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The content of effective teamwork mental models in self-managing teams: Ownership, learning and heedful interrelating

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ABSTRACT

A growing stream of theory and research suggests that overlap in team member mental models (i.e. socially constructed theories about systems and their expected behavior) has a positive influence on team processes and outcomes. In this article we argue that for self-managing work teams (SMWTs), the content of those shared mental models is also important. We begin by reviewing theory on SMWT effectiveness to determine the content of effective teamwork mental models in SMWTs. These are proposed to include: (1) psychological ownership of team processes and outcomes; (2) a need for continuous learning; and (3) a need for heedful interrelating. We then conduct content analyses of four published longitudinal studies of SMWTs to uncover the opportunities and challenges to developing and sustaining these mental models in dynamic organizations. Results suggest these mental models flourish when organizational supports back up their existence. However, since mental models are fluid and adapt to explicit and implicit messages, they weaken if shifting priorities cause organizational support to wane. Finally, the implications of our findings are discussed.

KEYWORDS

self-managing teams ■ shared cognition ■ shared mental models
■ work team effectiveness

Introduction

There is growing evidence that the existence of shared mental models among the members of a work team has a positive effect on team processes and effectiveness (Klimoski & Mohammed, 1994; Levine & Moreland, 1991; Mathieu et al., 2000; Weick & Roberts, 1993). Shared mental models are socially constructed cognitive structures that represent shared knowledge or beliefs about an environment and its expected behavior. They influence team member behavior and improve coordination by enabling members to anticipate one another's actions and needs (Cannon-Bowers et al., 1993; Weick & Roberts, 1993). This is particularly important when work events are unpredictable or when frequent communication is difficult (Mathieu et al., 2000; Weick & Roberts, 1993).

Theory and research on shared mental models have focused on establishing that the higher the convergence in member mental models (i.e. the more 'shared' the model), the better the team will perform (Blickensderfer et al., 1998; Cannon-Bowers et al., 1993; Mathieu et al., 2000; Rouse et al., 1992). We agree that convergence is important; however, we join others in arguing that the content of shared models is equally important (see Mathieu et al., 2000). For example, team members may have strong convergence around a model that denotes team leaders to be better able to resolve member conflicts than team members themselves. Convergence around this model would probably be better than no shared mental model about conflict resolution. However, when compared to a shared model denoting the team to be best able to resolve its own conflicts, the former model would more likely lead to dependence on the leader, a lower sense of team efficacy, and in the long run, a lower level of effectiveness (i.e. viability, member growth and well-being, and customer satisfaction; see Hackman, 1986). We argue that since shared mental models affect behavior (Mathieu et al., 2000; Weick & Roberts, 1993), their content is of central importance to their impact on team effectiveness. We also assume that the content of shared mental models is most important in the early stages of team development when they have the greatest impact on behavior because actions and processes are not yet routine, casual, or automatic (Weick & Roberts, 1993).

In this article we examine the content of effective shared mental models in self-managing work teams (SMWTs). We focus specifically on SMWTs because evidence suggests that effective shared mental models would be more essential to outcomes in SMWTs than in traditional teams that have formal leaders directing their activities (see Cohen et al., 1996; Polley & Van Dyne, 1994). Also, the growing use of SMWTs in organizations (Lawler, 1998) has prompted repeated requests for research that lends insight into the behaviors

that support their effectiveness (Cohen, 1994; Cohen & Bailey, 1997; Nygren & Levine, 1996).

In this article, we aim to meet three objectives: (1) to identify the content of effective shared mental models in self-managing teams; (2) to examine how these effective mental models emerge in SMWTs; and (3) to examine how they endure in dynamic organizational contexts. We begin by conducting a content analysis of five existing theories of SMWT effectiveness in order to identify the specific shared mental models they suggest are important. We then conduct a second content analysis of four previously published longitudinal studies of SMWTs to search for evidence of these mental models, and to seek to understand the contextual factors that affect their development and endurance. We start with a thorough definition of shared mental models.

Shared mental models

The term 'mental model' refers to a symbolic representation of a system and its expected behavior (Holyoak, 1984). Johnson-Laird (1983) argued that human beings have an innate tendency to develop and use mental models because effective action requires an understanding of the system within which one is located. People define and enact appropriate behavior by putting their evolving knowledge of a system into a causal model that enables them to describe, explain and predict the consequences of behavior (Johnson-Laird, 1983; Rouse & Morris, 1986). More recently, theorists have used the concept of shared mental models to define the causal connections and 'working' models that are collectively constructed by the members of a team in order to calculate the consequences of potential actions and predict future states (Cannon-Bowers et al., 1993). A number of theorists have used the shared mental model concept to explain why specific team processes and outcomes materialize (Cannon-Bowers et al., 1993; Klimoski & Mohammed, 1994; Levine & Moreland, 1991).

It is important to note the difference between shared mental models and team norms, which are defined as stable behavior patterns that become informal rules (Feldman, 1984). Klimoski and Mohammed (1994) state that shared mental models differ from norms in that they 'go beyond consensus around actions and involve a conceptualization of the bases for that action' (p. 417). Shared mental models are the cognitive theories about how the system operates that underlie team behavioral patterns. We assume that mental models are antecedents to team behaviors and processes, which are in turn antecedents to team norms.

Rouse and his colleagues (Rouse et al., 1992) proposed that the content of team shared mental models falls into three categories: equipment models, task models and teamwork models. In this article, we focus on teamwork models because research indicates that they are more directly linked to team performance than task models (Mathieu et al., 2000) and they have received the least empirical or theoretical attention of the three categories (Rouse et al., 1992). Also, while equipment and task models are task specific, teamwork models are likely to be germane to teams conducting a wide variety of tasks.

The content of effective teamwork mental models

Little is known about the specific content of effective teamwork mental models (Blickensderfer et al., 1998; Kraiger & Wenzel, 1997; Mathieu et al., 2000). We, therefore, chose to identify such models through the use of a 'theoretical modeling' method, which 'involves using available theory and data to formulate assumptions about the form, structure, and perhaps parameters of mental models for particular tasks' (Rouse & Morris, 1986: 352). We began with a comprehensive literature review aimed at identifying theoretical perspectives on factors that facilitate SMWT effectiveness. We then performed an inductive content analysis of those theories to identify the core concepts or models that underlie them and that facilitate the behavior, beliefs and processes which they propose lead to team effectiveness.

