values) versus domains where heterogeneity is desired (e.g. sifting through new ideas for product design). Next, we outline how leaders can influence different types of social network structures that promote either homogeneous or heterogeneous mental models.

3.2. Building knowledge networks

Thus far we have proposed that organizational learning is: 1) significantly influenced by members who are developmentally ready to learn (knowledge catalysts), 2) will be accelerated when these members engage in developmental learning experiences, and 3) that catalysts holding critical gatekeeper positions within the organization can aid the creation and diffusion of new knowledge. Next, as shown in Fig. 1, we move to the meso level and discuss the development of knowledge networks within and between which these actors operate. Specifically we discuss leadership influence on improving knowledge network structure and functioning.

Social networks maintain intricate architecture, have nonlinear and discontinuous relationships between members, and will adapt to both internal competition for resources and external influences (Cilliers, 1998; Redondo, 2007). Networks tend to form based on the type of social capital or resources exchanged. Some examples include trust, information, and advice networks (Bono & Anderson, 2005; Sparrowe & Liden, 1997). While most social networks tend to be helpful to the organization, some types can be dysfunctional (i.e., hindrance networks) and lead to lost productivity (Sparrowe, Liden, Wayne, & Kraimer, 2001). One type of network that has received little attention is the *knowledge network*. Our view is similar to that of Balkundi & Kilduff (2005), in that the management of social networks – and specifically knowledge networks – is inherent to the leader's role in any organization. The self-organizing nature of social emergence suggests that leaders cannot directly control complex network dynamics, but rather can direct those dynamics toward learning by setting the proper conditions and fostering learning-oriented behaviors and activities of members (Marion & Uhl-Bien, 2001).

We know that information sharing across networks leads to knowledge emergence and decision quality (Larson, Christensen, Franz, & Abbott, 1998), yet information and knowledge are decidedly different. As distinguished by Nonaka (1994), information is merely the flow of messages while knowledge involves processing information that leads an actor to form a "justified true belief" (p. 15). In other words, information becomes knowledge once an actor has *made meaning* of the information via understanding how the information relates to other knowledge. Following Nonaka's lead, we similarly distinguish an information network from a knowledge network; the former describes how information is spread across the collective, while the latter describes a network that effectively evokes meaning from and usability of the information.

At the collective level, new information is transformed and legitimized during the meaning-making process and this process is heavily influenced by the existing tacit and explicit knowledge of the collective (Nonaka, 1994). Given this influence of existing knowledge, knowledge networks influence how individual members create new knowledge, modify it, and diffuse it within the network via social enactment (Weick, 2001). This notion is furthered by Nonaka, who writes "an informal community of social interaction provides an immediate forum for nurturing the emergent property of knowledge at each level and developing new ideas" (p. 17). We turn now to describe how leaders foster such forums. Specifically, Borgatti & Everett (1992) and Sparrowe & Liden (1997) present that social networks can be described both by the unique properties of their *structure* and also by the qualities of the relationships between the network members, which we refer to as network *functioning*. This provides several points for leadership to enhance knowledge network effectiveness, and we begin by discussing structure.

3.3. Improving knowledge network structure

Social networks are comprised of nodes (members of the network) and links (social relationships between nodes in the network) (Borgatti, 1994). Nodes can be conceptually partitioned by the similarity of their positions in the network, or by how

strongly or closely subsets of nodes are related to one another (Borgatti & Everett, 1992). The notion of "position" has many important theoretical distinctions depending upon how the nodes are being modeled (i.e., based on status, roles, functions, or other factors). Likewise, the pattern of links also has important theoretical implications. For example, Krackhardt (1995) has offered that close social relationships tend to naturally form in triads of three people, or what he terms "Simmelian ties." Krackhardt proposes that triads provide a natural counterbalance in social exchange that is not present in either dyads or larger groupings.