Our analysis began with the location of five comprehensive theories, four deductive and one inductive, each specifying contextual and process related constructs proposed to influence SMWT effectiveness. These included: Campion et al. (1993); Cohen (1994); Druskat (1996); Hackman (1986); and Pearce and Ravlin (1987). The theories used multidimensional definitions of team effectiveness that included: (1) productivity (Campion et al., 1993; Cohen, 1994; Druskat, 1996; Hackman, 1986; Pearce & Ravlin, 1987); (2) team member satisfaction and growth (Campion et al., 1993; Cohen, 1994; Druskat, 1996; Hackman, 1986; Pearce & Ravlin, 1987); (3) manager satisfaction (Campion et al., 1993; Druskat, 1996); (4) team development (Hackman, 1986); and (5) amount of absenteeism and turnover (Cohen, 1994; Pearce & Ravlin, 1987). Consequently, 'effective' mental models are defined as those that contribute to any of these five dimensions of team effectiveness.

We subjected the five theories to an inductive content analysis focused on identifying their core concepts. We used Boyatzis's (1998) recommendations for thematic content analysis because he outlines a clear and

systematic way of identifying themes. The process began with the first author conducting a within-theory analysis of each theory. This involved repeatedly reading a theory and taking thorough notes on each construct in order to capture the author's description and intent. This reduced the essential information in each theory to an outline that was then used for comparing across theories (Boyatzis, 1998).

Constructs were then categorized as focusing on either team context or team process.¹ We defined context focused constructs as originating outside the team (e.g. managerial support, team task design, or adequate material resources). We defined process focused constructs as originating inside the team (e.g. open communication, coordination, or commitment to the group). We chose to include the contextual variables in our identification of teamwork mental models because, like the process focused constructs, they revealed conceptual information about what SMWTs need to manage in order to perform well.

The summaries of each theory were then compared and contrasted to look for similarities and patterns. This led to the categorizing of constructs driven by similar underlying theories about what leads to team success. At this point, the first author handed the list of categories and the constructs within each category to the second author who had also carefully read each theory. The second author scrutinized the list and made a second list of questions and suggested changes. The two researchers then met for the purpose of discussing and coming to agreement about: (1) the final categories, (2) the constructs within each category, and (3) representative labels and definitions for each category. Because it was important that the labels and definitions capture the underlying concepts of the respective theories, our discussion involved repeated re-examination of the theories to clarify the thinking of the authors and to refine our ideas.

This process resulted in three categories of constructs and a mental model that described each category. The mental models included: (1) psychological ownership over team processes and outcomes, (2) a need for continuous learning, and (3) a need for heedful interrelating. Our analyses determined that these mental models represented the heart of each of the five theories. Table 1 presents the constructs from each of the theories categorized into the three models.

We now discuss each of the three mental models and the constructs that support them as a core concept underlying SMWT effectiveness. Since shared mental models have been found to predict specific team processes (Mathieu et al., 2000), we assume that teams holding the core shared mental models listed in the following sections will engage in teamwork behavior and processes that lead to team effectiveness. Convergence around the shared mental

Table 1 Constructs included in theories of self-managing team effectiveness categorized by underlying mental models of ownership, learning and heedful interrelating

<i>Author(s)</i>	<i>Process or context focus</i>	<i>Psychological ownership</i>	<i>Continuous learning</i>	<i>Heedful interrelating</i>
<i>Deductive Theories of Effectiveness in Self-Managing Teams</i>				
• Campion et al. (1993)	Team process	• Potency	–	<ul style="list-style-type: none"> • Communication/cooperation within group • Communication/cooperation between groups • Social support • Workload sharing
	Org. context	<ul style="list-style-type: none"> • Managerial support for team concept • Team job design includes self-management, participation, task variety, task significance and task identity 	• Training	<ul style="list-style-type: none"> • Task interdependence • Goal interdependence • Interdependent feedback and rewards
• Cohen (1994)	Team process	<ul style="list-style-type: none"> • Norms • Group self-efficacy/potency 	–	<ul style="list-style-type: none"> • Process activities that facilitate innovative thinking • Coordination • Caring

Table I (cont.)

<i>Author(s)</i>	<i>Process or context focus</i>	<i>Psychological ownership</i>	<i>Continuous learning</i>	<i>Heedful interrelating</i>
	Org. context	<ul style="list-style-type: none"> • Task design has variety, identity, significance and autonomy • Team decision-making power • Rewards tied to performance • Adequate equipment and resources • Supervisor encourages team self-evaluation, goal-setting, reinforcement, criticism, rehearsal and high expectations 	<ul style="list-style-type: none"> • Group task design provides task feedback • Available training 	<ul style="list-style-type: none"> • Kept informed about customers, competitors, organizational performance and organizational change
• Hackman (1986)	Team process	<ul style="list-style-type: none"> • Ample effort • Aligned and energized performance • Norms • Task appropriate strategies 	<ul style="list-style-type: none"> • Sufficient knowledge and skills 	–
	Org. context	<ul style="list-style-type: none"> • Clear and engaging direction • Motivating task • Motivating reward system • Adequate material resources 	<ul style="list-style-type: none"> • Education system • Expert coaching 	<ul style="list-style-type: none"> • Information system
• Pearce & Ravlin (1987)	Team process	<ul style="list-style-type: none"> • Commitment to the group 	–	<ul style="list-style-type: none"> • Open communication • Variety of member responses • Coordination of members • Minimal status differences • Flexible coordination

Table I (cont.)

<i>Author(s)</i>	<i>Process or context focus</i>	<i>Psychological ownership</i>	<i>Continuous learning</i>	<i>Heedful interrelating</i>
<i>Inductive Theory of Effectiveness in Self-Managing Teams</i> • Druskat (1996)	Org. context	<ul style="list-style-type: none"> • Active, public managerial support for team self-management • Managerial expectations well defined • Incentives for old norm violation • Task is meaningful • Task has uncertain processes • Autonomy over assignments 	<ul style="list-style-type: none"> • Training in decision skills • Training in group development 	<ul style="list-style-type: none"> • Rewards at group and individual level
	Team process	<ul style="list-style-type: none"> • Performance orientation • Team confidence • Proactive problem solving • Organizational resourcefulness 	<ul style="list-style-type: none"> • Attention to feedback • Team self-evaluation • Organizational awareness 	<ul style="list-style-type: none"> • Interpersonal understanding • Unified effort and cooperation • Confronting members who break norms • Creating clear work procedures • Flexibility • Building relationships with other teams
	Org. context	–	–	–

models will enable members effectively and efficiently to predict and coordinate behavior, while the constructive content of these mental models will ensure that the team acts productively.

A psychological sense of ownership

The first theme emerging from our analysis was the need for a team to experience a psychological sense of ownership over its work processes and outcomes. Theory on psychological ownership suggests it to be a state of mind that changes one's relationship to work by strengthening feelings of responsibility and influence over how it gets done, and by increasing the amount of pride and identity invested in outcomes (Druskat & Kubzansky, 1995; Pierce et al., 2001). Psychological ownership has been found to generate the conscientiousness and extra-role activity that facilitates SMWT effectiveness, especially in dynamic organizational environments where roles and requirements continually change (Pierce et al., 1991, Vandewalle et al., 1995). Ownership is the means through which self-management enhances team effectiveness (Campion et al., 1993) and is perhaps the most important ingredient for defining the transition from a traditional (manager-led) team to a self-managing unit.

A shared mental model of psychological ownership would involve the collective belief that all members were part owners, and that team actions and outcomes were under the team's authority and responsibility, i.e. this is 'our' team. Members would take pride in the team and its outputs, and would be able to assume that teammates cared about performing well, and would put in the effort needed to develop and carry out effective strategies. As mental models are adaptable to changes in context (Johnson-Laird, 1983), the shared ownership model would encourage ownership behaviors focused on the specific needs of the team at any point in time. If external information or resources were needed the model would incite members to obtain them, if decisions had to be made it would create involvement in the process. Team psychological ownership would also enhance the need and desire to engage in learning and development in order to effectively take over the responsibilities of team self-management – our second teamwork mental model.

The theories of SMWT effectiveness we reviewed offered a number of process-related constructs that would exemplify an underlying mental model of psychological ownership. These include: commitment (Pearce & Ravlin, 1987); norms supporting proactive effort (Campion et al., 1993; Cohen, 1994; Druskat, 1996; Hackman, 1986); and a sense of potency or efficacy about the team's ability to perform well (Campion et al., 1993; Cohen, 1994; Druskat, 1996). Psychological ownership has been proposed to build efficacy

by motivating people to increase knowledge and authority over the owned target – in this case the team's work (Pierce et al., 2001).

The theories we examined also included a number of antecedent or contextual constructs that would promote the existence of an ownership mental model. These addressed management style, job design and incentive systems. They included: managerial and organizational encouragement of team self-management through public support, the provision of autonomy and decision making power, and access to material resources (Campion et al., 1993; Cohen, 1994; Hackman, 1986; Pearce & Ravlin, 1987); a meaningful job design that would facilitate team control and involvement through task uncertainty, variety, significance and identity (Campion et al., 1993; Cohen, 1994; Hackman, 1986; Pearce & Ravlin, 1987); and a compensation system that would provide incentives for personal involvement and ownership of outcomes (Cohen, 1994; Hackman, 1986; Pearce & Ravlin, 1987).

A need for continuous learning

Membership in a self-managing team requires learning how to behave under a new management philosophy including the new roles and skills required, and the unlearning of old habits and behaviors, e.g. waiting for managers to solve problems (Pearce & Ravlin, 1987). It also requires growth in the team's capacity to manage itself as a unit, and to acquire, share and use knowledge to make effective decisions (Slavin, 1991). Learning is necessary in SMWTs because of the need for such teams to engage in complex group decision-making, self-evaluation and self-correction (Druskat & Kayes, 2000; Hackman, 1986). In order for this to occur, all members must have the appropriate knowledge and training to meaningfully evaluate member inputs, team processes and the quality of team outputs.

A shared mental model that defines effective teamwork as requiring learning would support and encourage team activities that advance learning and development. Team members would expect each other to seek out both knowledge and feedback, and to share them with the team. As the team faces changing circumstances, the search for learning opportunities might vacillate between seeking formal learning opportunities such as company-sponsored training sessions, and seeking less costly learning opportunities such as sharing knowledge among teammates, or obtaining it from co-workers and experts outside of the team or the organization. The more a team and its members are aware of the importance of learning and acquiring new knowledge, the more they are likely to become conscious of the need to build relationships to facilitate such learning – our third teamwork mental model.

It has become increasingly clear that a potential barrier to learning in

teams is the difficulty of admitting to a knowledge deficit or of discussing developmental subject matter, i.e. feedback, assessment and mistakes (see Argyris, 1982; Edmondson, 1999). For example, asking for help or feedback can pose enough of a psychological threat that it inhibits the willingness to seek learning opportunities (Argyris, 1982; Lee, 1997). A shared mental model supporting the need to learn must, therefore, be strong enough to transcend any perceived risk.

The need for learning was evident in all five theories of SMWT effectiveness, each of which proposed its own methods for increasing team and individual learning. Process-related constructs that exemplified an underlying mental model focused on learning included: possessing and applying sufficient knowledge and skills (Hackman, 1986); attending to feedback from the task (Druskat, 1996); team self-evaluation of its strengths and weaknesses; and attending to events and trends in the broader organization (Druskat, 1996).

The theories also included antecedent or contextual constructs that would promote the existence of a learning model and emphasize its importance. These include: formal training (Campion et al., 1993; Cohen, 1994; Hackman, 1986) with a focus on teaching group development issues and group decision skills (Pearce & Ravlin, 1987), expert coaching (Hackman, 1986), and a task design that builds in the provision of task feedback (Cohen, 1994).

A need for heedful interrelating

The third and final mental model emerging from our content analysis was the necessity for heedful interrelating among members of the team and in member interactions with individuals outside of the team boundary. As defined by Weick and Roberts (1993), heed is not a behavior; rather it refers to the way in which behaviors are enacted. Interpersonal interactions assembled with heed are attentive, purposeful, conscientious and considerate. They increase team effectiveness by improving members' ability to work together efficiently (Cohen, 1994). Without the enactment of heed, interpersonal interactions and relationships are paid little regard.

A shared mental model about the need for heedful interrelating would be rooted in recognition of team member interdependence and the interdependence between the team and its environment. It would describe the team as a system in which members act with an understanding that the system relies on connected action (Weick & Roberts, 1993). Weick and Roberts (1993) propose that the more heed reflected in member interactions, the greater a team's capability to reduce process errors and adapt effectively to

evolving needs and unexpected events. If organizational priorities allowed few formal opportunities for building and maintaining heedful relationships, a well-developed shared mental model of heedful interrelating would drive team members to find informal ways to develop and maintain such relationships, for example, through within-group communication, or communication with external constituents.