As shown in Fig. 1, we propose that leaders can influence the spread of knowledge across the knowledge network by tailoring the structure of the network. Building on the work by Balkundi and Harrison (2006) and Sparrowe et al. (2001), we suggest that leaders improve knowledge network structure by: 1) embedding key knowledge catalysts in central network nodes, 2) increasing the network density of semi-autonomous networks, and then 3) linking knowledge catalysts by establishing bridging ties between semi-autonomous networks.

3.4. Centrality of knowledge catalysts

Based on these network concepts, leaders can purposively develop individual knowledge catalysts and ensure that they occupy key positions (nodes) in their respective network. Leaders may also embed knowledge catalysts into certain key gatekeeper positions that out of necessity require that member to build bridges to other key members and triads. These key positions have high levels of *centrality*, defined by the extent they are socially connected to others, which moderates their influence and power (Sparrowe et al., 2001). Ibarra (1993) has specifically linked centrality of key actors to increased innovation. Additionally, Sparrowe and Liden (1997) have argued that an individual with high levels of centrality is both perceived as more influential and is also granted greater levels of trust and respect by others, which we propose will promote the diffusion of his or her knowledge and mental models across the network (Katz, 1982; Klimoski & Mohammad, 1994).

3.5. The network density paradox

Leaders can also influence overall network density by proactively setting the conditions to encourage the formation of new linkages between key knowledge catalysts in other networks (i.e., through social introductions, shifting resource flow, or changing policies that requires interaction). These linkages, also known as *bridge links*, are defined by Rogers (2003) as "an individual who links two or more cliques in a system from his or her position as a member of one of the cliques" (p. 340). For example Granovetter (1973), who terms these bridges "weak ties", found in a job placement study that only 17% of 282 respondents found jobs through a close friend or relative. Rather, the majority of respondents found their jobs through weak ties to other networks, as those ties offered much more critical *new* information than their strong ties (e.g., close friends) did. Given this, we suggest that weak links within organizations can in fact act as fulcrums for knowledge flow and learning.

Paradoxically, however, network density appears to have a curvilinear relationship with learning based on excessive levels of homophily. According to Rogers (2003), homophily is "the degree to which two or more individuals who interact are similar in certain attributes, such as beliefs, education, [and] socioeconomic status" (p. 19). Heterophily, conversely, is the degree to which individuals who interact are different in the same attributes. Rogers states that networks form naturally based on homophily where members are attracted to one another based on perceived similarities and compatibilities, and that these similarities then aid in communication. The varied individual differences associated with heterophily, conversely, hinders communication and diffusion of knowledge between parties. Nevertheless, it is likely those differences that bring new ideas and knowledge and allows members of the network to identify the nuances of new knowledge and capitalize the most from what is being learned (Rogers, 2003).

So whereas homophily promotes exchange of existing knowledge between like-agents, it deters innovation and exploration as these like-agents may have little new knowledge to exchange (Balkundi & Kilduff, 2005; Fang, Lee, & Schilling, 2008; March, 1991; Pelz & Andrews, 1966). This sentiment is echoed by Uzzi & Dunlap (2005), who stated that "too much similarity restricts your access to discrepant information, which is crucial to both creativity and problem solving" (p. 57), and thus avoids groupthink. As an example, Rogers (2003) points out that the National Institutes of Health (NIH) practices consensus development, a process by which NIH leaders bring together stakeholders such as scientists, practitioners, and consumers to discuss safety issues of new products. Thus, by connecting the various social networks that may not usually interact, the NIH ensures that it receives the best possible viewpoints. Empirical support for this sentiment is found in the work of Kilduff, Angelmar, & Mehra (2000), who found that cognitive diversity within teams had a direct positive impact on firm performance.

In summary, one of the biggest dilemmas before leaders is recognizing that knowledge is best created by linking heterophilous networks together, while also recognizing that knowledge is best diffused through homophilous networks. Leaders thus face a precarious balancing act when intervening in knowledge networks to promote learning, and below we suggest how they might do so.