All five theories included constructs addressing the need for team members to engage in heedful interactions. Process-related constructs that would exemplify an underlying mental model of heedful interrelating involved: effective communication processes such as open communication, variety of member responses, and constructive interactions that stimulate innovative thinking (Campion et al., 1993; Cohen, 1994; Druskat, 1996; Pearce & Ravlin, 1987); cooperative and supportive processes such as member cooperation, workload sharing and caring (Campion et al., 1993; Cohen, 1994; Druskat, 1996; Pearce & Ravlin, 1987); and processes mindful of the actions and needs of others such as coordination, flexibility, confronting members who break norms, interpersonal understanding and building relationships with other teams (Cohen, 1994; Druskat, 1996; Pearce & Ravlin, 1987).

The theories also included antecedent or contextual constructs that would promote the existence of a model of heedful interrelating. The first set of constructs would stimulate conscientious interactions by increasing the extent to which team members depend upon one another to accomplish their work. They include: task interdependence, goal interdependence, and interdependent feedback and rewards (Campion et al., 1993; Pearce & Ravlin, 1987). Their intent is to enable the benefits of teamwork by making information sharing, knowledge integration and collaboration a necessity (Campion et al., 1993). A second set of contextual constructs promote information sharing so that team members become aware of the interdependencies and connections within the system. These include an information system that notifies the team about customer needs and big-picture issues within the organization (Cohen, 1994; Hackman, 1986).

Summary

A content analysis of theory on SMWT effectiveness produced three core concepts that if developed as shared teamwork mental models could result in the efficient and reliable enactment of effective team processes and strategies. We assume that these core mental models are incorporated to some degree in most SMWTs. What varies are the level of member convergence around the model (i.e. the extent to which the model is shared among

members), and the strength or salience of the model. Research indicates that mental models with high levels of convergence are more likely to predict behavior (Mathieu et al., 2000) and that the strength of a mental model impacts on its endurance; models that are weak or developing are more open to alteration or extinction through the influence of incoming information (Fiske & Taylor, 1991). Thus, model convergence and strength may be particularly important for mental models that are at the core of SMWT effectiveness. In the next section, we explore factors that influence the development and sustainability of these mental models in dynamic organizational environments.

The emergence of effective shared mental models

Shared mental models emerge as team members interact to make sense of their situation and cultivate shared beliefs about how they should work together to complete their task (Donnellon et al., 1986; Klimoski & Mohammed, 1994). Mental model theorists discuss three primary sources of information that can influence the development and sustainability of the shared mental models that emerge in a team: (1) team member history or prior experience in teams (Rentsch et al., 1994), (2) team task, and (3) organizational culture and environment (Kraiger & Wenzel, 1997). The specific antecedents emerging from our content analysis of theories on SMWT effectiveness reviewed earlier can be subsumed under these three sources of information. What follows is a discussion of these sources and how they might affect shared mental models of ownership, learning and heedful interrelating in SMWTs.

The teamwork mental models held by individual members have an important influence on the specific shared models that are socially constructed within a team. Member individual models are shaped by one's history and prior experience in teams (Rentsch et al., 1994), which generate expectations about what should or could happen in a new team (Feldman, 1984). Bettenhausen and Murnighan (1985) propose that cognitive representations from past group experiences provide a frame for interpreting new experiences. They state, 'When new information is presented people search through their memory to find similar situations to help them organize and make sense of the new stimuli' (p. 353).

Rentsch and her colleagues (Rentsch et al., 1994) examined empirically the differences in teamwork mental models of individuals with high levels of team experience and those with low levels of team experience. Results showed that experienced individuals have schemas that are more (1) concise,

(2) abstract and general, as opposed to focused on details, and (3) consistent across different research methods suggesting that these individuals are aware of how they understand teamwork (Rentsch et al., 1994).

As SMWTs take on responsibilities that are not required for traditional manager-led teams, an important question is whether team members have experience in SMWTs and how much mental model alternation must occur when moving to a SMWT. Members inexperienced in SMWTs may have difficulty accepting ownership of team processes and outcomes. They may also be naive about the amount of extra learning necessary to effectively take on the tasks of team self-management, or the high level of interdependence they will experience with teammates and external constituents.

A second influence on the specific shared mental models constructed in a team is the task. Goodman (1986) argues that if there is any fact that emerges from the group literature it is that task influences how a group behaves and performs. One key component in a team's task is the level of interdependence among members such that the outcomes of one individual are influenced by the actions of another (Thompson, 1967). As discussed in the previous section, member sense of interdependence is likely to have an impact on the emergence of shared mental models of heedful interrelating and psychological ownership. A task with a low level of interdependence would suggest that heedful interrelating is unrelated to team effectiveness and that ownership involves responsibility only for each person's individual part of the overall task.

A second relevant task characteristic discussed by Goodman (1986) is task predictability or routineness. A routine task reduces the amount of team self-management required and thus, the level of ownership, learning and heedful interrelating necessary. On the other hand, research indicates that teams conducting tasks involving a high level of operational uncertainty perform better when self-managed (Cordery et al., 1997). Thus, unpredictable tasks would require stronger shared models of ownership, learning and heedful interrelating.

Work teams are also complex adaptive systems that interact with and are influenced by their organizational environment (Arrow et al., 2000). Kraiger and Wenzel (1997) have argued that organizational culture, in particular, has a strong influence on the shared mental models a team develops. Organizational culture is defined as the pattern of basic assumptions an organization has

. . . invented, discovered or developed to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new

members as the correct way to perceive, think, and feel in relation to these problems.

(Schein, 1985: 9)

Schein further states, 'basic assumptions are congruent with what Argyris has identified as "theories-in-use," the implicit assumptions that actually guide behavior. . . . [They], like theories-in-use, tend to be nonconfrontable and nondebatable' (p. 18). These assumptions define what are perceived within the organization to be appropriate behavior, processes and outcomes. They are communicated through both formal and informal channels. Formal channels involve task descriptions, training programs and explicit expectations set by managers. Informal channels involve implicit expectations conveyed indirectly or symbolically through artifacts and through the values, priorities and actions of important organizational members.

According to Schein (1985), when groups first come together the most fundamental questions they look to the organization to answer are 'What are we really here for?' and 'What is our task?' An important additional question for a SMWT is 'How much autonomy and power do we really have?' (Cohen, 1994). Each team member brings into the team his or her own basic and often unconscious assumptions of how the organization answers these questions (Schein, 1985). These influence the shared mental models that emerge to answer the team's questions.