3.6. Linking homophilous subunits

Recent theory and empirical work have suggested that structure can be used as a device for leaders to achieve a balance between knowledge exploration and exploitation (Benner & Tushman, 2003; Berson et al., 2006; Ethiraj & Leninthal, 2004; Miller, Zhao, & Calantone, 2006; Siggelkow & Levinthal, 2003; Vera & Crossan, 2004). Indeed, focusing on exploitation of existing

knowledge may become myopic, relying on tried and true solutions to the detriment of exploration of new knowledge (Denrell & March, 2001).

Therefore, we propose that leaders may enhance organizational learning by maintaining fairly high levels of homophily within various networks, yet establish a system of overall organizational heterophily between networks by creating bridging ties (Burt, 1992) between dissimilar networks, as shown in Fig. 1. Specifically, at the meso level, we suggest that leaders seek to develop well defined and highly dense learning networks as such networks sponsor the diffusion of knowledge (Ahuja, 2000; Uzzi & Dunlap, 2005), yet keep these network clusters semi-autonomous from other clusters in order to maintain a requisite level of variety in knowledge, as such variety promotes creativity, innovation and exploration (Schilling & Phelps, 2007; Uzzi & Spiro, 2005).

Over time we could envision leaders building what Balkundi & Kilduff (2005) call a "small world effect," which is conceptually similar to the hub and spoke system used by major airlines. In such a system, leaders establish the relatively few linkages between key knowledge catalysts and gatekeepers that are at the "hubs" of their respective networks (i.e, they have high centrality). This allows them to simultaneously build knowledge capacity by linking the new ideas and knowledge of one semi-autonomous network to the numerous networks at the "spokes" connected to those hubs. Such a system would be a larger version of Valente & Foreman's (1998) model of radiality presented earlier which has been shown to increase innovation. Based on the homophilous properties within each of the newly-linked networks, the new knowledge gained from the other network should rapidly diffuse. Here we reinforce the role of knowledge catalysts in performing gatekeeper functions. Gatekeepers link network clusters and provide access to knowledge resources that differ from those in their own network (Granovetter, 1973).

To develop or expand a hub and spoke network system, leaders may, for example, assign members to various cross-functional efforts where they must bridge between teams responsible for creating knowledge (i.e., designing cross functional teams from sales, marketing and production departments) (Sparrowe & Liden, 1997). Doing so exposes members to alternative mental models as they interact with other teams, and this alone may serve as a critical learning event. Leaders can also increase bridging ties by instituting policies and procedures friendly to knowledge creation and diffusion, such as removing barriers and controls for email and other communications, and by creating more productive work space (Nonaka, 1994).

Proposition 5. *Leaders can enhance knowledge network structure through 1) developing or embedding key knowledge catalysts in central network nodes, 2) increasing the network density of homophilous semi-autonomous networks, and 3) linking knowledge catalysts through establishing bridging ties between semi-autonomous networks.*

3.7. Improving knowledge network functioning

Social networks are by definition largely socially constructed and are preserved by reciprocity, trust, and other forms of positive social exchange (Balkundi & Kilduff, 2005; Sparrowe & Liden, 1997). Therefore, as leaders seek to develop the aforementioned high-density and semi-autonomous network clusters, it may be prudent to focus on not only network structure, but also network functioning. We propose leaders can increase network functionality through moderating their level of task control and by increasing shared leadership and interdependence.

3.8. Loose-tight leadership

Marion & Uhl-Bien (2001, p. 400) argue that leaders in complex organizations should seek a "coupling pattern" that balances structure and autonomy in a way that is sufficiently loose enough to establish the conditions for organization members to create novel solutions and sponsor change, yet is sufficiently tight enough to set boundaries and structures that prevent organizational chaos. Kauffman (1993, p. 220) appropriately refers to this state as "the edge of chaos." Similarly, the loose-tight model of leadership (Peters & Waterman, 1982; Sagie, 1997; Sagie, Zaidman, Amichai-Hamburger, Te'eni, & Schwartz, 2002) suggests that a pairing of participative (loose) and directive (tight) leader behaviors can create a dynamic environment where greater leader-member cooperation can grow.