An understanding of the ongoing, fluid nature of mental model development and evolution reveals the important influence of organizational culture and its symbolic messages on teamwork models. Incoming information from the organization continually shapes and reshapes the shared mental models within a team, particularly if those mental models are receptive to influence because they are weak, tentative, or developing (see Fiske & Taylor, 1991). For example, job descriptions and managerial rhetoric can facilitate the development of a teamwork mental model of heedful interrelating and cooperation. However, if the organizational culture requires that team members be rewarded only for their individual achievements, this sends a powerful symbolic message that is likely to override the cooperation model. Likewise, coaching and training programs developed for SMWTs at the time of their implementation may enforce a shared model of the need for continuous learning. Yet, if these programs are not sustained by the organization's culture and prove to be only temporary, the shared mental model is likely to fade as well – especially if the model was weak or developing when the training ended.

To summarize, member prior team experience, team task and organizational culture influence the development of shared teamwork mental

models. In the following section we examine the existence of these antecedents in four published longitudinal case studies of SMWT implementations. We pay particular attention to the role of organizational culture and environment because member prior experience and team task are relatively fixed. Also, because work teams are continually engaged in intricate two-way exchanges with their environment (Arrow et al., 2000), it is likely that organizational and environmental factors will play an ongoing role in the development and endurance of shared teamwork models.

The development and evolution of ownership, learning and heedful interrelating in four field studies

In this section we examine published field studies of SMWT implementations to examine how shared mental models of psychological ownership, learning and heedful interrelating might be affected by the challenges and opportunities presented in a team's work environment. Although a secondary analysis of case studies cannot allow the certain identification of team shared mental models, previous theorists have shown that such an analysis allows for the identification of behavior that is suggestive of specific mental models (see for example Dunn & Swierczek, 1977; Weick, 1993). In this analysis, our purpose is to: (1) look for reported patterns of team behaviors and processes that suggest whether the core teamwork mental models we have proposed were present; (2) identify patterns of reported organizational and environmental factors that suggest opportunities and challenges to the development of those shared models; and (3) look for temporal relationships between team behaviors and contextual opportunities and challenges that elucidate the influence of context on teamwork mental models.

A review of the literature yielded four studies that examine the success over time of organizational interventions involving the implementation of SMWTs. These particular studies were selected because they utilize longitudinal analyses that permit exploration of the changing experiences of the individuals, teams and organizations. The field studies examine interventions at the Gaines Dog Food Plant in Topeka, Kansas (Walton, 1977, 1982), the Rushton Mining Company in Osceola Mills, Pennsylvania (Goodman, 1979, 1982; Trist et al., 1977), a confectionery plant in southeast England (Kemp et al., 1983; Wall et al., 1986), and a minerals processing plant in Australia (Cordery et al., 1991). A short summary of each study is presented. This is followed by a synthesis of the findings and a discussion of their implications.

The Gaines Dog Food Plant

Self-managing teams were implemented in the newly designed General Foods, Gaines Dog Food Plant in Topeka, Kansas in 1971 to enhance human and business conditions and create a high level of employee commitment (Walton, 1977, 1982). The intervention was designed so that jobs completed by the teams were whole tasks, skill requirements for team members were high, teams were given accountability for a large part of the production process, pride and peer pressure replaced formal controls, and supervisors became team leaders² who facilitated team development and decision-making (Walton, 1982). Two independent studies examined the results of the intervention in 1973 and 1974 (see Walton, 1977). Both reported excellent outcomes including high levels of worker participation, freedom to communicate, expressions of warmth, human dignity, commitment and individual self-esteem. By 1974, employee satisfaction and organizational and team commitment were on the decline (Walton, 1977, 1982). At this time the plant was experiencing greater work demands, which required longer work hours. A reassessment in 1976 showed that, although the plant continued to be productive, problems also continued. Team members helped each other less often, identified less with plant management and perceived they had little upward influence. By 1978, commitment and satisfaction began to increase as the plant introduced new products and the work force became challenged and energized.

The Rushton Mining Company

The Rushton Mining Company in Osceola Mills, Pennsylvania, also implemented self-managing teams in the early 1970s (Goodman, 1979, 1982; Trist et al., 1977). The Rushton plant had been in operation for eight years when the self-managing teams were implemented in one experimental section of the mine. Team members were given the autonomy to make day-to-day decisions, the responsibility for production and work assignments, were expected to become multiskilled and learn all the jobs conducted by their team, and received the top rate of pay available to miners at Rushton. Teams underwent six full-day training sessions. All-day conferences scheduled every four–six weeks were used to review past performance, solve problems, plan and communicate, and included all members of the section, management, the union and the research team.

Results measured after one year showed that the miners in the experimental group experienced a significant improvement in attitudes when compared to a one-year baseline period. They felt they had more control over making decisions, perceived more variety in their jobs, and showed an

increase in job skills. In 1974, the plant extended the intervention to a second newly developed section within the mine. After the entire mine converted to self-management, attitudes improved but eventually came back down to their original baseline levels measured in 1973 (Goodman et al., 1988). By 1979, the intervention had been terminated and no evidence of its prior existence remained.

A confectionery plant

A third study examined the implementation of self-managing teams at a newly built confectionery plant in southeast England (Kemp et al., 1983; Wall et al., 1986). Here, the teams were given autonomy and responsibility for allocating jobs, reaching production and quality targets, solving local production problems, recording production data, organizing breaks, ordering raw materials, delivering finished goods, calling for engineering support, and selecting and training new recruits. Researchers conducted a longitudinal quasi-experimental study that utilized control groups to assess the effectiveness of the self-managing teams (Kemp et al., 1983; Wall et al., 1986). Longitudinal results showed that members of the self-managing teams consistently reported significantly higher levels of perceived autonomy, intrinsic job satisfaction, and higher levels of consideration and tolerance for freedom from management. Extrinsic satisfaction increased at the 6-month measure but diminished by the 30-month measurement point. No increases were found for intrinsic job motivation or organizational commitment. Turnover was slightly higher for members of the self-managing teams. Importantly, there was evidence of the inability of the teams to solve their interpersonal problems. The managers of the self-managing teams had to rely on formal sanctions to correct problems more often than the managers of the conventional sites.

A minerals processing plant

Another longitudinal field study examined the implementation of self-managing teams in a newly built minerals processing plant in Australia (Cordery et al., 1991). Self-managing teams were given responsibility for allocating work, maintaining safety and housekeeping standards, planning shift operations, determining work priorities, ordering supplies, making recommendations on new hires and learning all jobs conducted by the team. A skills-based pay system was implemented and a modular training system was available for learning the necessary skills. Researchers conducted a longitudinal study using control groups to measure team effectiveness. Results of

this study were similar to those reported by Wall et al. (1986) with the exception of employee commitment. Members of these self-managing work groups rated themselves as significantly higher than the control groups in organizational commitment. The self-managing team commitment scores did drop significantly between the 8-month and 20-month measurements, but continued to remain significantly higher than the controls. Self-managing team members also rated themselves as consistently higher in extrinsic and intrinsic job satisfaction. They did not rate themselves to have greater trust in management. Finally, absenteeism and turnover were found to be higher for the self-managing employees (Cordery et al., 1991).

Synthesis of the field studies

All four organizations were well organized and prepared when implementing their SMWTs. In each organization, structures were put in place that supported team ownership, learning and heedful interrelating. Psychological ownership was encouraged through task designs that promoted autonomy and through orientation sessions on the philosophy of self-management. Learning was supported through formal training, coaching from external leaders and feedback from the broader organization. Information sessions promoted purposeful (i.e. heedful) relationships with individuals outside of the team boundaries where team member questions were answered, information was exchanged among teams, and teams received direction. Finally, job designs that promoted reciprocal interdependence among team members (i.e. two-way exchange) facilitated the need for heedful interrelating within the teams.

All of the plants except Rushton were 'greenfield sites' meaning that they were new plants, hiring new employees. At Rushton, members in transition to SMWTs worked in an experimental section of the mine. For all the studies, there is little evidence that team members entered their positions with experience as members of SMWTs or clear mental models about their new role as a member of a SMWT. This would make cues from the organization and the task particularly important to the formation of the core mental models we have proposed.

Over time, changing environmental conditions resulted in progressively reduced attention from management and the alteration or neglect of many contextual supports that proved to be temporary rather than permanent reflections of the organizational culture (e.g. team member orientations, regularly scheduled meetings and consistent feedback). As discussed earlier, mental models tend to remain steadfast until contradicted by incoming data (Fiske & Taylor, 1991; Johnson-Laird, 1983). Indeed, the field studies

revealed that as organizational attention and resources waned due to changing priorities, team member behavior consistent with the core mental models also declined. For example, at Gaines, when the number of team meetings was reduced because of time constraints, team member conflicts increased. This suggests that in dynamic organizational contexts, it is important that SMWTs develop strong mental models of ownership, learning and heedful interrelating early in their tenure when organizational support is more consistently available. Strong mental models that are well incorporated are less likely to be altered by turbulence in the organizational environment (see Fiske & Taylor, 1991).

What follows is an examination of the challenges faced in developing, enacting and sustaining mental models of ownership, learning and heedful interrelating. We begin with an overview suggesting how mental models in each of the content areas played out in the case studies. Since there is evidence that team behavior was initially consistent with the three core mental models, but that this behavior diminished over time, we use evidence presented in the case studies to theorize what may have influenced the shared teamwork mental models and team member behavior.

Evidence and evolution of the core teamwork mental models

Psychological ownership

Initially, behaviors consistent with psychological ownership were evident at Gaines, Rushton and the minerals processing plant (Cordery et al., 1991; Goodman, 1982; Walton, 1977). Teams in these organizations demonstrated ownership in a variety of ways including higher levels of participation (Walton, 1977), higher levels of commitment to the organization (Cordery et al., 1991) and increased efforts at both job safety and task proficiency (Goodman, 1982). In these organizations, the sense of ownership was facilitated by task designs that included reduced supervision, increased control over decision-making, and the completion of whole tasks. Walton (1982) states that high commitment (i.e. ownership) was the underlying premise of the task design at Gaines. Teams in the confectionery plant also worked without close supervision and reported high levels of perceived autonomy; however, the behavior of these teams exhibited relatively lower levels of ownership. Overall, they showed no increase in motivation and managers had to continually step in and apply formal sanctions to correct problems and conflicts. Wall and colleagues propose three reasons for these outcomes at the confectionery plant: (a) lack of complete training due to insufficient resources; (b) performance rewards awarded to individuals rather than

groups; and (c) performance feedback that mixed individual with group level feedback (Wall et al., 1986). In an earlier section we reviewed theory suggesting that incentive systems that reward team-level performance and team self-management support the development of a shared ownership model (see Cohen, 1994; Hackman, 1986; Pearce & Ravlin, 1987).

In the three organizations where high levels of ownership seemed initially present, it faded over time. At Gaines, Walton (1977) reported that the sense of ownership of and commitment to the task had measurably declined three years after SMWTs were implemented. At the Rushton Mining Company, attitudes about the job including sense of autonomy and commitment improved slightly, but within three years had returned to their original levels (Goodman et al., 1988). The minerals processing plant also experienced initial increases in both perceived autonomy and commitment. Although these measures remained above those of the control groups at this site, they had decreased significantly by the time of the 20-month measurement (Cordery et al., 1991).

The field studies also suggest that as time passed and formal support from the organization decreased, the role of the external team leader took on a greater level of importance. Unfortunately, there was evidence at Gaines, Rushton and the confectionery plant that external leaders were experiencing mixed messages about their role from the organization, role ambiguity and job dissatisfaction and that these factors affected the level of psychological ownership experienced by teams. At Gaines, the team leaders felt they were neither part of management nor part of the workforce (Walton, 1982). They received criticism from the teams for providing too much guidance and criticism from management for not providing enough. At Rushton, the change in role for the foremen caused great job stress (Goodman, 1982). At the confectionery plant, they reported the highest levels of stress in the plant (Wall et al., 1986).

There is ample evidence that these problems led the external leaders to spend more time and effort intervening and managing the teams than was ideal for sustaining teamwork mental models of ownership. At the confectionery plant, evidence indicated that external leaders spent a lot of time resolving disputes that may have been better handled by the self-managing teams. At both Gaines and Rushton there was evidence that teams felt the supervisors were intervening too often. At Rushton, one team called for the removal of their foreman because he would not allow the team to self-manage. While this example demonstrates a high level of team ownership it also suggests that all external leaders were not supportive of team ownership. The field studies reveal that the optimal balance between leader intervention and team ownership is difficult to achieve and that external leaders tended

to err on the side of over-controlling. This can obstruct the development, strength and persistence of a team's mental model of ownership over its processes and outcomes, particularly if the team is taking its cues about the balance between autonomy and dependence from its external leader.

Our analysis leads us to propose that once shifting organizational priorities caused the organizations to pass the major responsibility for team self-management onto external leaders, the role confusion they experienced caused them to limit team autonomy, which reduced team sense of ownership. This conclusion underscores the importance of an organizational culture that supports team self-management, and persistent messages aimed at both team leaders and SMWTs emphasizing the importance of team ownership.