Taking an organizational learning and network perspective, Nonaka (1994) proposes that "to bring personal knowledge into a social context in which it can be amplified, it is necessary to have a 'field' that provides a place in which individual perspectives are articulated and conflicts are resolved in the formation of higher order concepts" (p. 23). This suggests that a loose orientation would be beneficial to allow members to have a voice, which is consistent with the findings of Sagie et al. (2002).

Taking this reasoning an additional step, we hold that transformational leaders (Bass, 1985; Avolio, 2002) are likely better suited to establish fields that are conducive to learning. First, transformational leadership includes a central development focus (Avolio, 2002; Bass, 1985) where we would expect individually considerate leaders to focus behaviors more on the development of knowledge catalysts. Further, the practice of intellectual stimulation would likely enhance participation and engagement by more network members into the learning process (Bass, 1985). Finally, the collective vision and values that transformational leaders communicate (Avolio, 2002) may enhance the quality of interpersonal network exchanges as well as the selfless pursuit of knowledge for the good of the organization. Indeed, Bono & Anderson (2005) found that transformational leaders tend to occupy central positions in advice and influence networks. Transformational leadership has also been related to more effective brainstorming (Jung, 2001) and the exploration of new knowledge (Waldman & Atwater, 1992).

In sum, these findings suggest that there appears to be an optimal "looseness versus tightness" when leading knowledge workers (Pelz & Andrews, 1966). This sentiment is echoed in the empirical work by Sagie & coauthors (2002), who found that information sharing had a much stronger correlation with directive leadership (tight) than it did with participative leadership, but

that both were highly compatible within the same organization, and followers reported that both impacted their attitudes towards job satisfaction and commitment. Similarly, Mumford & colleagues (2002) found a curvilinear effect for direct leader involvement where the more effective leaders provided initiating structure by assisting in the definition or construction of problems and by exercising goal setting and other actions that reduce uncertainty, while simultaneously providing a sufficiently loose structure within which creativity can operate. Leaders may also provide resources and establish collaborative links as previously outlined, yet should be less engaged or controlling during execution.

3.9. Shared leadership and interdependence

Further reinforcing our position of loose-tight leadership, we hold that to increase the level of agency (Bandura, 1986) of network members, thereby promoting their engagement and involvement in knowledge creation and diffusion, leaders may consider initiating shared leadership structures within teams. Ensley, Hmieleski, & Pearce (2006, p. 218) define shared leadership as a "mutual influence process within a team that is characterized by 'serial emergence' of official as well as unofficial leaders." Pearce (2004) proposes that leadership is most appropriately shared in work that requires interdependence, creativity, and complexity. We hold that these are the exact conditions present in effective knowledge networks in complex organizations.

Further, shared leadership reduces status differences, which may counter the tendency of low status group members to otherwise withhold knowledge (Diehl & Stroebe, 1987). Assumed here is that such engagement and interdependence are enhanced by high quality exchanges between leaders and followers, as well as between team members (for example, leader-member and team-member exchanges; see Graen, 2006; Graen, Hui, & Taylor, 2004; Graen & Uhl-Bien, 1995; Tierney, Farmer & Graen, 1999; Sparrow & Liden, 1997 for a more in-depth review). Indeed, relationship quality has been related to both group members' creativity and innovation (Tierney et al., 1999). Groups that seek feedback, openly share knowledge, and reflect on mistakes also experience greater levels of learning (Edmonson, 1999).

Maintaining high levels of interdependence is critical to knowledge networks as individual members have cognitive limitations for making meaning of knowledge (Miller, 1956). By developing highly functional social networks where members form close relationships, they can create a form of a transactive memory system. Returning to the concept of compatible versus shared mental models presented earlier, Wegner (1991) refers to this as an implicit joint memory system. Here, given the limitation of each member to store all required knowledge, network members begin to establish roles of who should be responsible in the group for specific areas of knowledge. Over time, group members learn how to best share each of their "pieces" of knowledge as they perform collective tasks. Importantly, information sharing has been linked to subsequent knowledge emergence and decision quality (Larson et al., 1998).

Leaders can intervene to increase knowledge sharing practices through structural changes within teams that foster the sharing of leadership and management responsibilities (Graen, 2006; Pearce, 2004). Leaders can also design tasks that are intrinsically interdependent and require members to collectively share knowledge and find innovative ways to solve problems (Molm, 1994). We previously recommended the use of action learning (Raelin, 2006), a process where followers engage in hands-on, complex problem solving within groups and share learning methodologies and results.

Proposition 6. *Leaders can increase the functioning of knowledge networks by: 1) stressing a balance of "loose" and "tight" practices and policies pertaining to knowledge processes, and 2) increasing network interaction through shared leadership and task interdependence.*

4. Leadership interventions targeting the system/organizational level

At some point in the knowledge creation and diffusion process, senior leaders may select certain knowledge to be diffused to all or large portions of the organization to create shared or compatible mental models. As shown in Fig. 1, we propose that formal leaders may at this point take a more active role in personally envisioning, championing, and providing resources for new mental model diffusion. Clearly, it is critical that strategic-level macro diffusion processes are synchronized with micro and meso processes, and not imposed through a purely top-down approach. However, senior leaders still play an important role. For example, if new knowledge is to be accepted by other formal and informal leaders from social networks that were distant to the source networks, and who perhaps had no hand in its creation or the early stages of diffusion, senior leaders may need to provide resources and personally endorse or provide enhanced vision for these new models.

4.1. Leader sanctioning and championing

Research by Cohen & Levinthal (1990) suggests that effective leaders perform a scanning function where they serve to identify current challenges and opportunities, and by extension, support new ideas. We propose that if lower-level leaders establish the conditions for micro-level individual knowledge creation and its subsequent diffusion over effective meso-level knowledge networks, then leaders at higher organizational levels will have a rich "field" of emergent knowledge from which to select from and personally champion for macro-level diffusion. Indeed March (1991) proposes that innovations are often driven by seeking opportunities versus focusing on addressing solutions to problems. Here we suggest that higher-level leaders focus on scanning for opportunities and "best practice" knowledge emerging from knowledge networks.

For example, the website www.companycommand.army.mil was first started by a group of U.S. Army officers. These informal leaders, with minimal funding and volunteered man-hours, wanted to build an informal online community for low- and mid-level

officers to exchange knowledge on their leadership experiences. After a few years of observed successes, the Army's top leaders decided to fund and build the Center for Company-Level Leadership which administers that website and now several others that cater to various levels of informal Army leadership communications. Though existence of the community largely diffused via word of mouth for the first few years, it now boasts over 16,000 members, has a permanent staff and budget, and still remains somewhat separate from the Army's formal structure. Sanctioned by senior leaders, yet remaining semi-autonomous in structure, the Center has continued to innovate, branching out from networking and information exchange to now developing education modules that focus on leadership and ethics development. These modules are then diffused over bridging links to various networks in the Army.

4.2. Targets and timing of system-wide diffusion

We return to the concept of a hub and spoke network system, and apply it here to the macro level. Leaders can not only select the appropriate time to initiate system-level knowledge diffusion, but also to which organization sectors that knowledge is diffused. Specifically, Benner and Tushman (2003) speak of an ambidextrous organization that can simultaneously pursue both exploitation and exploration. Such an organization might be structured such that some sectors are pursuing exploitation in which a greater level of shared mental models might be desired, whereas in other sectors focused on exploration, greater heterophily and perhaps compatible mental models are more beneficial. For example, there may be utility in isolating new product development or "skunk-works" divisions, such as the Army Center example above, from the mainstream organization until products have reached a sufficient level of development before releasing to the larger organization (Benner & Tushman, 2003). Such a critical strategic decision may entail transforming a "star" to a "cash cow". Indeed, timing of system-wide diffusion is critical as March's (1991) work clearly shows that when the speed of organizational learning is too high, the outcome of learning tends to be suboptimal. This research, as well as that of Fang et al. (2008), suggests that rapid diffusion of underdeveloped knowledge has significantly less impact on organizational performance.