Continuous learning

Formal training and development and the acquisition of team member knowledge and skills were emphasized in the four organizations. Shared mental models emphasizing a need for learning appeared evident at both Gaines and Rushton where it was noted that team members' serious approach to learning contributed to early successes. At Rushton, Goodman (1982) stated that team members worked hard to increase their knowledge about mining and safety and that this effort and emphasis on learning played a large role in the success of the first experimental section. At Gaines, Walton (1977) states that team members worked to build technical and social skills that contributed to three years without a lost time accident.

Eventually, however, changing priorities and increasing time pressures meant the organizations provided less time for formal training and education. The implicit message sent through these actions surely had an influence on team mental models and expectations about learning and its importance to the job. The researchers at Gaines (Walton, 1977) and Rushton (Goodman, 1982) felt the diminished opportunity for training, particularly for the new employees, had an adverse impact on the overall success of the interventions. At Gaines, time pressures left old employees with less opportunity to focus on development and new hires were given little clear information, skills training, or introduction to self-management (Walton, 1977). This lack of knowledge and information marginalized the participation of new hires and reduced their contribution to team efforts. At Rushton, the teams were most adversely impacted by a stark reduction in the number of conferences in which teams met with management, the union and researchers to review performance, solve problems and plan (Goodman, 1982). These meetings, originally scheduled every four to six weeks, had been a major source of

education, development and support, and a symbol of organizational commitment to team learning.

As proposed earlier, task routineness and predictability also played a role in the amount of team learning required over time. In the first year of operation at Gaines, learning was a fundamental part of the role and team members were engrossed in learning new technical and social skills that received immediate reinforcement due to member skilled-based pay. Teams were also given the opportunity and tools to compute the dollar costs of their mistakes, providing instant feedback and opportunities for self-correction. Unexpected changes in the broader environment also provided learning opportunities. For example, in the first year of operation, a rail strike provided unexpected problems and tested the teams' ability to adapt to changing environmental conditions. Over time, however, as tasks and the use of technology became routine, team members had less need to continue learning and boredom became a problem. In his retrospective account of the situation at Gaines, Walton (1982) claims that he has since seen the same type of maturation and ensuing boredom occur in a number of similar plants. He states:

From initial start-up to normal operation, a plant's task technology evolves from uncertainty to relative certainty, from a greater to a lesser need for problem-solving capability. . . . Eventually, decision rules evolve to handle the more common variations. . . . In contrast, the new plant's workforce develops from a lesser to a greater possession of technical skills and knowledge, and from lesser to greater group problem-solving capacities. . . . A 'potential skill surplus' then grows and stabilizes when the work force's learning curve flattens.

(p. 265)

The skill surplus had consequences at Gaines. Walton (1982) proposes that as time passed, it contributed to a decrease in intrinsic interest in the work, and to the decline of the overall intervention.

The extent to which shared mental models need to support continuous learning is an important question. Clearly, learning was required in all four organizations at the early stages of the interventions and shared mental models supporting the need to learn were a necessity. In the early stages, the organizations cued that need to learn. The field studies also suggest that in dynamic organizational environments with shifting priorities, opportunities for learning may decrease over time. Future research should examine the ebb and flow of learning needs in SMWT environments.

Heedful interrelating

The field studies showed concrete examples of the positive effects of heedful interaction in early stages of the interventions and of the negative effects of a lack of heedful interaction in later stages; this suggests both the presence of the shared mental model and its decrease over time. Important opportunities for heedful interaction (i.e. attentive, purposeful, conscientious) occurred in the early stages of the interventions when organizational priorities included creating time for team meetings. At Rushton, a primary opportunity for interaction and information sharing within and across the team's boundaries occurred in all-day conference meetings where team members and their advisors and managers solved problems, developed future plans and shared ideas. However, shifting organizational priorities reduced the frequency of these meetings. Goodman (1982) believes their reduction played a key role in the eventual decline of SMWTs at Rushton.

At Gaines, systematic meetings early in the intervention gave team members opportunities to interact, build trust and solve problems. According to Walton (1977), for the SMWT system to work at Gaines team members had to contribute to problem solving, conscientiously judge an idea on its merits, and objectively evaluate the qualifications of peers for higher pay rates. The system worked well in the first year or so of the intervention and then began to decline as the time made available for team meetings was reduced. Walton (1977) believed this lack of opportunity for interaction led to decreasing levels of trust, openness and cooperation among team members. It manifested itself in behaviors such as a lack of honesty in peer evaluations, a rise in team conflict and a decline in satisfaction and commitment.

Another example of the importance of heedful interrelating and the shared mental model that supports such interaction was seen at the confectionery plant. There, team members' inability to interact heedfully contributed to high levels of interpersonal conflict and resulted in the need for frequent managerial intervention (Wall et al., 1986).

Evidence from the field studies concurs with previous research and theory emphasizing the importance of heedful interrelating to team effectiveness (Campion et al., 1993; Cohen, 1994; Druskat, 1996; Hackman, 1986). It suggests that the ideal performance condition is one where a predictable and reliable time and place for building relationships and exchanging perspectives and information exists. When the organization supported such structures at Gaines and Rushton, the teams thrived. However, changing organizational priorities and pressures resulted in a reduction of formal opportunities for interaction and the teams suffered. The data presented here

indicate that self-managing teams cannot rely on continuing organizational support for opportunities for communicating or building relationships. A shared mental model supporting heedful interrelating within and across a team's boundary must be strong enough so that the team works to create opportunities to make it happen.

Implications for theory and practice

Analyses of the field studies left us with a number of insights about the mental model construct and the development and sustainability of shared mental models that support ownership, learning and heedful interrelating. First, these mental models must develop early in a team's history when it is most likely that an organization will provide supports that can facilitate their development. The field studies suggest that it would be difficult to develop these mental models in the absence of contextual support. For example, it appeared that teams in the confectionery plant did not develop strong mental models of ownership. This most likely contributed to a downward spiral of internal problems that needed to be resolved by management leading to increasing dependence on management, and decreasing ownership of those problems and their solutions. Under such circumstances it would be difficult for an ownership model to emerge without reliable intervention and an organizational culture that fully supported team ownership.

A related insight is the issue of turnover in the team and the importance of helping new members understand and become a part of the shared mental models that drive team behavior. Since team member mental models influence a team's shared mental models, it is imperative that time is taken to give new members information about team expectations and teamwork models. According to Levine and Moreland (1991), effective socialization requires that a new member assimilates into the team and that the team accommodate in some ways to the new member. Such socialization enables and encourages new members to contribute fully to the achievement of the team's goals. At Rushton and Gaines, it was noted that the reduction of orientation sessions and new member training in self-management contributed to the downfall of the SMWTs. It appears that this hindered the ability of new team members to fully assimilate their team's shared mental models and hindered each team's ability to accommodate to new members. Theory and research indicate that the greater the overlap in individual mental models within a team (i.e. the more shared the model), the better the team will perform (Blickensderfer et al., 1998; Cannon-Bowers et al., 1993; Mathieu et al., 2000; Rouse et al., 1992). Thus, new team members entering a team

without a clear sense of the team's charter or a formal opportunity to assimilate into the team may increase the dissimilarity of shared mental models within that team, ultimately hindering the team's ability to predict behavior, coordinate action and perform well.

Another insight surrounding the challenges that a team faces in sustaining these mental models is the impact of changing organizational priorities that lead to diminished organizational support and attention. The susceptibility of mental models to contextual influence (Johnson-Laird, 1983; Weick, 1995) exacerbates this challenge. As organizational priorities shifted, time was taken away from team meetings, training sessions were shortened or discontinued, and teams were left with less and less organizational support. Some of the researchers theorized that this withdrawal of organizational attention and support contributed to the eventual drop in team performance and satisfaction (Goodman, 1982; Walton, 1982). Mental models adapt to fit the work system. Thus, if an organization's culture only variably supports ownership, learning and heedful interrelating, the challenge may be in finding a way to create such well-developed teamwork mental models that they are sustained despite the changing level of organizational support. For instance, a team with a well-developed mental model of continuous learning can seek out alternative means for orienting new members despite cutbacks in formal training. Similarly, a team that is able to sustain a mental model of ownership of its own tasks and processes would not only take responsibility for its task, but would also create opportunities to reinforce its shared mental models even in the face of reduced organizational support.

An alternative argument is that teams and organizations must adapt to the changing needs of their environments. The lack of time for formal team support might suggest that these organizations and the environments in which they existed had little time or patience for the time-consuming nature of team self-management. The most critical point may be that made by Hackman (1997) who in his thesis on 'why teams don't work' claims that the gravest of mistakes occurs when organizations use teams for work that is better done by individuals. This is an important point, but it is relevant to note that the field studies showed the teams thriving under self-management in the early stages of the interventions when team psychological ownership, learning and heedful interrelating were fully supported by the organization.

There are a number of practical implications in our thesis. The increasing use of SMWTs in organizations (Lawler, 1998) has expanded the need for empirically driven theory that can inform practicing managers how to develop and improve SMWT effectiveness. The existing opinion, that most team research and theory are not of much use for the training and development of work teams, suggests the need for practical theory (Cannon-Bowers

et al., 1995). Our framework suggests that factors in a team's context influence teamwork mental models, which in turn influence team processes, strategies and effectiveness. It emphasizes the need to attend to shared cognition and how teams make sense of their environment. Shared mental models help team members determine appropriate actions, form expectations of each other, explain how the team operates, describe the current state of the team, and predict its future state (Rouse et al., 1992). Organizations should attend to the shared, socially constructed causal connections that provide a blueprint for team action, and intervene early to mold these connections into effective shared mental models. Our analyses suggest that it is of particular importance that an organization recognize the concrete and symbolic influence its culture and actions have on the ongoing development of shared mental models in teams.

By adding to knowledge of how and why teams engage in specific processes and strategies, the shared mental model construct permits a deeper understanding of team behavior and is an ideal point of leverage for improving team effectiveness (Rouse & Morris, 1986). Research indicates that effective mental model training includes interventions that emphasize the relevance of mental models, provide cognitive information about the principles that underlie team effectiveness, and couple that information with guidance about when and how this information should be used (Rouse et al., 1992; Rouse & Morris, 1986). Knowledge about shared mental models without guidance on how the information can be used has been shown to be ineffective and unhelpful for transferring information into real world situations (Mathieu et al., 2000; Rouse & Morris, 1986).

Understanding the mental model construct can also improve coaching interventions. For example, working with a team to identify the shared mental models that drive its behavior, including an examination of the evidence used to develop the model, may be a first step towards creating behavioral change in a team. It can bring to the surface experience-related, task-related, or organizational culture-related factors that propagate a current model, and facilitate the development of interventions that support the models that matter most to team effectiveness.

Our theory has a number of limitations that point to directions for future theory and research. First, we have focused exclusively on shared teamwork mental models and have ignored the relevance of shared mental models of task and equipment. These mental models very likely influence and are influenced by teamwork models. Future theory should examine the interactions between various categories of shared mental models. Second, our assessment of the application of shared models of ownership, learning and heedful interrelating was a secondary analysis of previously published

studies. Thus, our propositions and conclusions must be interpreted with caution. The existence, endurance and relevance of mental models of ownership, learning and heedful interrelating must be empirically examined. Questions for future research include: do effective SMWTs generally hold the core teamwork mental models we described here, and how do these mental models change over time? Additionally, the antecedents of such models and the challenges and opportunities around their development and maintenance must also be studied. What strategies and tactics can teams use to sustain shared mental models in the face of changing environmental support? How can strong mental models be developed early on in a team's life in order to weather those changes? Finally, our thesis has not attempted to address the questions of whether shared mental models must be uniformly shared by team members and, if not, what degree of sharing is required (see Carley, 1997). These questions, which were beyond the scope of this article, call for further theoretical and empirical attention.

Conclusion

Like others before us (Klimoski & Mohammed, 1994; Levine & Moreland, 1991; Mohammed et al., 2000; Rouse et al., 1992), we believe the shared mental model construct shows great promise for increasing understanding of what drives team behavior. We have argued that the current theoretical focus on the importance of mental model convergence among team members is incomplete because it does not recognize that some shared mental models are more appropriate than others. We have presented an analytical review of the literature on SMWTs resulting in the proposal that effective teamwork mental models in such teams emphasize ownership, learning and heedful interrelating. Our review has also examined and proposed factors that influence the emergence and sustainability of these models in dynamic organizations. We hope our analyses and ideas encourage continued research on the ways mental models operate to influence team behavior in dynamic organizational systems.

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Notes

- 1 We omitted variables having to do with team composition because they were not relevant to team mental models focused on teamwork.
- 2 The generic title used throughout this paper for the external manager or supervisor most directly in charge of a SMWT is 'external leader'. However, the authors of the four studies refer to external leaders as team leaders, foremen and support managers. When discussing a specific study, we use the title specified by the author(s).

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