4.3. Stages of diffusion across organization systems

Once leaders determine targets and timing, leading the diffusion of knowledge across organizations is a multiphase process and requires a systems approach. Labianca, Gray, & Brass (2000) determined through grounded theory that changes in mental models occur over four phases: 1) motivation to change phase, where members of a collective begin to *want* to change their classification of information, 2) new mental model generation phase, where members of a collective begin to draw in new information gained through learning, classify it, and reclassify the old model, 3) iterative model comparison stage, where members of a collective compare new and old knowledge to determine what is best suited for their use, and 4) the stabilization phase, where the new shared mental model becomes institutionalized in processes and culture.

4.4. Systems-level leader actions

The motivation to change and the new model generation phases are likely to be the most time-intensive for leaders as they attempt to institutionalize emergent knowledge. Here leaders face having to overcome cognitive biases and complacency and get the organization to embrace a need for change. Research has shown that strategic leaders can influence the appropriation of new mental models through the strong and effective articulation of a compelling new vision (Bartunek, Lacey, & Wood, 1992). Leaders may highlight gaps in current knowledge and articulate the importance of learning new models and may initiate a campaign of reinforcing messages, symbolism, myths, and rituals throughout the organization (Johnson, 1987). Rogers (2003) notes the widespread use of Bass' (1969) communication model (originally created for marketing) in diffusion research. This model has shown that potential adopters of a new innovation are best influenced simultaneously by mass-media communication channels as well as interpersonal communications channels. This speaks to a multilevel approach as we have modeled, comprising both strategic leader messages and actions and the activation of social networks to champion the new knowledge at the meso level.

Contrary to more leader-centric approaches to organizational learning (e.g. Berson et al., 2006; Vera & Crossan, 2004), we have focused on the leader's role as social architect that serves to maximize collective learning and knowledge emergence. Based on this approach, we believe that in an effective learning organization, the new vision may not necessarily be developed exclusively by a senior "visionary" leader. Rather, it may very well be one that largely emerges from within the organization's social networks and is "harvested" by coalitions of leaders in other social networks, only later to be sanctioned by a formal senior leader. For example, academic institutions often form committees to review and at times restate a school or department's vision and core values, perhaps as part of accreditation review processes. The committees are often comprised of both professors and administrators from a variety of disciplines in order to provide diverse perspectives. Once the committee completes its task, a high-level administrator (e.g., the school president) then reviews and endorses, or modifies, the vision statement and values.

The most critical phase for leadership action may be while organization members iteratively compare new to old mental models. Here followers will tend to use old mental models as the biased lens through which to view and assess incoming information about the new model (Bartunek & Moch, 1987). During this phase, organization members may be ambivalent, anxious, confused, or disruptive, especially when operating under stressful conditions. In this stage, the collective may also tend to focus too heavily on both new and old schemas and compare their actions to the actions of their leaders (Labianca et al., 2000). Returning to

the previous example, the iterative comparison stage might be challenging to leaders if the new school vision changes its orientation from teaching toward a greater research focus. Faculty raised under the old system will naturally question the logic of the shift and how they can be successful under the new vision. Here, it would be critical for strategic leaders to reinforce the importance of making the shift (e.g., it will lead to growth, prestige, and resources) and to make explicit the guidelines for success (e.g., expectations for earning and maintaining tenure, and gaining grants).

Further, Latour (1992) proposes that ideas need "energy" to diffuse through an organization, and that people, whether users or creators of the idea, must energize the idea every time it is translated. Lack of sufficient energy during all phases of translation can cause the new model to be abandoned and there is a potential for alteration every time the model is translated. We thus again emphasize the importance of having catalysts at multiple and central levels of the social networks to "champion" the diffusion of new models. Continuing with our academic institution example, strategic leaders may wish to name a vice dean for the school's research and create research coordinator positions in each department, providing them with enough resources to both ensure success and to send a clear message that research is now a key part of the institution's strategy.

As processes of social enactment proceed into the final stabilization stage, a newly accepted mental model will eventually go through a process of appropriation where individuals accept the new model and lose sight of its socially derived nature (Augoustinos & Walker, 1995). The new mental model thus becomes transformed into a perceived external reality and, over time, eventually becomes "the way things were always done." During this stabilization phase, leaders may ensure that new knowledge is "crystallized" (Nonaka, 1994) into concrete forms such as systems, procedures, and cultural features of the organization (Crossan et al., 1999). Closing with our academic institution example, strategic leaders could dedicate resources towards building or supporting existing virtual communities of scholars in order to promote collaboration and to link the organization's various social networks, helping to crystallize the new vision.

5. Implications and conclusions

The foremost implication of this framework is that leading organizational learning is a multilevel and multistage process requiring an integrated micro (individual), meso (network), and macro (systems) approach to the actions of leaders. Our position is that the process is best affected when a system of formal and informal leaders (i.e. leadership): 1) foster follower developmental readiness at the individual level and promote their learning through engagement in developmental experiences, 2) facilitate effective knowledge networks for these key knowledge catalysts to operate within and between, and 3) scan, sanction, and institutionalize critical emergent knowledge at the systems level using both leadership and management practices. Together these actions promote absorption of internal and external complexity and ongoing adaptive learning. Our model holds that individuals are the fulcrum of organizational learning and require developmental readiness to learn. Achieving organizational learning, however, requires diffusion of knowledge sponsored by highly effective learning networks. Individual and network approaches are thus each necessary, yet not sufficient without the other. We have also argued for both a top-down and bottom-up approach to leadership where leaders set the conditions and structure for knowledge creation and emergence, allow the creative process to self-organize, and later reinforce diffusion and crystallization.

Some boundaries of our model should be noted. First, although we argue leaders can influence the conditions for knowledge to emerge, we know that leader influence is restrained as social networks are partially self-organizing. Indeed, complexity theory informs us that the emergent products of human interactions are dynamic and difficult to predict (Marion & Uhl-Bien, 2001). Reinforcing our call for loose-tight leadership, we propose that too extensive of an intrusion of leadership into the dynamic of social networks can be counter-productive. Further, this model assumes organization members have ample access to information that then serves to initiate the knowledge process. The proposed model would likely be ineffective in organizations that silo or horde information for purposes of control. Finally, we are aware that the attributes of the new knowledge itself (e.g. its complexity or intangibility) will influence the rate of its diffusion and adoption (Rogers, 2003), and that these attributes may require different leadership interventions.

We suggest that the testing of this model might begin with assessing the levels of developmental readiness (e.g., metacognitive ability, goal orientation, and learning efficacy) of members in a sample of social networks and subsequently assess how networks with members of greater versus lesser readiness create and diffuse knowledge. Further refinement could be made by assessing network structure and functioning. Controlling for developmental readiness, researchers might assess how the aspects of network structure (e.g. density), functioning (e.g. team LMX), and leader behaviors (e.g., vision, loose-tight, and so forth) may influence the creation and diffusion of knowledge. Additionally, initial research could assess the positions (nodes) and centrality of highly developed knowledge catalysts in their given social networks to determine the manner in which they serve to diffuse knowledge within and serve as gatekeepers between social networks by creating bridging ties. Further, although it has been conducted computationally through simulation (e.g. Fang et al., 2008; March, 1991), researchers in a field setting might observe the performance of semi-autonomous clusters versus more homophilous structures in the creation and diffusion of knowledge.

In summary, by focusing on establishing the conditions for individual learning and the diffusion of mental models across social networks and systems, we believe that leaders can create a true, veritable learning organization where learning is not something the organization merely does, but is inculcated into the climate and culture and reinforced throughout social networks as a way of being. This requires not only powerful individuals at the top of the organization, but perhaps more importantly, powerful, empowered formal and informal leaders who are capable and willing to intervene across levels for the purpose of learning.

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